Chapter I

Introduction
CHAPTER I

INTRODUCTION

Since the inception of human history, the importance of environment in sustaining life has been realized. Sages, saints and recluses had permanent abodes in the forest, far away from the din and bustle of ordinary human habitation. They regarded trees, plants, wild birds and animals as the kith and kin of man. The great poet Kalidasa depicted a vivid picture on this aspect in his 'Abhijnan Sakuntalam'. The generosity of nature to cater to the needs of human beings and their development had been amply gauged even in those days of yore. In fact, nature has played a vital role through ages in influencing different customs, cultures and civilizations. Even now, we come across in some tribal and non-tribal societies the custom of worshipping trees and plants with a view to propitiating Gods and Goddesses. But, in course of time, man has lost the sense of gratitude for the benevolence of nature. Now the passion for modernization, urbanization and technological development has become predominant at the cost of the preservation of natural resources.

An ominous human tendency to inflict enormous cruelty on nature is increasing just to achieve selfish ends. The momentary thrill and sense of adventure in hunting has also abetted inhuman treatment to wild life, which is an indispensable part of environment and without which the ecological balance of the earth can not be properly maintained. No body could perhaps visualize the impending crisis that has now overtaken the present generation and threatens to obliterate the entire human race if the current trend continues.
In the last century, the gravity of the situation could not be imagined. Therefore, only formal legislative measures were taken to deal with the environmental problems. The Indian Penal Code 1860 provided that spreading infection of dangerous diseases, fouling water, making the atmosphere noxious to health, etc., were penal offences. Thus, the Police Act 1861 prohibited slaughtering of animals at public places. The Indian Forest Act 1865 regulated matters relating to the forest. Similarly, the Code of Criminal Procedure 1898 provided that the executive could remove public nuisance and prohibit occupations injurious to public health.

PROBLEMS OF POLLUTION

Till the first world war, the environmental problem was not so acute. So it was all along neglected. Battles and warfare were carried on unabated. As a result, incalculable damage was inflicted on environment.

- Large-scale industrialization and automobilisation gave rise to the problem of formidable pollution,
- The accelerated growth of population,
- The concomitant rapid industrialization, unplanned urbanization with over-crowded localities,
- Migration of people from the congenial rural habitat to urban slums,
- Various modes of transportation,
- Indiscriminate destruction of natural resources and onslaught on flora and fauna have made the magnitude of the problem all the more acute (Bhattacharya, 2001).
Introduction

Ecological Crisis

Man, today is facing one of the most horrible ecological crisis and the problem of pollution of his environment which some time in the past was pure, virgin, undisturbed, uncontaminated and basically quite hospitable for him. According to UNICEF –

- Indoor air pollution,
- Outdoor air pollution,
- Unsafe drinking water,
- Poor sanitation,
- Infectious diseases,
- Exposure to hazardous chemicals.

In India, where 80% of households use biomass fuel, estimates show that nearly 5,00,000 women and children under 5 years die every year largely from acute respiratory infections. Studies in less developed countries have linked indoor air pollution to lung cancer, still birth, low birth weight, heart
ailments and chronic respiratory diseases, including asthma. 60% of diseases associated respiratory infections are linked to exposure to air pollution. Air pollution has now become major killer with 3 million people dying of it every year.

- Problem of water pollution has also assumed a serious proportion. The fourteen major rivers in India carry about 85 per cent of the surface run off. There are different kinds of pollutants such as sewage, organic chemicals, pesticides, inorganic chemicals, industrial wastes, harmful microorganisms and sediments which cause different diseases in human beings and also unstabilize our ecosystem.

Harmful effects of Fertilizers and Pesticides

- Mercury compounds, pesticides like DDT, fertilizers, common effluent pollutants and metallic pollutants are very harmful for flora and fauna. Ground water gets contaminated as a result of leaching of nitrates into ground water due to excessive use of nitrogen based fertilizers (Singh and Aggarwal, 1998).
India's land resources are under immense pressure as reflected in the fact that it shares only 2% of the world's geographical area, but supports around 18% of the world's population and over 15% of the world's livestock. The resultant overstraining of land resources and disproportionate human and animal population is at the root of widespread land degradation and non-sustainability of an eco-system. Current estimate shows that about 60% of the land suffers from soil erosion, water logging and salinity. Floods and sediments cause damage to upper layer of soil. Sediment also fills in lakes, reservoirs and rivers, causing displacement of water, which can hinder flood control efforts and reduces growth of aquatic plants and animals. 800 species of wildlife have become extinct and 11,000 more are threatened.

Deforestation

Desertification is a man made phenomenon caused by over-cultivation, over-grazing, deforestation, ill-planned irrigation projects and air, water and soil pollution. It is destructive to ecosystem, results in reduced
Introduction

fertile land for cultivation culminating in food-shortage and various climatic changes (Shah, 1998).

- The generation of unreasonable noise within the environment is regarded as a form of pollution because it lowers the quality of life. Noise pollution is caused by heavy traffic, blaring music over loudspeakers, jet-planes and industries. It causes threat to our physiological well-being, in terms of deafness, having impairment, cardiovascular problems etc. and mental well-being. It causes even killing of certain organisms- animals and plants.

Radiation Pollution

- The environment is also harmed due to radiation pollution through cosmic radiations from medical and dental exposure, radiations from television sets, mobiles, from nuclear power plants and radioactive fall out from nuclear weapons. Ionizing radiations cause mutations, abnormality and lethality in many organisms, including man. Cancer is
Introduction

commonly caused even under low level exposures. Radiation effects persist for a very long period in the environment.

- In addition to these, solid wastes such as e-waste, polythene, plastics, glass and biomedical wastes also cause environmental pollution. Some of the agricultural, animal, agro industrial and community wastes available in rural and adjoining areas are at present not utilized in an economic manner. Due to these wastes, unhygienic conditions prevail in the society. Increasing population is also creating a threat to our environment and natural resources. Environmental crisis in India and abroad is due to population explosion, poverty, urbanization and industrialization, energy crisis, technology, illiteracy and ignorance, heavy transport etc. (Bedi and Pattnaik, 1999).

**SOURCES OF POLLUTION**

- Over the last few years, the ozone concentration of the earth's atmosphere is decreasing largely due to increasing use of CFCs,

- Acid rain is another major irritant in air pollution. Acidic fumes of sulphur dioxide and nitrogen oxide emitted from the industrial establishments mix with rainwater and snow to cause acid rain,

- Various pollutants emitted by the vehicles are carbon monoxide, hydrocarbon, oxides of nitrogen and suspended particulate matter. These cause various diseases like respiratory diseases, cardiac diseases, cancer, bronchities, nervous disorders, gastero intestinal disorders etc. So urbanization with growth of vehicle population, sanitation, increasing industrialization, power consumption, deforestation, poverty are the main sources of air pollution (Hazarika, 2003).
Global warming is now a serious threat. An insulating layer has been created in the atmosphere due to heavy concentration of green house gases produced by haphazard industrial and commercial activities on our earth. This in turn has a consequential effect on the climatic condition as well as on the ecology of the earth. Scientific studies state that the earth’s climate is constantly changing over time. Many climatologists believe that the temperature of the earth fluctuates slowly overtime. In fact, several scientists estimate that between 15,000 and 30,000 years ago the earth was covered by large sheets of ice. This period of time was known as the Ice Age. As the
temperature of the earth began to rise 7,000 years ago, the Ice Age came to an end. From the late 14th century to the end of the 19th century, the earth experienced a ‘Little Ice Age’. Extreme cold and harsh conditions caused several famines and the expansion of glaciers, most notably in the Alps, Scandinavia, Iceland and Alaska. However, by 1850 the temperature of the earth had warmed considerably and scientists were looking for an answer. The first theory of global warming came in 1824 when the French mathematician, Jean Baptiste Joseph Fourier, discovered that the earth’s temperature was slowly increasing. In the late 19th century, Fourier’s theory was labelled the ‘greenhouse effect’. Scientific studies began to predict that increased carbon dioxide emissions, due to increased use of fossil fuels, would trigger an outbreak of global warming. This led to a steady rise in the belief that human activity was dramatically affecting the environment. In 1992, at the United Nations Conference on Environment and Development more than 150 signed a declaration committing themselves to reducing Carbon dioxide emissions in their countries. In 1994, the United Nations Panel on Climate Change asserted that global warming was still a threat and nations needed to enact drastic changes in order to negate the effects of global warming. The Kyoto Protocol (an international agreement to fight global warming) was called for countries to reduce their emission of the greenhouse gases and was to take effect in 2005. The treaty was signed and ratified by 125 countries. However, the United States, which is estimated to be the world’s largest producer of greenhouse gases, refused to sign the treaty.
TABLE 1.1: World's Top Ten Emitters (2005)

<table>
<thead>
<tr>
<th>Country</th>
<th>CO₂ emissions in billion tonnes (Gt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>5.96</td>
</tr>
<tr>
<td>China</td>
<td>5.32</td>
</tr>
<tr>
<td>Russia</td>
<td>1.70</td>
</tr>
<tr>
<td>Japan</td>
<td>1.23</td>
</tr>
<tr>
<td>India</td>
<td>1.17</td>
</tr>
<tr>
<td>Germany</td>
<td>0.84</td>
</tr>
<tr>
<td>Canada</td>
<td>0.63</td>
</tr>
<tr>
<td>Britain</td>
<td>0.58</td>
</tr>
<tr>
<td>South Korea</td>
<td>0.50</td>
</tr>
<tr>
<td>Italy</td>
<td>0.47</td>
</tr>
</tbody>
</table>

Source: Netherlands Environmental Assessment Agency

India signed and ratified the Kyoto Protocol in August 2002. The 42nd Amendment to the constitution enshrined by India (a developing country) to environment protection and improvement may be regarded as a land mark in this respect.

EFFECTS OF GLOBAL WARMING

- The global average temperature increased by 0.74°C (0.07°C per decade) over the last 100 years (1906 to 2005). The warming in the last 50 years was almost twice (0.13°C per decade) that of the last 100 years (IPCC
Introduction

2007). Eleven of the warmest years in this period occurred after 1990, with 2005 the warmest on record.

- The CO₂ level in the atmosphere hit 385 ppm in the summer of 2005, a level never reached in the climate history of past 650 thousand years (Siegenthale et al., 2005).

- The trends pose serious threats to the livelihood and security of the millions of people living in the Himalayas and its geographical milieu.

- Potential impacts are changed in the freshwater regime, forest ecosystem, biodiversity, agriculture and food production, human health and infrastructure, and an increasing incidence of floods and droughts, among many others.

- It is projected that the sea level rise in India’s vicinity would be around 15-38 cm by 2050. Climate change is likely to have wide-ranging and mostly adverse impact on human health, with significant loss of life. It is highly desirable for all of us, including the governments, to understand and internalize the seriousness of climate change and its varied impacts on the environment and human security. It is highly imperative for us to work for an alternative policy framework and build greater institutional and organizational capacity in this regard.

- Environmental degradation, environmental refuges, deforestation and other such associated environmental issues have increasingly occupied the core of development debate among the academicians, activists, policy planners and common citizens of the country for the last 60 years since India’s independence. Environmental concerns of the Indian state do not match those expressed globally. Environment still remains a marginal issue for India. The six decades after independence have not shown any significant changes in the field of environment. Today, when the Himalayan glaciers are among some of the fastest receding glaciers
Introduction

in the world and when environment is being seen as more intimately connected with livelihood issues, it is important that we evaluate and understand the relationship between environmental concerns and human security (Khawas, 2007). In the present context of environmental awareness, global warming is the buzzword that reverberates in every corner of our planet.

- Global warming is an increase overtime of the average temperature of earth’s atmosphere and oceans. The global warming theory states that the temperature has risen since the late nineteenth century due to human causes, principally emissions of carbon dioxide increasing the “greenhouse effect.”

Environmental problems in India are of two types one arising from the negative effect of the very process of development and the other arising as a result of conditions of poverty and under development. Poorly planned projects are usually environment destructive. At present, there are about 30 major enactments related to the protection of environment. Some important are: The Wildlife Protection Act 1972, The Forest (Conservation) Act 1980, The Water (Prevention and Control of Pollution) Act 1974, The Air (Prevention and Control of Pollution) Act 1981, The Water (Prevention and Control of Pollution) Act 1977, and the Environment (Protection) Act 1986. Besides, the Motor Vehicles Act 1938 as amended in 1988, The Factories Act and the Insecticides Act are also there. The Ministry of Environment and Forests is the nodal agency for managing and controlling hazardous chemicals, wastes and microorganisms. A National Waste Management Council has been set up to suggest ways and means for active utilization of wastes. The Central Ganga Authority (CGA) was set up in 1985 to oversee the implementation of the Ganga Action Plan drawn up for clearing polluted stretches of the river Ganga. The national conservation strategy and policy statement on
environment and development adopted by the Government in 1992 lays down strategies and action plans for integration of environmental considerations in the development activities of various sectors of the country, thus paving the way for achieving sustainable development. There is a need of strengthening of official involvement in environmental management, with increased scientific, technical, administrative and legislative back up at central and state levels (Bedi and Pattnaik, 1999).

Man's life, in terms of quality and sustainability, is dependent on the interrelationships among the natural environment, social environment and technological environment. Environment protection and conservation must be operationalised into a concept of sustainable development which implies, "meeting the needs of the present generation without compromising the needs of future generations." Rather, the ecological implications are taken seriously as they tend to limit the sustainability of human activities. This development has given the background for the general realization that the environment has to be safeguarded in any case. This has been accepted as a major guiding factor for striving for an environmentally friendly development particularly in the poor and developing world. Thus environmental awareness may prove itself very useful in increasing the knowledge of people about environment and sustainable human development.

**ENVIRONMENT**

*Odum (1971)* has defined environment as everything around us the air, the water, the land, plants, animals and micro-organisms. Everything i.e. living and non-living constitutes one's environment. Environment includes biotic and abiotic factors.
Introduction

Douglass and Holland (1978) has described environment as all the external forces, influences and conditions which affect the life, nature, behaviour and the growth, development and maturation of living organisms.

Woodworth (1982) viewed the environment as everything that affects the individuals except his genes. Environment covers all the outside factors that have acted on the individual since the life began.

According to Concise Encyclopaedia of Science and Technology (1984) the environment is the sum of all external conditions and influences affecting the life and development of organisms. Various ecological principles and concepts have been developed in regard to the environment. Two main aspects of the environment are usually considered, the abiotic and biotic. These divisions are artificial in the sense that neither can be separated when organisms are studied. All environmental aspects and their influences on living organisms must be considered together (Parker, 1984).

Brockhampton Dictionary of Science (1997) has defined environment in ecology, the sum of conditions affecting a particular organism, including physical surroundings, climate and influence of other living organisms. In common usage, 'the environment' often means the total global environment without reference to any particular organism. In genetics it is the external influences that affect an organism's development and turn its phenotype (Lafferty and Rowe, 1977).

According to Oxford Dictionary of Psychology (2001) environment is the external surrounding with which an organism lives, any external factor that affects the organism's development or behaviour, as distinct from intrinsic or genetic factors (Colman, 2001).

Webster (2001) says environment is a surrounding or being surrounded; something that surrounds: All the conditions, circumstances, and influences
surrounding, and affecting the development of, an organism or group of organisms: often contrasted with heredity.

According to Collins Co Build Advanced Learner’s English Dictionary (2003) environment is all the circumstances, people, things and events around them that influence their life. It is the natural world of land, sea, air, plants, and animals (Sinclair, 2003).

Mohan (2003) in his article pointed out that slow seepage of the industrial effluents into the Sutlej by the industrial units at Nangal and Ropar has had an adverse impact on the flora and fauna of the wetland, home to over 200 varieties of local birds and halting place for thousands of migratory bird.

Prasad (2003) expressed his concern over the impact of global warming, he further explained that the average temperature was rising, glaciers were receding, heat waves aggravating and weather pattern becoming erratic.

According to Sinclair (2003) environment is all the circumstances, people things and events around them that influence their life. It is the natural world of land, sea, air, plants and animals

ENVIRONMENTAL AWARENESS

Environmental consciousness is very important for protecting environment. It includes integrated and interacting elements: awareness, real-life situations, conservation and sustainable development. Awareness involves making the individual conscious about physical, social and aesthetic aspects of the environment and how it is polluted and degraded by man's activities. Awareness of the environment is growing everywhere in the world, it is not growing as fast as the pollution we are creating globally. Real-life situation links the environment to life itself. It includes necessary measures to be taken to facilitate the achievement of sustainable development. The other two elements, namely conservation and sustainable development, are concerned
with the preservation of the natural environment and rational use of natural resources within an ethical framework (Verma, 2000).

Though several audio-visual programmes are organized by the government through its Directorate of Field Publicity or through the Non-Governmental Organizations (NGOs), the feasibility of these programmes is limited in terms of the extent of their coverage. A well-planned strategy for creating environmental awareness on the problems concerning degradation of environment and its impact on natural surroundings is vital. For sustaining development and creating environmental awareness, motivation and mobilization of people become essential and effective functions of the media. The proper use of inter-personal communication media at the end-level is effective in achieving the optimum results. The role of inter-personal media in the feedback process has enormous impact on the environmentally strong development process. It is the time when media should exploit all avenues to harness the energies of the common masses to stop the nation's heading towards an environmental disaster.

The achievement of sustainable development now appears to offer the only hope for the future is thus contingent upon framing a programme of environmental education which contains not only the scientific and technological aspects but also emphasizes relevant aspects of socio-economic development and more important, the ethical and moral aspects of our actions vis-a-vis the environment. Such a programme should also aim to raise the level of public awareness of the environment. The chief objective of environmental education is that individual and social groups should acquire awareness and knowledge, develop attitudes, skills and abilities and participate in solving real life environmental problems. Environmental education and awareness should bring in environmental concerns in all subject areas so that an environmental bias permeates into all facets of one's life and does not get compartmentalized at one place. Many environmental problems in India are also due to lack of
knowledge and awareness. The efforts of the present government to check pollution on many occasions have not been recognized or accepted by the people, resulting in a waste of efforts (Hazarika, 2003).

Environment Awareness is the sensitivity to the total environment and its allied problems. The development of environmental awareness means to understand the environmental problems and to develop critical thinking and problem solving skill in the people.

Environmental Attitude means to acquire a set of values and feelings of concern for the environment and the motivation of active participation in environmental improvement and protection.

According to the Concise Dictionary of Education (1982) Environmental studies – In higher or secondary education, an interdisciplinary course or programme of study and research drawing on such areas as ecology and other biological sciences, the earth sciences, economics and political science (Hawes, 1982).

Hawes and Hawes (1982) has defined environment as the totality of external surroundings, including conditions, circumstances, and events; in education, often considered for the extent to which such surroundings facilitate or impede learning. The natural environment as generally viewed by the environmentalist movement prominent in the U.S in 1960s.

Parker (1982) has defined environment as the sum total of all conditions and influences that affect the development and life of organism. Various ecological concepts and principles have been developed in regard to the environment. Ecologists usually divide the environment into three parts: Abiotic, Biotic and Climatic factors. All environmental aspects and their influences on living organisms must be considered together. Environmental education is a permanent process in which individual gain awareness of their environment and acquire the knowledge, values, skills, experiences, and also
the determination which will enable them to act individually and collectively to solve present and future environmental problems in order to meet their needs without compromising those of the future generations.

Paxton (1984) has defined environmental pollution for the undesirable effects of many human activities. One of the most obvious types of pollution is air pollution, resulting chiefly from the combustion of fossil fuels (coal and oil).

According to the Concise Oxford Dictionary of Botany (1992) environmental Science is the study of environments. This may be interpreted fairly strictly as the physical environment; or may include the biological environment of an organism; or, in its widest sense, may also consider social, cultural, and other aspects of the environment (Allaby, 1992).

Sharma (1997) defines environmental awareness as the sensitivity to the total environment and its allied problems. The development of environmental awareness means to understand the environmental problems and to develop critical thinking and problem solving skill in the people. Awareness includes making the individual conscious about physical, social, and aesthetic aspects of the environment.

According to Evan Sigler Dominant's Advanced Dictionary of Ecology and Environment (2000) Environmental biology is that branch of biology which deals with the study of plants and animals in relation to their environments. In other words, it deals with the study of organisms in relation to their environments, and hence the name environmental biology. Plant ecology deals with the study of plants in relation to their environments. And animal ecology deals with the study of animals in relation to their environments. The concept of modern ecology (environmental biology) therefore mainly represents the study of the physiology of the environment.
showing the physiological relationships between organisms and their environments (Chand, 2000).

Price (2004) defines environmental science as the branch of biology concerned with the relations between organisms and their environment, bionomics, ecology. The subject is broadly classified into: (a) biological science (b) palaeoecology (c) biotic community (d) association.

Chopra (2005) views environmental education: according to the Environmental Education and Training Partnership (EETAP), environmental education “is a learning process that increases people’s knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action.” Although some educators have long argued that environmental curriculum, the movement to incorporate it has gained ground in recent years as more and more schools have incorporated at least some of its elements.

PROGRAMMES FOR ENVIRONMENTAL AWARENESS

- Elements of the natural study, conservations, general ecological principles are the approaches to environmental awareness. Environmental education has three domains such as cognitive, affective, psychomotor which contain various objectives for creating environmental awareness (Shan, 2003).

- In our country too, people, conscious of the future survival of the society, initiated number of activities to highlight the importance of ecological balance for the sustainable development of the human race. In addition to the several measures initiated by the state in this direction, there has been impressive participation of non-governmental
organizations with commendable activism and involvement. The most noteworthy movements like the Chipko and the Narmada Bachao... have entered the consciousness of the people in general, radically affecting their attitude towards environment (Ghanta and Rao, 1998).

- In order to widen the base of the green brigade in the country, the Ministry of Environment has directed states and the Union Territories to set up the National Green Corps (NGC) also in colleges and increase the number of the eco-clubs in schools. Today, in Punjab, there are 1,700 eco-clubs with 85,000 members, in Haryana, the number of clubs will increase to 2,850, in Himachal Pradesh and Chandigarh, the number of the clubs will increase to 1,720 and 137 respectively (Gulati, 2003).

- This work is not sufficient to achieve our targets because International experts in the Technical and Vocational Education (TVE) of Five Asian Countries have observed that there is a clear lack of appreciation of environment component in the education, in China, India, Indonesia, Phillipines and Malaysia. So there is need of designed comprehensive system to accommodate economic and ecological needs through partnership and cost sharing between government, employees, technical and vocational educational institutions, NGOs and society. Streaming of institutional framework at national level, curriculum modifications, review and regular updating, networking for information sharing, capacity building and industry swaps are required. Here, UNESCO can act as a binding force between the five target nations (Tribune, 2003).

- Environmental protection and its improvement requires well coordinated, decentralized planning, cooperation and participation from each segment of society including government and political parties. Education has a great role for generating awareness among the masses and removing the problem of environmental illiteracy in our country.
Introduction

- Representatives from around the world expressed international concern for environmental quality at the United Nations conference on the human environment in Stockholm. One outgrowth of this 1972 meeting was the Intergovernmental Conference on environmental education, organized by UNESCO and held in Tbilisi, USSR, in 1977. Participants enumerated recommendations for implementing environmental education at the national, world-regional and international levels. Furthermore, environmental education involves the three domains of learning: cognitive, affective and psychomotor. Knowledge, beliefs, and manipulative skills are all considered essential elements in facilitating environmentally responsible behavior.

- Although some progress has been made, environmental education research efforts regarding factors which influence attainment of environmental concepts can best be characterized as diffuse and uncoordinated. One important area in which the next environmental education research projects should be undertaken is in the initiation of baseline and longitudinal studies of teaching methods and learning strategies. It is thus apparent that research in environmental education needs to address the effectiveness of teaching and learning techniques that are designed to promote the comprehension of environmental concepts. Concepts are a significant component of educational programs including those in environmental education. Concept mapping is one of the methods by which students learn concepts.

A view of the above attempts in environmental awareness concepts with the wide spectrum of pressing environmental issues makes it amply evident that we have not even made a worthwhile beginning, and we have a long way to go. Unfortunately, time is a big constraint and unless educational efforts are identified and tackled urgently, we will be the victims of environmental hazards largely due to our own inaction and ignorance.
Introduction

CONCEPT MAP

Ausubel’s learning theory emphasizes the central role that concepts and the relationships between concepts play in the learning process. The theory of learning developed by Ausubel (Ausubel, 1963; Ausubel, Novak and Hanesian, 1978) stresses the importance of concepts in learning. Ausubel states in the epigraph:

If I had to reduce all of educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly.

The most important aspects of “what the learner already knows” are the particular concepts that the learner possesses in cognitive structure. His theory is generally referred to as the theory of meaningful learning. In this concepts that are learned meaningfully can expand a person’s knowledge of related concepts. Since meaningful learning involves the intentional construction of substantive, logical links between new concepts and pre-existing knowledge, information learned meaningfully will be retained longer. Finally, these concepts can later serve as subsumers-mental anchors-for learning additional related concepts.

Ausubel points out that each student’s store of concepts is unique. Therefore, each person will construct different concept links while involved in the same learning task. In order to enable each student to accomplish this, instruction must allow learners to reformulate the material in ways that are meaningful to them. Although the theory of meaningful learning has numerous additional implications for educational practice, those discussed here are the most relevant to the concept mapping strategy investigated in this study. It follows that concept learning activities based upon Ausubel’s theory of meaningful learning should involve learners in -
Introduction

- identifying concepts in the material to be learned,
- determining which of these concepts are the more general and inclusive,
- meaningfully linking these concepts to each other and
- meaningfully relating these concepts to concepts they already know.

An instructional technique and learning strategy that has been designed according to these theory-based criteria is the concept map. This approach was developed and is being assessed by Joseph Novak and his research group at Cornell University (Stewart, Vankirk and Rowell, 1979; Novak, 1981; Novak and staff, 1981).

Over the past decade, the concept map has emerged as a versatile and promising tool in the area of science education, especially in research that seeks to investigate students’ conceptual understandings (Good et al (1990); Markham et al (1994); Novak, 1990a). Concept mapping was developed as a strategy to probe knowledge structures of learners (Driver, 1989), and has further utility as a tool for representing and assessing conceptual understandings, alternatively termed structural knowledge (Jonassen et al., 1993) or cognitive structure (Action et al., 1994).

The concept map as a vehicle to represent and assess changes in students’ understandings about science was pioneered by Novak and Colleagues (Horton, et al. 1993; Novak, 1990b; Novak and Musonda, 1991; Okebukola, 1992). Novak and Gowin (1984) have recommended three uses of concept maps in concert with interviews to evaluate students’ understandings: (a) to inform the development of interview questions, (b) to explicate “Post hoc” the student understandings data captured by the interview transcripts, and (c) to assess student understandings as captured in the interview transcripts. Wander see et al. (1994) cite Novak and Gowin’s seeing concepts maps constructed from taped interviews as an excellent way to multiply the
power of two tools “[concept maps and interviews]”. These interview-related applications of concepts maps have been recommended and applied by several researchers and are reviewed in detail (Rye, 1995). White (1985) posited that individuals who are equally knowledgeable may differ in their facility to recall relevant elements of that knowledge and that “the source of such a difference is an absorbing realm for research ...... if explained, may lead to dramatic improvements in human performance.”

In the knowledge engineering literature (Smith, 1987) a concept map like structure-labeled a conceptual graph structure (CGS) has been employed as a tool in conjunction with interviews to elicit or “extract” knowledge from experts (Gordon and Gill, 1989; Gordon et al., 1993). Like concept maps, CGS are comprised of nodes connected by labeled links that explicate numerical interrelationships. A study was conducted as part of a National Science Foundation sponsored Teacher Enhancement Project (Rubba et al., 1995). This project sought to develop teacher-leaders and curricula to further science technology-society (STS) education in middle/junior high school science. The STS issues of focus were global warming and others encompassed by global atmospheric change (Ennis and Marcus, 1994; Houghjton et al., 1992). A concept map was found very effective as process and evolving product, facilitating the externalizations of students knowledge in the interview setting. So concept maps facilitate metacognition and elaboration and explication by students of their conceptual understanding. The concept map provides a graphic visual of structural knowledge that, in theory extends working memory. As such, it seems logical that it would trigger spread of activation and enhancement of recall. Furthermore, the act of concept mapping should force critical thinking (Novak and Gowin, 1984), and accordingly, enhance the externalization of interrelationships amongst concepts.

Ausubel et al (1978) states the concept map as an external representation of structural knowledge serves as a visual image: It may trig
recognition, thereby lowering the threshold of availability and increase recall of knowledge held in long-term memory.

**Stewart et al (1979)** defined concept map as a graphic device for representing the conceptual structure of a discipline or a segment of a discipline.

**Stewart et al (1979)** states that a concept map with labels representing the most general, inclusive concept (s) located at the top of the map. As one reads downward, concepts depicted on the map are less inclusive and more specific. No words appear on lines which link related concepts. This is a hierarchical concept map.

**Gowin (1981)** termed concept as a regularity in objects and/or events, designated by a label.

**Novak and staff (1981)** explains hierarchical-propositional concept map as a concept map which includes both a general-to-specific (hierarchical) organization and phrases (propositions) which describe relationships between pairs of concepts on the map.

**Novak (1981)** states propositional concept map as a concept map which includes phrases that describe relationships between pairs of concepts. These propositional statements are written on lines which link related concepts on the map. Concepts are not intentionally organized into a hierarchy on this type of concept map.

**Flavell (1985)** states that metacognition “includes any knowledge or cognitive activity that as its object or regulates, any aspect of any cognitive enterprise”. Metacognition includes “strategic actions of the reasoner” such as questioning, self-checking and generating alternatives.

**Driver (1989)** termed concept map as strategy to probe knowledge structures of learners.
Johnson and Thomas (1992) considers the concept map as a graphic meta cognitive tool.


Jonassen (1996) consider concept map as it provides an external representation of structural knowledge in the form of a two-dimensional semantic network, potentially extends working memory, and encourages critical thinking. So, concept map is a “mind tool” which facilitate strategic actions.

Carr (2006) identified concept maps in three ways that support teaching and learning: for instructional planning, for learning and for assessment.

Daley (2007) defined concept maps as an instructional strategy that promotes meaningful learning.

Beyerback (2008) defined concept mapping as a technique of graphically representing concepts and their hierarchical interrelationships along two dimensions to examine the growth of students' knowledge.

Mehta and Henderson (2008) defined concept mapping, as a student-driven assessment tool, is used to compare student attitudes toward various kinds of environments.

Chiou (2009) defined concept map as a hierarchically arranged, graphic representation of the relationships among concepts. Concept mapping (CMING) is the process of constructing a concept map.

CONSTRUCTION OF CONCEPT MAP (Novak and Canas, 2006)

Concept maps are graphical tools for organizing and representing knowledge. They include concepts, usually enclosed in circles or boxes of some type, and relationships between concepts indicated by a connecting line.
linking two concepts. Words on the line, referred to as linking words or linking phrases, specify the relationship between the two concepts. We define concept as a perceived regularity in events or objects, or records of events or objects, designated by a label. The label for most concepts is a word, although sometimes we use symbols such as + or %, and sometimes more than one word is used. Propositions are statements about some object or event in the universe, either naturally occurring or constructed. Propositions contain two or more concepts connected using linking words or phrases to form a meaningful statement. Sometimes these are called semantic units, or units of meaning.

Another characteristic of concept maps is that the concepts are represented in a hierarchical fashion with the most inclusive, most general concepts at the top of the map and the more specific, less general concepts arranged hierarchically below. The hierarchical structure for a particular 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, which we have called a focus question. The concept map may pertain to some situation or event that we are trying to understand through the organization of knowledge in the form of a concept map, thus providing the context for the concept map.

Another important characteristic of concept maps is the inclusion of cross-links. These are relationships or links between concepts in different segments or domains of the concept map. Cross-links help us see how a concept in one domain of knowledge represented on the map is related to a concept in another domain shown on the map. In the creation of new knowledge, cross-links often represent creative leaps on the part of the knowledge producer. There are two features of concept maps that are important in the facilitation of creative thinking: the hierarchical structure that is represented in a good map and the ability to search for and characterize new cross-links.
A final feature that may be added to concept maps is specific examples of events or objects that help to clarify the meaning of a given concept. Normally these are not included in ovals or boxes, since they are specific events or objects and do not represent concepts.

Concept maps were developed in 1972 in the course of Novak’s research program at Cornell where he sought to follow and understand changes in children’s knowledge of science (Novak & Musonda, 1991). During the course of this study the researchers interviewed many children, and they found it difficult to identify specific changes in the children’s understanding of science concepts by examination of interview transcripts. This program was based on the learning psychology of David Ausubel (1963; 1968; Ausubel et al., 1978). The fundamental idea in Ausubel’s cognitive psychology is that learning takes place by the assimilation of new concepts and propositions into existing concept and propositional frameworks held by the learner. This knowledge structure as held by a learner is also referred to as the individual’s cognitive structure. Out of the necessity to find a better way to represent children’s conceptual understanding emerged the idea of representing children’s knowledge in the form of a concept map. Thus was born a new tool not only for use in research, but also for many other uses.

PSYCHOLOGICAL FOUNDATIONS OF CONCEPT MAPS

The question sometimes arises as to the origin of our first concepts. These are acquired by children during the ages of birth to three years, when they recognize regularities in the world around them and begin to identify language labels or symbols for these regularities (Macnamara, 1982). This early learning of concepts is primarily a discovery learning process, where the individual discerns patterns or regularities in events or objects and recognizes these as the same regularities labeled by older persons with words or symbols.
This is a phenomenal ability that is part of the evolutionary heritage of all normal human beings. After age 3, new concept and propositional learning is mediated heavily by language, and takes place primarily by a reception learning process where new meanings are obtained by asking questions and getting clarification of relationships between old concepts and propositions and new concepts and propositions. This acquisition is mediated in a very important way when concrete experiences or props are available; hence the importance of "hands-on" activity for science learning with young children, but this is also true with learners of any age and in any subject matter domain.

In addition to the distinction between the discovery learning process, where the attributes of concepts are identified autonomously by the learner, and the reception learning process, where attributes of concepts are described using language and transmitted to the learner, Ausubel made the very important distinction between rote learning and meaningful learning. Meaningful learning requires three conditions:

1. The material to be learned must be conceptually clear and presented with language and examples relatable to the learner's prior knowledge. Concept maps can be helpful to meet this condition, both by identifying large general concepts held by the learner prior to instruction on more specific concepts, and by assisting in the sequencing of learning tasks though progressively more explicit knowledge that can be anchored into developing conceptual frameworks.

2. The learner must possess relevant prior knowledge. This condition can be met after age 3 for virtually any domain of subject matter, but it is necessary to be careful and explicit in building concept frameworks if one hopes to present detailed specific knowledge in any field in subsequent lessons. We see, therefore, that conditions (1) and (2) are interrelated and both are important.
The learner must choose to learn meaningfully. The one condition over which the teacher or mentor has only indirect control is the motivation of students to choose to learn by attempting to incorporate new meanings into their prior knowledge, rather than simply memorizing concept definitions or propositional statements or computational procedures. The indirect control over this choice is primarily in instructional strategies used and the evaluation strategies used. Instructional strategies that emphasize relating new knowledge to the learner’s existing knowledge foster meaningful learning. Evaluation strategies that encourage learners to relate ideas they possess with new ideas also encourage meaningful learning. Typical objective tests seldom require more than rote learning (Bloom, 1956; Holden, 1992). In fact, the worst forms of objective tests, or short-answers tests, require verbatim recall of statements and this may be impeded by meaningful learning where new knowledge is assimilated into existing frameworks, making it difficult to recall specific, verbatim definitions or descriptions. This kind of problem was recognized years ago in Hoffman’s (1962) The Tyranny of Testing.

As noted above, it is important to recognize that because individuals vary in the quantity and quality of the relevant knowledge they possess, and in the strength of their motivation to seek ways to incorporate new knowledge into relevant knowledge they already possess, the rote-meaningful distinction is not a simple dichotomy but rather a continuum. Creativity can be seen as a very high level of meaningful learning.

People often confuse rote learning and meaningful learning with teaching approaches that can vary on a continuum from direct presentation of information (which may be conceptually obscure or conceptually explicit) to autonomous discovery approaches where the learner perceives the regularities and constructs her/his own concepts. Both direct presentation and discovery
teaching methods can lead to highly rote or highly meaningful learning by the learner, depending on the disposition of the learner and the organization of the instructional materials. There is the mistaken notion that “inquiry” studies will assure meaningful learning. The reality is that unless students possess at least a rudimentary conceptual understanding of the phenomenon they are investigating, the activity may lead to little or no gain in their relevant knowledge and may be little more than busy work.

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 (Mintzes et al., 2000; Novak, 1990; Novak & Gowin, 1984). Concept maps are also effective in identifying both valid and invalid ideas held by students, and this will be discussed further in another section. They can be as effective as more time-consuming clinical interviews for identifying the relevant knowledge a learner possesses before or after instruction (Edwards & Fraser, 1983).

Another important advance in our understanding of learning is that the human memory is not a single “vessel” to be filled, but rather a complex set of interrelated memory systems.

**EPISTEMOLOGICAL FOUNDATIONS OF CONCEPT MAPS**

As indicated earlier, we defined concept as a perceived regularity (or pattern) in events or objects, or records of events or objects, designated by label. It is coming to be generally recognized now that the meaningful learning processes described above are the same processes used by scientists and mathematicians, or experts in any discipline, to construct new knowledge. In fact, Novak has argued that new knowledge creation is nothing more than a relatively high level of meaningful learning accomplished by individuals who have a well organized knowledge structure in the particular area of knowledge,
and also a strong emotional commitment to persist in finding new meanings (Novak, 1977, 1993, 1998). Epistemology is that branch of philosophy that deals with the nature of knowledge and new knowledge creation. There is an important relationship between the psychology of learning, as we understand it today, and the growing consensus among philosophers and epistemologists that new knowledge creation is a constructive process involving both our knowledge and our emotions or the drive to create new meanings and new ways to represent these meanings. Learners struggling to create good concept maps are themselves engaged in a creative process, and this can be challenging, especially to learners who have spent most of their life learning by rote. Rote learning contributes very little at best to our knowledge structures, and therefore cannot underlie creative thinking or novel problem solving.

As defined above, concepts and propositions are the building blocks for knowledge in any domain. We can use the analogy that concepts are like the atoms of matter and propositions are like the molecules of matter. There are only around 100 different kinds of atoms, and these make up an infinite number of different kinds of molecules. There are now about 460,000 words in the English language (most of which are concept labels), and these can be combined to form an infinite number of propositions. Although most combinations of words might be nonsense, there is still the possibility of creating an infinite number of valid and meaningful propositions. Poets and novelists will never run out of new ideas to express in new ways. We shall never run out of opportunities to create new knowledge! As people create and observe new or existing objects or events, the creative people will continue to create new concepts and new knowledge. Creating new methods of observing or recording events usually opens up new opportunities for new knowledge creation. For example, the creation of the concept mapping method for recording subject’s understandings has led new opportunities to study the process of learning and new knowledge creation.
While there is value in studying more extensively the process of human learning and human knowledge creation, this is beyond the scope of this document. The reader is invited to peruse some of the references cited. Some important considerations for construction of better concept maps and facilitation of learning will be discussed further below.

CONSTRUCTING GOOD CONCEPT MAPS

In learning to construct a concept map, it is important to begin with a domain of knowledge that is very familiar to the person constructing the map. Since concept map structures are dependent on the context in which they will be used, it is best to identify a segment of a text, a laboratory or field activity, or a particular problem or question that one is trying to understand. This creates a context that will help to determine the hierarchical structure of the concept map. It is also helpful to select a limited domain of knowledge for the first concept maps.

A good way to define the context for a concept map is to construct a Focus Question, that is, a question that clearly specifies the problem or issue the concept map should help to resolve. Every concept map responds to a focus question, and a good focus question can lead to a much richer concept map. When learning to construct concept maps, learners tend to deviate from the focus question and build a concept map that may be related to the domain, but which does not answer the question. It is often stated that the first step to learning about something is to ask the right questions.

Given a selected domain and a defined question or problem in this domain, the next step is to identify the key concepts that apply to this domain. Usually 15 to 25 concepts will suffice. These concepts could be listed, and then from this list a rank ordered list should be established from the most general, most inclusive concept, for this particular problem or situation at the top of the
list, to the most specific, least general concept at the bottom of the list. Although this rank order may be only approximate, it helps to begin the process of map construction. We refer to the list of concepts as a parking lot, since we will move these concepts into the concept map as we determine where they fit in. Some concepts may remain in the parking lot as the map is completed if the mapmaker sees no good connection for these with other concepts in the map.

It is important to recognize that a concept map is never finished. After a preliminary map is constructed, it is always necessary to revise this map. Other concepts can be added. Good maps usually result from three to many revisions. This is one reason why using computer software is helpful.

Once the preliminary map is built, cross-links should be sought. These are links between concepts in different segments or domains of knowledge on the map that help to illustrate how these domains are related to one another. Cross-links are important in order to show that the learner understands the relationships between the sub-domains in the map.

After a preliminary map is constructed, cross-links should be sought. These are links between concepts in different segments or domains of knowledge on the map that help to illustrate how these domains are related to one another. Cross-links are key to show that the learner understands the relationships between the sub-domains in the map.

It is important to help students recognize that all concepts are in some way related to one another. Therefore, it is necessary to be selective in identifying cross-links, and to be as precise as possible in identifying linking words that connect concepts. In addition, one should avoid “sentences in the boxes”, that is, full sentences used as concepts, since this usually indicates that a whole subsection of the map could be constructed from the statement in the box. “String maps” illustrate either poor understanding of the material or an inadequate restructuring of the map.
Introduction

Students often comment that it is hard to add linking words on to the “lines” of their concept map. This is because they poorly understand the relationship between the concepts, or the meanings of the concepts, and it is the linking words that specify this relationship. Once students begin to focus-in on good linking words, and on the identification of good cross-links, they can see that every concept could be related to every other concept. This also produces some frustration, and they must choose to identify the most prominent and most useful cross-links. This process involves what Bloom (1956) identified as high levels of cognitive performance, namely evaluation and synthesis of knowledge. Concept mapping is an easy way to encourage very high levels of cognitive performance, when the process is done well. This is one reason concept mapping can also be a very powerful evaluation tool (Edmondson, 2000).

Finally, the map should be revised, concepts re-positioned in ways that lend to clarity and better over-all structure, and a “final” map prepared. When computer software is used, one can go back, change the size and font style, and add colors to “dress up” the concept map.

Thus, we see that concept maps are not only a powerful tool for capturing, representing, and archiving knowledge of individuals, but also a powerful tool to create new knowledge.

FACILITATING COLLABORATIVE AND DISTANCE LEARNING

There is a growing body of research that shows that when students work in small groups and cooperate in striving to learn subject matter, positive cognitive and affective outcomes result (Johnson et al., 1981; Berk & Winsler, 1995). Vygotsky (1978) introduced the idea that language and social dialogue
can support learning, especially when members of the social group are at about
the same Zone of Proximal Development (ZPD).

CmapTools provides extensive support for collaborative work during
concept map construction. The concept maps built using CmapTools can be
stored on servers.

The extensive support that CmapTools provides for the collaborative
construction of concept maps by groups, whether they are at the same location
or in distant locations, has encouraged the increasing use of collaboration
during map building. In a variety of educational settings, concept mapping in
small groups has served us well in tasks as diverse as understanding ideas in
assimilation learning theory to clarifying job conflicts for conflict resolution in
profit and non-profit corporations (e.g., Beirute & Mayorga, 2004). Concept
maps are now beginning to be used in corporations to help teams clarify and
articulate the knowledge needed to solve problems ranging from the design of
new products to marketing to administrative problem resolution.

A CONCEPT MAP-CENTERED LEARNING ENVIRONMENT

CmapTools provides a variety of features that make it possible for
teachers to use concept maps for a variety of the tasks that students perform
(Cañas & Novak, 2005). In addition to a network environment that fosters
collaboration and the possibility of constructing knowledge models, the
software allows users, among other features, to (a) search for information based
on a concept map (Carvalho et al., 2001), by which a student can use the Cmap
to research information to learn more about the topic, leading to an improved
map with linked resources, and iteratively proceed on another search; (b)
record the process of constructing a Cmap for later playback, providing support
to the teacher in what is considered to be a key aspect of concept mapping: the
process of constructing a map; (c) piece-wise display a concept map and associated resources full-screen for oral presentations; (d) graphically compare two Cmaps, allowing the teacher to compare the student’s map to his/hers for an initial evaluation. The concept map can thus become an artifact around which the various activities of the learning process can be centered.

Based on the features provided by CmapTools, the student can use the concept map prepared as a pre-test as an initial step towards learning the pieces of knowledge that he/she needs to better understand, as the basis on which to perform the research that leads to this understanding, as a way to organize the various sources from which the student will construct this understanding, as the artifact with which to collaborate with peers, and as the means to present his/her findings at the end of the unit. Furthermore, the concept maps constructed by the student can become the foundation for a portfolio evaluation.

FOCUS QUESTION, PARKING LOTS AND EXPERT SKELETON MAPS

A concept map-centered learning environment implies that concept maps are used throughout the development of a learning unit or module. Concept maps within this environment are likely to be used as the mechanism to determine the level of understanding students have about the topic being studied before the topic is introduced. The maps are then developed, extended and refined as the students develop other activities on the topic and increase their understanding, possibly concluding with complex knowledge models that link resources, results, experiments, etc., and that can be used if desired as a final presentation by the students.
Just as there are many possible uses of concept maps within the classroom activities, there are a variety of “starting points” for the construction of the initial concept maps by students.

Each student can construct the initial concept map individually, giving the teacher feedback on the level of understanding of every student. Within the option of individual construction of the map, the students can be allowed to collaborate through a Knowledge Soup (Cañas et al., 1995; Cañas et al., 2001), where students are able to share propositions but not see each other’s maps. The concept map can be constructed by students working in couples or small groups, where the teacher must pay attention to the level of participation of every student. CmapTools has a recorder feature that allows recording and playback of steps in map construction, including identification of each contributor.

The concept map can also be a class effort, using a projector, where all students give their opinion and participate in the construction of the map. Teachers must be alert to evaluate the individual participation of every student.

Likewise, the starting point from which the map is constructed can vary depending on the expected previous understanding by the students, the difficulty and novelty of the topic, and the teacher’s confidence in mastering the topic.

**FOCUS QUESTION**

The starting point for constructing a concept map can consist of only the focus question. For example, “How do we measure time?” can be given to the students as the question to answer through the construction of the concept map. The type of focus question makes a difference in the type of concept maps that the student builds. A question like “What are plants?” will lead to a declarative,
more classificatory concept map than the question “Why do we need plants?”
Experiments show that not only the focus question, but also the root concept of
a concept map have a strong influence on the quality of the resulting concept
map (Derbentseva et al., 2004, 2006). It is important that a question be given
and not just a topic (e.g. “make a concept map about plants”), since answering
the question helps the students focus on their maps. Whenever a concept map is
made with CmapTools and then saved, the maker is asked to provide a focus
question, as well as key concepts for this concept map.

PARKING LOT

We refer to a list of concept waiting to be added to a concept map as the
parking lot of concepts. The staring point for the construction of the concept
map can be a list of concepts that the teacher wants to make sure all students
include in their map.

EXPERT SKELETON MAPS

For difficult topics – whether difficult for the students as determined by
the teacher’s previous experience, or difficult for the teacher because of his/her
background – using an “expert skeleton” concept map is an alternative. An
“expert skeleton” concept map has been previously prepared by an expert on
the topic, and permits both students and teachers to build their knowledge on a
solid foundation. “Expert skeleton” concept maps serve as a guide or scaffold
or aid to learning in a way analogous to the use of scaffolding in constructing.

CONCEPT MAPS FOR EVALUATION

We are now beginning to see in many science textbooks the inclusion of
custom concept mapping as one way to summarize understandings acquired by
students after they study a unit or chapter. Change in school practices is always slow, but it is likely that the use of concept maps in school instruction will increase substantially in the next decade or two. Other innovative practices for assessing student understanding of subject matter are also available (Mintzes et al., 2000). When concept maps are used in instruction, they can also be used for evaluation. There is nothing written in stone that says multiple choice tests must be used from grade school through university, and perhaps in time even national achievement exams will utilize concept mapping as a powerful evaluation tool. This is a chicken-and-egg problem because concept maps cannot be required on national achievement tests if most students have not been given opportunities to learn to use this knowledge representation tool. On the other hand, if state, regional, and national exams would begin to include concept maps as a segment of the exam, there would be a great incentive for teachers to teach students how to use this tool. Hopefully, in the next two decades, this will come to pass. Currently there are a number of projects in the USA and elsewhere that are doing research to see if better evaluation tools can be developed, including the use of concept maps. We should begin to see significant advances in this area in the next several years. Some features of the latest versions of CmapTools also facilitate the use of concept maps for assessment. For example, the “Compare concept maps” tool allows the comparison of an “expert” concept map for a topic with maps constructed by students, and all similar or different concepts and propositions are shown in color.

CONCEPT MAPS AND CURRICULUM PLANNING

In curriculum planning, concept maps can be enormously useful. They present in a highly concise manner the key concepts and principles to be taught. The hierarchical organization of concept maps suggests more optimal
sequencing of instructional material. Since the fundamental characteristic of meaningful learning is integration of new knowledge with the learners’ previous concept and propositional frameworks, proceeding from the more general, more inclusive concepts to the more specific information usually serves to encourage and enhance meaningful learning. Thus, in curriculum planning, we need to construct a global “macro map” showing the major ideas we plan to present in the whole course, or in a whole curriculum, and also more specific “micro maps” to show the knowledge structure for a very specific segment of the instructional program. Faculty working independently or collaboratively can redesign course syllabi or an entire curriculum.

Using concept maps in planning a curriculum or instruction on a specific topic helps to make the instruction “conceptually transparent” to students. Many students have difficulty identifying the important concepts in a text, lecture or other form of presentation. Part of the problem stems from a pattern of learning that simply requires memorization of information, and no evaluation of the information is required. Such students fail to construct powerful concept and propositional frameworks, leading them to see learning as a blur of myriad facts, dates, names, equations, or procedural rules to be memorized. For these students, the subject matter of most disciplines, and especially science, mathematics, and history, is a cacophony of information to memorize, and they usually find this boring. Many feel they cannot master knowledge in the field. If concept maps are used in planning instruction and students are required to construct concept maps as they are learning, previously unsuccessful students can become successful in making sense out of science and any other discipline, acquiring a feeling of control over the subject matter (Bascones & Novak, 1985; Novak, 1991, 1998).
CAPTURING AND ARCHIVING EXPERT KNOWLEDGE

One of the uses of concept maps that is growing at a fast rate is the use of concept maps to capture the “tacit” knowledge of experts. Experts know many things that they often cannot articulate well to others. This tacit knowledge is acquired over years of experience and derives in part from activities of the expert that involve thinking, feeling and acting. Often experts speak of a need to “get a feeling for what you’re working on”. In fact, the biography of one Nobel Lauriat in biology (Barbara McClintock) was entitled, A Feeling for the Organism (Keller, 1983). Nonaka and Takeuchi (1995) stress the importance of capturing and using the knowledge of corporate expert’s tacit knowledge if a company wants to become “the knowledge creating company”.

Most of the methods used prior to concept maps consisted of various forms of interviews and analyses with experts, including case studies of how experts accomplished some remarkable achievement (Hoffman et al., 1995; Klein & Hoffman, 1992). In fact, these methods continue to be highly popular with many cognitive scientists, most of whom are unfamiliar with Ausubel’s work and the kind of epistemological ideas on which concept mapping is based. Thus, the concept map not only allowed us to represent the expert’s knowledge, but also to find gaps in the knowledge structure we were procuring through interviews.

Case study analyses, “critical incident” analyses and similar techniques will have value in extracting and representing expert knowledge, it is likely that the end product of these studies might still be best represented in the form of concept maps, perhaps with some of the interview data and other information presented through icons on maps.
Toulmin (1972) also stressed the epistemological role of concepts. asserted that concepts are the basic elements of human thought and knowledge. To portray the relationship among elements of the knowledge making process, Gowin (1981) developed the heuristic device shown in simplified form Fig. 1.1.

![Epistemological V Diagram]

**Fig. 1.1: Gowin’s Epistemological V (after Novak and Staff, 1981).**

This “Epistemological V” demonstrates the interplay between the conceptual domain (concepts, principles, and theory) and the methodological domain (data records and statistical transformations) of the process of knowledge production.
Fig. 1.2: Concept Map Showing Global Atmospheric Change

(Rye and Rubba, 1996)
Figure 1.2 shows a concept map of global atmospheric change in the process of global warming. The most inclusive concept, global warming, appears at the top of the map. As one progresses down the map, the concepts become less inclusive and more specific. Unlike an outline, a concept map is two dimensional. This characteristic allows the portrayal of the complex connections that exist among concepts. For example in figure 1.2 the concept “Green house gas” is linked vertically to the more general concept, above it and to the more specific concept, coolants, below it. Furthermore, the map includes the concepts chlorofluorocarbons which lie at the same hierarchical level.

In essence, a concept map is a diagram that indicates relationships among concepts in a discipline, a part of a discipline, or an interdisciplinary area of study. Maps depict not only concepts themselves but also propositions, which describe meaningful relationships between Pairs of concepts. A teacher, a student, or a group of students can construct a concept map.

CRITERIA OF A CONCEPT MAP

Since each person possesses a unique organization of concepts and propositions in his or her cognitive structure, a concept map that is meaningful to its maker may not be the most meaningful arrangement to another person. The best maps are those that are most meaningful to persons who construct or read them. However, each map should also meet the following criteria (Bousquet, 1981):

1. Concepts are arranged in a hierarchy; i.e., the map starts with the most general concepts at the top and proceeds downward to the most specific concepts or examples;

2. Related concepts are linked by lines (Principles) that show these relationship; and
Introduction

3. Each principle has a label that describes how the linked concepts are related.

The characteristic of the concept mapping strategy are intended to be consistent with the four educational implications of the theory of meaningful learning discussed above. The procedure asks learners to identify concepts, decide which are more general and inclusive, and meaningfully relate these concepts to each other. Furthermore, since some concepts in any learning task should be concepts with which learners are already familiar, concept maps show learners how concepts they already know relate to the new concepts they are learning. Concept mapping, once mastered, has the potential to become a generalizable strategy which students can use to meaningfully learn the concepts of any area of study.

Since concepts are propositional in nature—that is, concepts are related to each other substantively, not arbitrarily—later forms of concept maps that Novak and his research group developed and studied possessed the added feature to having linking words written on the lines which connected pairs of concepts (Novak, 1981; Novak and Staff, 1981).

PROPOSITIONAL CONCEPT MAP

Recently, Novak (personal communication) stated that arranging concepts hierarchically sometimes makes graphic depiction of propositional relationships between concepts difficult because of the often confusing array of intersecting lines. In addition, the hierarchy in some concept groups is not clear-cut. He suggested that the general-to-specific organization of concept maps could possibly be omitted without affecting the educational value of the concept map. This proposed concept map type is termed the propositional (p) concept map, for purposes of this investigation.
Concepts are the fundamental components of scientific thought and knowledge production. Concepts, however, operate not only at the macro level of scientific enterprise but also at the individual level. Readiness for learning a given concept appears to depend upon the specific concepts a learner knows and possibly, upon the learner’s more general mental capabilities.

This study will help to investigate the relationship of certain cognitive characteristic of learners to their ability to construct concept maps and to their gains in knowledge of environmental concepts after constructing and learning these concept maps. Student’s background knowledge of environmental concepts and their level of cognitive development will be assessed.

ACHIEVEMENT MOTIVATION

Achievement motivation is a readiness to fulfill a planned objective. It is a psychological construct. Achievement motivation is the acquired tendency and one of the most important social needs. Thus achievement motivation may be regarded as a desire or a motive or a force with interest to obtain success.

In such a situation a subject shows concern with competition with a standard of excellence. Such concern may not be stated explicitly but there is always sufficient evidence to justify the existence of such a competition. The self imposed requirements for good performance and the descriptions of instrumental acts i.e. they are being carefully or seriously undertaken form the quality of the work. Sometimes they are involved in long-term goals of an achievement or in the accomplishment of some unique work. This may be called as the need to accomplish something worthwhile, unique or excellent, or need for mastery. This need appears to have two basic aspects: (i) motive to achieve i.e. an approach motive (ii) motive to avoid failure i.e. an avoidance motive. Achievement motive is a drive, which can be aroused experimentally by inducing a situation of ‘ego-involvement’ or ‘achievement orientation’. This
Introduction

manipulated situation of ‘ego-involvement’ produces the same kind of effect on the subject’s projection as is in the case of manipulation of hours of food. Achievement motivation which is characterized by a high desire to attain a standard of excellence and to accomplish a unique objective, was one of the first social motives to be studied in detail of McClelland in 1953. He expressed that social process of interaction with the environment is important and instrumental to learn various categories of motives. Achievement motive varies from person to person, group to group and it is open to cultural influences. The n-ach may be acquired through social and cultural milieu and training. The achievement motive (in both the aspects, i.e. approach and avoidance) are acquired by processes of reward and punishment.

Achievement motivation has been conceptualized as individual’s orientation to endeavor for conduction of activities in those situations where the performance has to be evaluated. In a society there are individuals who set high standards, for themselves work very hard to achieve them and respond with considerable feeling to their success or failure in meeting those standards. At the other extreme there are individuals who set very low standards, make little efforts, have little concern about their accomplishment and remain indifferent. These two types of individuals have different degrees of achievement motive, which has different behavioural consequences. Different levels of environmental variables, which exist in family, school and society, influence development of achievement motivation. When parents expect high level of excellence in the performance of their children and accordingly give them guidance to achieve the goal, achievement motive of the children is developed and influenced. Similarly, the impact of social expectation and models in society is seen on the mind of the children in the development of achievement motive. When children go to the school, their mental faculties are diversified due to their new experiences in the academic environment of the school. Role models of teachers and seniors, information of achievement of
towering personalities in various fields, etc. influence the mind of the students to develop higher level of achievement motivation.

Achievement motivation has been operationally defined as a desire to attain a high standard of excellence and to accomplish unique objectives. It is a measurement of self-imposed requirement for good performance or need to accomplishing something worth while and the scores obtained by students in the Deo and Mohan’s achievement motivation scale determine the level of achievement motivation.

Murray (1938) has defined achievement motivation as a special motive to master, manipulate or organize physical objects, human beings or ideas to do this as rapidly and independently is possible to over come obstacles and attain a high standard, to rival and surpass others and to increase self-regard by successful exercise of talent.

French (1955) defined achievement need as “need for the attainment of a standard of excellence”.

Crandall et al (1960) defined achievement behaviour as the one directed towards the attainment of approval or the avoidance of disapproval, for competence of performance in situations where standard of excellence are applied.

Atkinson (1964) found that achievement motivation for any person is the strength of the tendency to approach the task plus the strength of the tendency to avoid the task. It accounts for the determinants of the direction, magnitude and persistence of behaviour in a limited but very important domain of human activities. It applies only when an individual knows that his performance would be availed (by himself or by others) in terms of some standard of excellence and that the consequence of his action would be either a favourable evaluation (success) or an unfavorable evaluation (failure).
Introduction

According to McClelland (1965) achievement motivation is the desire to excel some standard of behaviour, it is an effect in connection with the evaluated performance in which competition with the standard of excellence is paramount.

Heckhausen (1967) explained that the standard of excellence might be “task related”, “Self related” and “Other related”, when it is task related, the person tries to gain perfection as the result of performance. When it is self related, the person compares it to his own previous achievements. When it is other related, the person tries to compare his achievement with those of others in competition. He further stated that whether the standard of excellence was task related, self related or other related, it considered of two parts, namely:

(i) Fear of failure
(ii) Hope of success

DeCecco (1970) defined achievement motivation as expectancy of finding satisfaction in mastering challenging and different performances.

According to International Encyclopedia of Social Sciences (1972) “Achievement Motivation is an important determinant of aspiration, effort and persistence when an individual expects that his performance will be evaluated in relation to some standard of excellence. Such behaviour is called achievement oriented (Sills, 1972)”.

Arnold et al (1972) viewed achievement motivation as a construct designed to explain inter and intra individual differences in the orientations, intensity and consistency of achievement motivation.

Wolman (1973) in Dictionary of Behavioural Sciences defined achievement motivation as a concern to improve, to do things better than one has done them before, to independently master objects and ideas and to increase self esteem by successful exercise of talent.
Dutt and Subhrawal (1973) terms achievement motivation as a disposition to strive for success in competition with others with some standard of excellence set by individual. Thus achievement motivation may be regarded as a desire or a motive or a force with interest to obtain success.

Davidoff (1976) has summarized the achievement motivation as follows:- The achievement motive, commonly considered a growth or social motive, is measured by having subjects construct stories about TAT pictures which are later scored for achievement related imagery.

- The achievement motive appears to be learning factors. An innate need for competence may also underline this motive.
- Men with high n-Ach generally persist in the laboratory and in real life. They also tend to prefer taking moderate risks as opposed to very high or very low ones to achieve success.
- To predict how specific individuals will perform in particular achievement situations it is necessary to consider their achievement motives, expectations of success in that situation, values placed on task success and achievement related fears of failure.

Evans (1978) stated that most people feel some sense of urgency to strive for success in various aspects of their life, and this general push has been termed as achievement motivation.

Goldenson (1984) in Longman Dictionary of Psychology and Psychiatry defines achievement motivation as the desire to accomplish difficult tasks and overcome obstacles and an individual is not so much concerned with success or failure in given task as with attaining a certain standard set for himself or herself.
Introduction

Mehndirata (1997) has defined achievement motivation as the psychological need and energetic drive, that prompts an individual to strive for and work toward mastering his or her environment by the successful accomplishment of a goal or goals, accompanied by a sense of satisfaction and self worth.

Colman (2001) has defined achievement motivation as a social form of motivation involving a competitive drive to meet standards of excellence.

Price (2004) states that achievement motivation is the desire to experience success and to participate in activities in which success is dependent on personal effort and abilities.

Chopra (2005) refers that achievement motivation is the desire to experience success and to participate in activities in which success is dependent on personal effort and abilities.

FACTORS AFFECTING ACHIEVEMENT MOTIVATION

The degree of achievement oriented behaviour, which the people with strong underlying achievement motivation show, depends upon factors like-

- child rearing practices,
- race environment,
- family structure,
- occupational status,
- climatic condition and so on,
- which directly or indirectly are responsible for the same (Bidyadhar, 2006).
NEED OF ACHIEVEMENT MOTIVATION

In the digital age, there is a great need to raise the level of achievement motivation of the students. High school students differ from one another in the strength of achievement motive. Activities also differ in challenge they pose and the opportunity they offer to expression of this motive. Teachers and conditions in the school also play important role in developing achievement motivation in the students. Their level of achievement motivation may be further enhanced and solidified because of role model of teachers and reinforcing conditions in the school. As a result they will develop awakening and awareness about the aims and objectives of their schooling. Teacher’s personality plays hypnotizing effect on the mind of the students to understand the reasons to have achievement motive in society.

IMPORTANT MOTIVATORS OF BEHAVIOUR

- Social learning (or observational) theory suggests that modeling (imitating others) and vicarious learning (Watching others have consequences applied to their behavior) are important motivators of behavior. Social cognition theory proposes reciprocal determination as a primary factor in both learning and motivation. In this view, the environment, an individual's behavior, and the individual's characteristics (e.g., knowledge, emotions, cognitive development) both influence and are influenced by each other two components.

- Bandura (1986, 1997) highlights self-efficacy (the belief that a particular action is possible and that the individual can accomplish it) and self-regulation (the establishment of goals, the development of a plan to attain those goals, the commitment to implement that plan, the actual implementation of the plan, and subsequent actions of reflection and modification or redirection. The work of Ames (1992) and Dweck
(1986) discussed below is a major component of social cognitive views on motivation.

**Fig. 1.3 : Social Cognitive Views on Motivation**

Most of the transpersonal or spiritual theories deal with the meaningfulness of our lives or ultimate meanings. Abraham Maslow (1954) has also been influential in this approach to motivation. Other influential scholars included Allport (1955), Frankl (1998), James (1997), Jung (1953, 1997).

**MOTIVATIONAL THEORY**

- One classification of motivation differentiates among achievement, power, and social factors (see McClelland, 1985; Murray, 1938, 1943).

In the area of achievement motivation, the work on goal-theory has differentiated three separate types of goals: mastery goals (also called learning goals) which focus on gaining competence or mastering a new set of knowledge or skills; performance goals (also called ego-involvement goals) which focus on achieving normative-based standards, doing better than others, or doing well without a lot of effort; and social goals which focus on relationships among people (Ames, 1992; Dweck, 1986; Urdan & Maehr, 1995). In the context of school
learning, which involves operating in a relatively structured environment, students with mastery goals outperform students with either performance or social goals. However, in life success, it seems critical that individuals have all three types of goals in order to be very successful.

- One aspect of this theory is that individuals are motivated to either avoid failure (more often associated with performance goals). In the former situation, the individual is more likely to select easy or difficult tasks, thereby either achieving success or having a good excuse for why failure occurred. In the later situation, the individual is more likely to select moderately difficult tasks which will provide an interesting challenge, but still keep the high expectations for success.

**REASONS FOR LACK OF MOTIVATION**

**Stipek (1988)** suggests there are a variety of reasons why individuals may be lacking in motivation and provides a list of specific behaviors associated with high academic achievement. This is an excellent checklist to help students develop the conative component of their lives. In addition, as stated previously in these materials, teachers efficacy is a powerful input variable related to student achievement *(Proctor, 1984)*.

**INTRINSIC AND EXTRINSIC MOTIVATION**

There are a variety of specific actions that teachers can take to increase motivation on classroom tasks. In general, these fall into the two categories discussed above; intrinsic motivation and extrinsic motivation.
Table 1.2: Intrinsic and extrinsic motivation

<table>
<thead>
<tr>
<th>Intrinsic</th>
<th>Extrinsic</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Explain or show why learning a particular content or skill is important</td>
<td>• Provide clear expectations</td>
</tr>
<tr>
<td>• Create and/or maintain curiosity</td>
<td>• Give corrective feedback</td>
</tr>
<tr>
<td>• Provide a variety of activities and sensory stimulations</td>
<td>• Provide valuable rewards</td>
</tr>
<tr>
<td>• Provide games and simulations</td>
<td>• Make rewards available</td>
</tr>
<tr>
<td>• Set goals for learning</td>
<td></td>
</tr>
<tr>
<td>• Relate learning to student needs</td>
<td></td>
</tr>
<tr>
<td>• Help student develop plan of action</td>
<td></td>
</tr>
</tbody>
</table>

As a general rule, teachers need to use as much of the intrinsic suggestions as possible while recognizing that not all students will be appropriately motivated by them. The extrinsic suggestions will work, but it must be remembered that they do so only as long as the student is under the control of the teacher. When outside of that control, unless the desired goals and behaviors have been internalized, the learner will cease the desired behavior and operate according to his or her internal standards or to other external factors. Achievement motivation refers to the level of need of individual person. The desire to improve academic achievement.

MOTIVATION AND ASPIRATION

According to Garry (1965) motivation can be considered synonymous to aspiration. These two are positively related. Achievement is also synonymous with accomplishment, proficiency in performance, social acknowledgement of one’s skill, one’s proficiency in a given area of leaving and depth of one’s knowledge. These are the indicators of the extent of one’s achievement.
SOURCES OF MOTIVATION

- Intrinsic
- Extrinsic

In general, explanations regarding the source(s) of motivation can be categorized as either extrinsic (outside the person) or intrinsic (internal to the person). Intrinsic sources and corresponding theories can be further subcategorized as either body/physical, mind/mental (i.e., cognitive, affective, conative) or transpersonal/spiritual.

Figure 1.4: Types of Motivation

In current literature, needs are now viewed as dispositions toward action (i.e., they create a condition that is predisposed towards taking action or making a change and moving in a certain direction). Action or overt behavior may be initiated by either positive or negative incentives or a combination of both. The following table provides a brief overview of the different sources of motivation (internal state) the have been studied. While initiation of action can be traced to each of these domains, it appears likely that initiation of behavior may be more related to emotions and/or the affective area (optimism vs. pessimism; self-esteem; etc.) while persistence may be more related to conation (volition) or goal-orientation.
### Table 1.3: Sources of Motivational Needs

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Behavioral        | • elicited by stimulus associated/connected stimulus  
                    • obtain desired, pleasant consequences (rewards) or  
                    • escape/avoid undesired, unpleasant consequences  |
| Social            | • imitate positive models  
                    • be a part of a group or a valued member |
| Biological        | • increase/decrease stimulation (arousal)  
                    • activate senses (taste, touch, smell, etc.)  
                    • decrease hunger, thirst, discomfort, etc.  
                    • maintain homeostasis, balance |
| Cognitive         | • maintain attention to something interesting or threatening  
                    • develop meaning or understanding  
                    • increase/decrease cognitive disequilibrium; uncertainty  
                    • solve a problem or make a decision  
                    • figure something out  
                    • eliminate threat or risk |
| Affective         | • increase/decrease affective dissonance  
                    • increase feeling good  
                    • decrease feeling bad  
                    • increase security of or decrease threats to self-esteem  
                    • maintain levels of optimism and enthusiasm |
Cognitive

- meet individually developed/selected goal
- obtain personal dream
- develop or maintain self-efficacy
- take control of one's life
- eliminate threats to meeting goal, obtaining dream
- reduce other's control of one's life

Spiritual

- understand purpose of one's life
- connect self to ultimate unknowns

**APPROACHES OF MOTIVATION**

A cognitive approach is expectancy theory (Vroom, 1964) which proposes the following equation:

\[
\text{Motivation} = \text{Perceived Probability of Success (Expectancy)} \times \text{Connection of Success and Reward (Instrumentality)} \times \text{Value of Obtaining Goal (Valance, Value)}
\]

Since this formula states that the three factors of Expectancy, Instrumentality, and Valance or Value are to be multiplied by each other, a low value in one will result in a low value of motivation. Therefore, all three must be present in order for motivation to occur. That is, if an individual doesn't believe he or she can be successful at a task OR the individual does not see a connection between his or her activity and success OR the individual does not value the results of success, then the probability is lowered that the individual will engage in the required learning activity. From the perspective of this theory, all three variables must be high in order for motivation and the resulting
behavior to be high. The third cognitive approach is cognitive dissonance theory which is in some respects similar to disequilibrium in Piaget's theory of cognitive development. This theory was developed by Leon Festinger (1957), as social psychologist, and states that when there is a discrepancy between two beliefs, two actions, or between a belief and an action, we will act to resolve conflict and discrepancies. The implication is that if we can create the appropriate amount of disequilibrium, this will in turn lead to the individual changing his or her behavior which in turn will lead to a changing in thought patterns which in turn leads to more change in behavior.

One of the most influential writers in the area of motivation is Abraham Maslow (1954).

![Figure 1.5: Maslow's Hierarchy of Needs](image)

Maslow (1954) attempted to synthesize a large body of research related to human motivation. Prior to Maslow, researchers generally focused separately on such factors as biology, achievement, or power to explain what energizes, directs, and sustains human behavior. Maslow posited a hierarchy of
Introduction

human needs based on two groupings: deficiency needs and growth needs. Within the deficiency needs, each lower need must be met before moving to the next higher level. Once each of these needs has been satisfied, if at some future time a deficiency is detected, the individual will act to remove the deficiency. The first eight levels are:

1) Physiological: hunger, thirst, bodily comforts, etc.;
2) Safety/security: out of danger;
3) Belongingness and Love: affiliate with others, be accepted; and
4) Esteem: to achieve, be competent, gain approval and recognition.
5) Cognitive: to know, to understand, and explore;
6) Aesthetic: symmetry, order, and beauty;
7) Self-actualization: to find self-fulfillment and realize one's potential; and
8) Self-transcendence: to connect to something beyond the ego or to help others find self-fulfillment and realize their potential.

Maslow's basic position is that as one becomes more self-actualized and self-transcendent, one becomes more wise (develops wisdom) and automatically knows what to do in a wide variety of situations. Daniels (2001) suggests that Maslow's ultimate conclusion that the highest levels of self-actualization are transcendent in their nature may be one of his most important contributions to the study of human behavior and motivation.

IMPLICATIONS OF ACHIEVEMENT MOTIVATION

Magill (1996) in International Encyclopedia of Psychology considers achievement motivation as the tendency to strive for success or the attainment of a desirable goal. Embedded with in the definition are number of important implications. First, achievement motivation involves an inclination on the part
Introduction

of the individual and how the personality influences a motivational state give the presence of certain environmental factors. Second, it involves a task-oriented behaviour that can be evaluated. Third, the task orientation is related to some standard of excellence that may be either internally or externally imposed. It plays an important role in individual and societal accomplishments.

Learning theories are the bases which help teachers and educators to understand diverse factors of individual differentiation in: perceiving information, encoding information, transferring information, scanning the representation of the information, and working memory capacity. There are three broad dimensions for considering human behaviour or activities: Cognition, affection, connation. All mental processes knowing, understanding and thinking in education are known as cognitivism, these processes may go in the human mind. Man here has became a mechanistic, reductionistic though rational and logical information processing system. The sequence of mental activity is conceptualized as S-O-R rather than the S-R, whereas represents the stimulus or information from the environment; O represents the organism and its internal sensory or perceptual processes which process this information by programmes like memory and schemata; and R symbolizes the organism behaviour. In sharp contrast to the behaviouristic approach these processes are regarded as an object of valid and legitimate scientific study. These processes include the acts of cognition like perceiving, recognising, remembering, imaging and thinking. These include R behaviors too, which are cognitive processes, leading to responses like problem solving (Newell and Simon, 2008). These involve mechanism that encode, transform, modify, store, retrieve and translate information received from the environment. Cognition is the
mental processing of information which is function of human mind that allows perceptions to grow into conceptions. When control over cognitive functions is there, then that is termed as metacognition. The processes of thinking are emphasized in the concept of meta cognition. So the cognitive ability to monitor and self regulate one’s thinking is termed metacognition. It is combined monitoring and regulation of one’s own thinking processes. It is a conscious verification of one’s personal cognitive status that allows a person to develop and expand upon new knowledge. Metacognitive skills predict success in academic endeavours and other areas of life. It plays an important role in communication, reading comprehension, acquisition of concept, social cognition, attention, self-control, memory, self-instruction, problem solving and personality development (Jahitha and Mohan, 2007).

Cognitive Style identifies the ways individuals react to different situations. Cognitive style describes consistencies in using cognitive processes. It includes stable attitudes, preferences or habitual strategies that distinguish the individual styles of perceiving, remembering, thinking and solving problems. There are number of cognitive styles but in the present study only convergent and divergent type is considered.

Cognitive style refers to the modes an individual employs in perceiving, organizing and tabling various dimensions of the environment. Cognitive style in this study refers to the convergent- divergent variable as measured by Joyce-Hudson scale of convergence-divergence (1973).

Broverman (1960) conceptualizes cognitive style as expression of different response probabilities or response strengths in certain types or classes of behaviour.
Kogan et al (1963) defined cognitive style as stable individual preferences in mode of perceptual organization and conceptualization of external environment.

Zagonc (1968) maintained that cognitive structure mediates between the environment input and the organism’s output. He added the idea that cognitive structures organize behaviour as well as input.

Messick (1976) defined cognitive style in terms of consistent patterns of organizing and processing information.

Goldstein and Blackmen (1978) defined cognitive styles as the characteristic ways in which individual conceptually organizes the environment. They have treated cognitive style as ways in which thought is structured and behaviourial consistency is viewed by them as the product of this structure.

Page and Thomas (1978) in International Dictionary of Education considered cognitive style as an individual's preferred or habitual style of learning or thinking. It is a logical approach rather than a process of trial and error.

Sharma and Aggarwal (1980) conceived style as a term that refers to stable individual performance in mode of perceptual categorizations of external environment.

Schilling (1981) defined cognitive style as the characteristic performance that different individuals show for different types of information. It refers to the methods employed by an individual in perceiving, organizing, and labelling various dimensions of the environment.

Wilson (1981) termed cognitive style as it purports to be bipolar with regard to level, neutral in value and universal rather than field specific. The
The bipolar nature of cognitive style means that each end of the continuum is held to reflect characteristic strengths and weaknesses, which reflect the functioning of the core personality. They differ for measures of abilities in that they describe how an individual tackles a task i.e. acquires, stores, receives it with the over tones of success and failure.

According to Kolb (1984) the four basic learning modes are defined as active experimentation (AE), reflective observation (RO), concrete experience (CE), and abstract conceptualization (AC). In addition, the learning process is not only active and passive, but also concrete and abstract. This model can also be considered as a four-stage model: (a) concrete experience, (b) observation and reflection, (c) the formation of abstract concepts and generalizations, and (d) hypothesis tested by active experimentation leading to new concrete experience.

According to Messcik (1984) cognitive style is “Characteristic self consistencies in information processing that develop in congenial ways around underlying personality trends”.

Satterly (1985) holds that there is no universally agreed definition of cognitive style but most researchers have emphasized three features.

- styles are characteristics of individuals;
- they describe processes which are relatively stable over time;
- and intra-individual stabilities are consistent across tasks having similar requirements.

Entwistle (1985) cognitive style is the term used to describe different way in which people process information, including perception, storage, transformation and utilization of information from the environment. It
Introduction describes habitual processes of perceiving and thinking which are qualitatively distinct.

**Aggarwal (1987)** defined cognitive style as sum total of individual’s performance for physical, social, emotional, and environmental elements in the course of learning.

**Cecil and Lester (1987)** agreed that cognitive style should be thought of as one of the personality characteristic or traits that are related to other personality characteristic. Further more, while cognitive styles cannot always be distinguished or separated from cognitive skills, they are distinct from cognitive styles.

**Tennant (1988)** defined cognitive style as “an individuals characteristics and consistent approach to organizing and processing information”.

**Riding and Cheema (1991)** considered style to be a fairly fixed characteristic of an individual while cognitive strategies are the ways that may be used to cope with particular situations and tasks. Strategies may be learned and developed. Styles by contrast, are static and are relatively inbuilt features of the individual.

**Riding et al (1993)** termed cognitive style as “a fairly fixed characteristic of an individual” and “are static and are relatively inbuilt features of an individual”.

According to **Messick’s (1993)** definition “cognitive styles are characteristic modes of perceiving, remembering, thinking, problem solving, decision making that are reflective of information processing regularities that develop in congenial ways”.

66
Corsini (1994) discussed the term cognitive style in relation to behaviour and performance. It is value free, having no good or bad judgements. Cognitive style is confirmed with qualitative rather than quantitative differences of the dimensions.

Messick (1994) supported the idea that ‘ability’ describes performance in a given task where as ‘style’ describes the way the task is approached while intellectual abilities are primarily concerned with the ability to learn, cognitive styles are primarily concerned with differences in the ways of learning.

Liu and Ginther (1999) referred cognitive style to the individual’s consistent and characteristic predisposition of perceiving, remembering organizing, processing, thinking and problem solving.

Fatt (2000) describes that cognitive styles influence the personality of the individuals, and affect the psychological behaviours that indicate how learners perceive, interact with and respond to the learning environment.

Kazdin (2000) in Encyclopedia of Psychology has added that cognitive style refers to the characteristics, self-consistent models of functioning which individuals show in their perceptual and intellectual activities.

Scholl (2001) referred cognitive style as a dispositional variable that involves the ways in which the individual processes information. It operates in an unconscious manner, that is, while individual may be aware of the outcome of the information processing process he or she is often unaware of the mental processes used to acquire, analyze, categorize, store and retrieve information in making decisions and solving problems.

Parameswaran (2003) views that cognition is the process or set of activities of attending, to a new stimulus or condition, organizing the same, analyzing, understanding, and integrating this in to earlier store of knowledge.
or sense. Thus, sensing, attending, perceiving, comprehending, understanding and remembering are perhaps the various stages in the process of cognition. He has further added that style concerns with the way people cognize, perceive, and acquire knowledge in different ways. Style is also involved in the process of interpretation, organization and conceptualization of knowledge gained through perceptual process.

Chopra (2005) states that cognitive style has a typical approach to learning activities and problem solving. For example, some people carefully analyse each task, deciding what must be done and in what order. Others react impulsively to situations.

Each individual has preferred ways of organizing all that he sees; remembers and thinks about. Consistent individual differences in these ways of organizing and processing informations and experiences have come to called as “cognitive styles”. These style represent consistencies in the manner or form of cognition or the level of skill displayed in the cognitive performance. Cognitive styles are conceptualised as stable attitudes, preferences or habitual strategies determining a person’s typical modes of perceiving, receiving, remembering, thinking and problem solving (Hilgard and Bower, 1986). Cognitive style may entail generalized habits of information processing, but they develop in congenial way around underlying personality trends. There are also individual differences in styles of remembering, thinking, and judging, and these individual variations, if not directly part of the personality, are at the very least intimately associated with various non-cognitive dimensions of personality (Kogan, 1976).

Differences in the above factors are brought together to suggest that individuals have different cognitive styles and are different in intelligence, ability, personality, and achievement. It seems that our cognitive style
influences our: intellectual abilities; skills; personalities; teaching and learning; and performance. Certain individuals tend to respond very quickly in most situations (impulsive cognitive style), where as others are more reflective and slower to respond (reflective cognitive style). Even both types of individuals are equally knowledgeable about the task at hand (Woolfolk, 1993). Cognitive styles suggest that individuals approach the same task in different way. These variation don’t reflect levels of intelligence or patterns of general abilities.

STYLE AND ABILITY

There has been various arguments relating to the overlap between style and ability. Some researchers support the idea that ‘ability’ describes performance in a given task where as ‘style’ describes the way the task is approached (Messick, 1994), while intellectual abilities are primarily concerned with the ability to learn, cognitive styles are primarily concerned with differences in the ways of learning. Cognitive styles are styles of thinking probably influenced by and in turn influence cognitive abilities (Brodzinsky, 1982).

STRUCTURE OF COGNITIVE STYLE

Cognitive styles are intimately interwoven with affective temperamental and motivational structures as part of the total personality. According to (Piaget, 1970) there are two aspects of the human mind i.e. (i) cognitive structures and (ii) cognitive functioning. The initial cognitive structure of infants is supposed to incorporate only those cognitive abilities or potentials, which help them to do such acts as look, reach out, or grasp. These abilities are termed as Schema (Piaget, 1970). Cognitive functioning includes comparison of conveyed information with already stored information in the mind, analysis
enlargement, new form of information, interpretation, use of information/storage according to need of the time. Therefore, consistent individual differences mediate between environmental input (conveyed through the stimulus) and output of organism (result of cognitive functioning) (Hilgard and Bower, 1986).

CHARACTERISTICS OF COGNITIVE STYLE

Ausburn and Ausburn (1978) argued that cognitive styles were characterized by properties –

• stability across the tasks and generality;
• relative independence of cognitive styles from traditional measures of general ability;
• relationships with some specific abilities, characteristics and learning tasks.

DIFFERENT TYPES OF COGNITIVE STYLES

Cognitive styles have either positive or negative relationship with motivation and academic achievement depending upon the learning task. So cognitive styles are concerned with the form, pervasive dimensions and are stable, bipolar with regard to value judgement. Messick examined features of cognitive styles and integrated them into a unified framework that serves to define cognitive styles in contrast not only to abilities but also to other types of stylistic variables. Moreover, links between stylistic aspects and personality or social functioning are demonstrated, many of which have potential implications for education and human development.
According to Messick (1984), eight variables represent cognitive styles in the narrow sense: broad Vs narrow categorizing, cognitive complexity Vs cognitive simplicity, field independence Vs field dependence, leveling Vs sharpening, scanning Vs focusing, converging Vs diverging, automatization Vs restructuring and reflection Vs impulsivity.

Riding and Cheema (1991) described four distinct cognitive styles: Wholist, Analytics, Verbalizers, Imagers. They led to the formation of two groups: the wholists-analytic (WA) and the verbal-imagery (VI) dimensions.

However, some types of cognitive styles popularly known are:

(i) Field dependence and Field independence;
(ii) Motivation centred Vs Non-motivation centred;
(iii) Aural Vs Visual;
(iv) Impulsive and Reflective cognitive style;
(v) Individualistic Vs Non-Individualistic;
(vi) Environment oriented Vs Environment free;
(vii) Flexible Vs Non-flexible;
(viii) Responsible Vs Irresponsible;
(ix) Convergent Vs Divergent.

In the literature there are various lables of cognitive styles. In this study attention is focused on convergent/divergent cognitive style. The reasons for that are: this is dominant over the other cognitive styles in the literature and pervious work suggested that this is related to assessment.
CONVERGENT AND DIVERGENT COGNITIVE STYLES

Research on the Convergence-Divergence cognitive style has not received as much attention as the FDI cognitive style from educators and researchers. This polar (FDI) construct originated in Witkin’s work. Witkin's and Good enough (1981) investigated for many years the idea suggested by Gestalt psychology, that some people are dominated by any strong frame of reference or pattern in a stimulus field, to such an extent that they have trouble in perceiving elements that cut across the pattern. He investigated the personality in relation to the integrative process of making contact with the environment through perception.

The idea of convergent-divergent cognitive style has its origin with Hudson (1966) who, as an under graduate, had found himself better at some parts of intelligence tests than others: good at the diagrammatic questions, and relatively poor at the verbal and numerical ones. It was argued that typical intelligence test only measured what was termed ‘convergent thinking’ and not ‘divergent thinking’. Converging Vs diverging represents the degree of an individual’s relative reliance upon convergent thinking (pointed toward logical conclusions and uniquely correct or conventionally best outcomes) as contrasted to divergent thinking (pointed toward variety and quantity of relevant output). Convergence Vs divergence has been studied as a manifestation of intelligence Vs creativity distinction.

CHARACTERS OF CONVERGENT THINKERS

Convergent thinkers score highly in problems requiring one conventionally accepted solution clearly obtainable from the information available (as in intelligence tests), while at the same time obtaining low scores in problems requiring the generation of several equally acceptable solutions.
Divergent thinking deals with the capacity to generate responses, to invent new ones, to explore and expand ideas, and in a word, to diverge. Convergent thinking thus demands close reasoning; divergent thinking demands fluency and flexibility (Child and Smithers, 1973).

Hudson (1966, 1968) made an attempt to devise tests of aptitude for arts and science respectively. The new tests do not require the respondent to produce one right answer, and can take different forms. According to Hudson (1966), “the converger is the boy (sic) who is substantially better at the intelligence test than he is at the open-ended tests; the diverger is the reverse”. Most of the research related to convergent/divergent styles has concentrated on the relationship between divergent thinking and arts-science orientation. Research showed that there is a tendency for convergers to choose science subjects. Johnstone and Al-Naeme (1995) indicated that much science teaching is convergent and students are rewarded for convergent thinking leading to unique specific answers. However, this may not to be the case for biology it attracts both groups of students (Orton, 1992; Bahar, 1999). Bahar’s statement was that, “biology might be one of the science branches in which students might cope equally well with a convergent or a divergent bias”.

CHARACTERS OF DIVERGENT THINKERS

Many researchers tended to equate divergent thinking with creativity and convergent thinking with intelligence. This has caused a great deal of controversy, with different research supporting different results (Nuttall, 1972; Bennett, 1973; Runco, 1986; Fryer, 1996). Bahar (1999) showed that divergent pupils/students did not perform better in all cases compared to convergent pupils/Students. Thus, he suggested that the answer might be related with assessment techniques. Because a particular type of assessment
technique may favour a particular kind of cognitive style. In general, it seems that the language and the format of questions in relation to the cognitive style of an individual may be able to influence his/her performance. However, Al-Naeme's (1988) research showed that divergent students had higher scores than convergent students in mini projects in chemistry. Converging versus diverging is usually assessed by subtracting measures of divergent thinking from the relatively independent measures of convergent thinking (Hudson, 1966; Smithers and Child, 1974). To conclude that some one’s divergent thinking abilities out weigh his or her convergent thinking activities. A critical point in this cognitive style dimension is the emphasis on ability measures in assessing a preference construct. To conclude that some one’s divergent thinking abilities out weigh his or her convergent thinking abilities is not the same as to claim an individual preference for divergent thinking activities. An adequate operationalization of a cognitive style of converging versus diverging would call for assessing preferences for one or the other thinking activity. Consequently, there is insufficient evidence of a cognitive style dimension of convergent versus divergent thinking as a bipolar pervasive preference dimension (Tiedemann, 1989).

LEARNING STYLES

Based on the four basic learning modes, according to Kolb (1984), there are four basic learning styles: converger, diverger, assimilator, and accommodator. Their characteristics are described below respectively:

- **Converger**: The convergent learning style depends mainly on the dominant learning capacities of active experimentation and abstract conceptualization. This style has great advantages in decision making, problem solving, traditional intelligent tests, and practical applications.
Introduction

of theories. Knowledge is organized in a way of hypothetical-deductive reasoning. Therefore, persons with this style are superior in technical tasks and problems and inferior in social and interpersonal matters. They tend to choose to specialize in physical sciences.

➤ **Diverger**: The divergent learning style has the opposite learning advantages over converger. This style depends mainly on concrete experience and reflective observation; it has great advantages in imaginative abilities and awareness of meaning and values. Therefore, persons with this style tend to organize concrete situations from different perspectives and to structure their relationship into a meaningful whole; they focus on adaptation by observation instead of by action; they are superior in generating alternative hypothesis and ideas, and tend to be imaginative, people-or feeling-oriented; they tend to choose to specialize in liberal arts and humanities.

➤ **Assimilator**: The assimilative learning style depends mainly on abstract conceptualization and reflective observation. This style has great advantages in inductive reasoning, creating theoretical models, and assimilating different observations into an integrative entity. Similar to converger, persons with this style tend to be more concerned about abstract concepts and ideas, and less concerned about people. However, persons with this style tend to focus more on the logical soundness and preciseness of the ideas, rather than their practical values; they tend to choose to work in research and planning units.

➤ **Accommodator**: The accommodative learning style has the opposite learning advantages over assimilation. This style depends mainly on active experimentation and concrete experience; it has great advantages in doing things, implementing plans, and engaging in new tasks.
Introduction

Therefore, persons with this style focus on risk taking, opportunity seeking, and action; they tend to be superior in adapting themselves to changing immediate situations in which the plan or theory does not fit the facts; they also tend to intuitively solve problems in a trial-and-error manner, depending mainly on other people for information rather than on their own thinking. Therefore, persons with this style tend to deal with people easily; they tend to specialize in action-oriented jobs, such as marketing and sales.

ACQUISITION

Acquisition is the act of acquiring or gaining possession, something acquired, a person or thing of special merit added to a group (Collins Dictionary, 2003). It is the act of contracting or assuming or acquiring possession of something. Acquisition is the cognitive process of acquiring skill or knowledge; "the child's acquisition of language. It is an ability that has been acquired by training acquirement, skill, accomplishment, attainment ability, power, craftsmanship, horsemanship, literacy, marksmanship; mastership etc. The acquisition also includes learning basic cognitive process, conditioning, development learning, interaction, incorporation, imprinting, language learning, committal to memory, memorization, transfer of training i.e., application of a skill learned in one situation to a different but similar situation.

According to Collins Thesaurus of the Education (2002) acquisition is acquiring, gaining, achievement, procurement, attainment, acquirement, obtainment.

KNOWLEDGE ACQUISITION

Knowledge acquisition includes the elicitation, collection, analysis, modelling and validation of knowledge for knowledge engineering and knowledge management projects.
INTRODUCTION

Some of the most important issues in knowledge acquisition are as follows:

- Most knowledge is in the heads of experts
- Experts have vast amounts of knowledge
- Experts have a lot of tacit knowledge
  - They don't know all that they know and use
  - Tacit knowledge is hard (impossible) to describe
- Experts are very busy and valuable people
- Each expert does not know everything
- Knowledge has a "shelf life"

REQUIREMENTS FOR KNOWLEDGE ACQUISITION TECHNIQUES

Because of these issues, techniques are required which:

- Take experts off the job for short time periods
- Allow non-experts to understand the knowledge
- Focus on the essential knowledge
- Can capture tacit knowledge
- Allow knowledge to be collated from different experts
- Allow knowledge to be validated and maintained.

KNOWLEDGE ACQUISITION TECHNIQUES

Many techniques have been developed to help elicit knowledge from an expert. These are referred to as knowledge elicitation or knowledge acquisition (KA) techniques. The term, "KA techniques" is commonly used.
Introduction

The following list gives a brief introduction to the types of techniques used for acquiring, analyzing and modelling knowledge.

- Protocol-generation techniques include various types of interviews (unstructured, semi-structured), reporting techniques (such as self-report and shadowing) and observational techniques.

- Protocol analysis techniques are used with transcripts of interviews of other text-based information to identify various types of knowledge, such as goals, decisions, relationship and attributes. This acts as a bridge between the use of protocol-based techniques and knowledge modelling techniques.

- Hierarchy-generation techniques, such as laddering, are used to build taxonomies or other hierarchical structures such as goal trees and decision networks.

- Matrix-based techniques involve the construction of grids indicating such things as problems encountered against possible solutions. Important types include the use of frames for representing the properties of concepts and the repertory and grid technique used to elicit, rate, analyze and categories the properties of concepts.

- Sorting techniques are used for capturing the way people compare and order concepts, and can lead to a revelation of knowledge about classes, properties and priorities.

- Limited-information and constrained-processing tasks are techniques that either limit the time and/or information available to the expert when performing tasks. For instance, the twenty-questions technique provides an efficient way of accessing the key information in a domain in a prioritized order.

- Diagram-based techniques include the generation and use of concept maps, state transition networks, event disarms and process maps. The
use of these is particularly important in capturing the "what, how, when, who and why" of tasks and events.

**Introduction**

**Figure 1.6 : Knowledge techniques**

**TYPICAL USE OF KNOWLEDGE TECHNIQUES**

How and when are the many techniques described above used in knowledge acquisition project? To illustrate the general process, a simple method will be described. This method starts with the use of natural techniques, then moves to using more contrived techniques. It is summarized as follows:

- Conduct an initial interview with the expert in order to (a) scope what knowledge is to be acquired, (b) determine what purpose the knowledge is to be put, (c) gain some understanding of key terminology, and (d) build a rapport with the expert. This interview (as with all session with experts) is recorded on either audiotape or videotape.
Introduction

- Transcribe the initial interview and analyze the resulting protocol. Create a concept ladder of the resulting knowledge to provide a broad representation of the knowledge in the domain. Use the ladder to produce a set of questions which cover the essential issues across the domain and which serve the goals of the knowledge acquisition project.
- Conduct a semi-structured interview with the expert using the pre-prepared questions to provide structure and focus.
- Transcribe the semi-structured interview and analyze the resulting protocol for the knowledge types present. Typically these would be concepts, attributes, values, relationships, tasks and rules.
- Represent these knowledge elements using the most appropriate knowledge models, e.g. ladders, grids, network diagrams, hypertext, etc. In addition, document anecdotes, illustrations and explanations in a structured manner using hypertext and template headings.
- Use the resulting knowledge models and structured text with contrived techniques such as laddering, think aloud problem-solving, twenty questions and repertory grid to allow the expert to modify and expand on the knowledge captured.
- Repeat the analysis, model building and acquisition sessions until the expert and knowledge engineer are happy that the goals of the project have been realized.
- Validate the knowledge acquired with other experts, and make modifications where necessary.

Hence, as more knowledge is gathered and abstracted to produce generic knowledge, the whole process becomes more efficient. In practice, knowledge engineers often mix this theory-driven (top-down) approach with a data-driven (bottom-up) approach.
RECENT DEVELOPMENTS

A number of recent developments are continuing to improve the efficiency of the knowledge acquisition process. Four of these developments are examined below.

- First, methodologies have been introduced that provide frameworks and generic knowledge to help guide knowledge acquisition activities and ensure the development of each expert, system/is performed in an efficient manner.

- A second important development is the creation and use of ontologies.

- A third development has been an increasing use of software tools to aid the acquisition process.

- A fourth recent development is the use of knowledge engineering principles and techniques in contexts other than the development of expert systems. A notable use of the technology in another field is as an aid to knowledge management within organizational contexts. Knowledge management is a strategy whereby the knowledge within an organization is treated as a key asset to be managed in the most effective way possible. This approach has been a major influence in the past few years as companies recognize the vital need to manage their knowledge assets. A number of principles and techniques from knowledge engineering have been successfully transferred to aid in knowledge management initiatives, such as the construction of websites for company interact systems. This is an important precedent for the aim of the thesis to apply practices from knowledge engineering to the realm of personal knowledge.

IX GRADERS

IX graders are selected as a sample for present study. IX graders relate to students studying in the ninth standard or secondary classes and in the age
group of 13-15. They have the cognitive ability to understand environment concepts for getting environmental awareness. They will be able to understand the basic physical and biological features of environment i.e. living and non-living and non-living things and their classification. They already have some knowledge about different food chains operating in biosphere. They know about the basic thermodynamic variables like temperature, pressure, volume and different processes related with their imbalances in environment. They can also define pollution and discriminate between different types of pollution for creating environmental awareness. It is a time of rapid development and confusion, both physically and emotionally. As a matter of fact, the normally developing adolescent (secondary school students) tends to feel whether his self-attitude is favourable or unfavourable to acquire a concept related to environmental awareness. If environmental circumstances and personal attributes i.e. cognitive style, achievement motivation are at all favourable, the tendency is for the self-view to be positive rather than negative. In the current context the need for studying the environmental awareness of secondary school students was felt.

According to Kakkar (1992) by the age of 13 year or above, certain psychological changes with in him self, certain attitudes of others toward him, certain 'growing up' process operate to bring about change not only in the experience of young adolescents. But also in their effect upon his social relationship.

OPERATIONAL DEFINITIONS

Acquisition It refers to the attainment of certain abilities and development of certain skills during the learning process.
Environmental awareness is defined operationally as the sensitivity to the total environment and its allied problems. The development of environmental awareness means to understand the environmental problems and to develop critical thinking and problem solving skill in the people. Awareness includes making the individual conscious about physical, social and aesthetic aspects of the environment.

Concept mapping is requiring students to generate concept maps in which they depict their knowledge through the creation of identified nodes and links, may present another option to determine their cognitive growth. It refers to organised knowledge to make connection between new concepts and prior concepts.

IX grader is operationally defined as adolescents generally to be the years between the age of 12 and 18, and a time of rapid development.

Achievement motivation refers to the level of need of individual person. The desire to improve academic achievement and to attain a high standard of excellence and to accomplish unique objectives. It is a measurement of self-imposed requirement for good performance or need to accomplishing something worthwhile.

Cognitive style refers to the modes an individual employs in perceiving, organizing and tabling various dimensions of the environment. Cognitive style in this study refers to the convergent-divergent variables as measured by Joyce-Hudson scale of convergence and divergence (1973). It describes consistencies in using cognitive processes and includes stable attitudes, preferences or habitual strategies that distinguish the individual styles of perceiving, remembering, thinking and solving problems. Cognitive style, convergent vs
divergent style represents the degree of an individual's relative reliance upon convergent thinking as contrast to divergent thinking.

**REVIEW OF RELATED LITERATURE**

Human knowledge has the three phases: preservation, transmission and advancement. Practically all human knowledge can be found in books, journals and papers. By building upon the accumulated and recorded knowledge of the past, man constantly adds to vast store of knowledge which makes possible progress in all areas of human endeavour. The investigator can ensure whether considerable work has already been done on topic which are directly related to his proposed investigation. To assure this familiarity, every research project in the behaviour sciences, has to review the available theoretical and research literature.

The phase 'review of literature' consists of two words: review and literature. The term 'review' means to organize the knowledge of the specific area of research to evolve an edifice of knowledge to show that the proposed study would be an addition to this field. In research methodology the term literature refers to the knowledge of a particular area of investigation of any discipline which includes theoretical, practical and its research studies.

**W.R. Borg**—"The literature in any field forms the foundation upon which all future work will be built. If we fail to build the foundation of knowledge provided by the review of literature our work is likely to be shallow and naive and will often duplicate work that has already been done better by some one else".

In experimental research, the review of the literature serves a variety of background functions preparatory to the actual collection of data. Review of
related literature is an essential prerequisite for actual planning and the execution of any research work. About the importance of related literature John Best (1986) writes, “The search for reference material is a time consuming but fruitful phase. A familiarity with the literature in any problem area helps to discover what is already known, what others have attempted to find out, which methods of attack have been promising or disappointing and which problems remain to be solved”. A review of related literature means the view of the problem which has been dealt and is related to the problem under taken by the investigator. In these approaches, the literature is reviewed to create the context from the past for the new study to be conducted with new subjects and newly gathered data (Saxena and Mishra, 2006).

The study of literature provides a wide scope for any kind of investigation in any problem area to search what other researchers have already attempted to find out, the methodology they have used and to what extent they have been successful in their research and what problems still remain to be solved. The present project has been forwarded with the review of literature related to the main issues discussed, which the investigator could gather with all the resources available.

Considering the pros and cons of premier researches and the success of the investigators and educationists in these area, the present project has been forwarded with the review of literature related to the main issues discussed, which the investigator could gather with all the resources available.

In this chapter an effort is made to review the literature related to environmental awareness, concept mapping, achievement motivation and cognitive style.
STUDIES RELATED TO ENVIRONMENTAL AWARENESS

**Summers et al (2000)** studied primary school teachers’ understanding of environmental issues: an interview study. They used in-depth interviews to explore the understanding of a non-random sample of 12 practicing primary school teachers in four areas: (1) biodiversity; (2) the carbon cycle; (3) ozone; and (4) global warming. Those underpinning science concepts were identified that were well understood.

**Cumberbatch (2000)** reported the effect of outdoor environmental education on in-class behaviour of sixth, seventh and eighth grade students. This study focused on using the natural environment as a classroom with an environmental education curriculum. Three environmental education classes comprising ninety students were evaluated. The independent variable was academic grades after environmental education. Comparisons of academic conduct grades between classes taken before and after environmental education were made. Results indicated that there was a positive behavioural correlation between environment education and academic classes. A standardized tool for evaluating conduct grades would be essential.

**Cain (2000)** evaluated youth and environment: an evaluation of the Nova Scotia youth conservation corps program. In this study employment was given to youth aged 17 to 24. This program was evaluated in terms of its effects on the youth particularly in terms of its goals to improve environmental knowledge, environmental awareness, environmental effectiveness, environmental behaviour as well as leadership and presentations skills. These goals were evaluated using pre-test and post-test questionnaires and phone interviews. The questionnaires and phone interviews were developed using concepts from environmental psychology research. Results from these
indicated that the NSYCC Regular Summer Programme was successful in achieving its goals. Environmental knowledge and presentation skills statistically improved.

**Legault (2000)** examined the impact of an environmental education program on children’s and parent’s knowledge, attitudes, motivation and behaviours. This EEP comprised a formal curriculum and environmental activities. A control group of children was enrolled in schools where environmental issues were confined to the natural sciences subject. The goals of this study were three fold. Results suggested that children in the experimental group were more likely to ask teachers and parents for ecological information and presented a more self-determined motivational profile. Level of knowledge, other attitudes and behavioural measures did not differ significantly between the two groups. No other significant differences between groups of parents were found. Path analyses results suggested that parent’s perception of children’s provision of autonomy support and of ecological information, as well as joint child/parent involvement in ecological activities favored parent’s ecological attitudes and motivation.

**Dunaway (2000)** analyzed a study of the level of environmental knowledge, attitudes and behaviour among law students at the Brandeis School of Law at the University of Louisville and at the Salmon P. Chase College of Law at Northern Kentucky University. The researcher created a survey using surveys from the National Environmental Education Training Foundation (NEETF) to assess the environmental knowledge’ attitudes, and behaviours of law students at two state of Kentucky law schools. The results from these law students were compared with the national data from the NEETF survey to determine if differences existed for environmental knowledge, attitudes, and behaviours between the selected population of law students and the
representation of the general public in the NEETF studies. The results were then analysed to determine if significant differences existed between the law students at the Louis D. Brandeis School of Law and the students at the Salman P. Chase college of law and these male and female law students. The researcher concluded that the level of education is positively correlated to the level of environmental knowledge. These results demonstrated the need for continuing life long environmental education to maintain a population that may make informed decisions concerning the environment.

*Tickell (2002)* reported that the positive role of media in bringing about environmental awareness at World Summit on environment held in Johannesburg (Sep. 2002).

*The Tribune (2003)* has informed that basic concepts of environment and related information would be incorporated in school curriculum in 18 states under the World Bank assisted "Greening of Textbooks" programme by the end of the current year.

*The Tribune (2004)* has published judgement that the Supreme Court gave approval to National Council of Education Research and Training (NCERT) syllabus on environment studies in schools across the country and also made compulsory upto Senior Secondary level from current academic session.

*Wansheng and Wujie (2004)* revealed the moral education curriculum for junior high schools in 21st century China. It was found that moral education in the Chinese junior high school over the last 25 years was useful in implementation and practice of ‘quality-oriented education’. It described: three basic principles behind this new curriculum, focusing on the developing lives of students; curriculum characteristics with ideological, humanistic, practical
and integrative dimensions; and the objectives of developing feelings, attitudes and value orientations, competencies and knowledge. The curriculum was illustrated by four textbook and class-based examples of respect for parents, self-esteem, environmental awareness and being a responsible citizen, which offered some insights into contemporary moral education with distinctive Chinese characteristics. The significance of the moral education curriculum reform was there for ongoing challenges.

Jie (2004) studied incorporation of moral education into environmental education. It described the action taken by a school regarding the numerous complaints and criticisms about students trespassing on lawns, picking flowers and fruits, and destroying trees. The school decided to take the opportunity to launch an environmental education campaign to teach students to protect flowers, plants, and the environment. Environmental knowledge was integrated into various courses. In addition, secondary educational activities were also organized. Moral education was embedded in environmental education by celebrating Environmental Protection Day. It reinforced their collective spirit and attitude towards labour and environmental awareness. The school launched a series of activities based on the following principle: (1) combining large and small activities; (2) adopting various formats; and (3) endless efforts.

Devine-Wright et al (2004) explored situational influences upon children’s beliefs about global warming and energy. They found children’s beliefs about global warming and energy sources from a psychological perspective, focusing upon situational influences upon subjective beliefs, including perceived self-efficacy. The context of the research was one of growing concern at the potential impacts of global warming, yet demonstrably low levels of self-efficacy amongst both adults and children to effectively respond to this large scale environmental problem. A sample of 198 UK
Introduction

children and adults was selected. Results indicated that cooperative learning environments could have a significant and positive effect upon children's belief about large-scale environmental problems. Wood craft folk children reported significantly higher levels of personal awareness and perceived self-efficacy in relation to global warming in comparison to their peers. Unexpected differences were identified between levels of perceived self-efficacy in children and adult wood craft folk.

Gerstenberger et al (2004) evaluated the influence of an introductory environmental science class on environmental perceptions. An environmental concern scale (ECS) was administered to a group of college students before and after completion of an introductory environmental science class. A significant increase in the level of concern was seen in questions related to overall environmental awareness.

Eichler et al (2005) revealed carbopolis: a Java technology based free software for environmental education. In this study some characteristic of the pedagogical project of the “Carbopolis” software were described and some programming solutions that were found during the computational implementation of this software. Some pedagogical features necessary to develop computerized learning materials for scientific education were analysed. The programming solutions developed using a graphical interface, scenario mapping, data storage, book marking, notepad, browser, and the software installation were described. In addition, some information obtained in two contexts of the pedagogical project evaluation was presented: one context attempted to evaluate conceptual learning; the second attempted to show the software usability in different school settings.

Gomez (2005) revealed that in the name of environmental education: words and things in the complex territory of education environment.
development relations. It was found that the proclamation of the Decade of Education for Sustainable Development by the United Nations has placed education in general, and environmental education in particular, at the front of a future full of important and uncertain meanings. On the one hand, those inviting a conceptual theoretical and praxiological revision of the education-environment-development relationship appealed to the role of education in the construction of “sustainability” and life styles that would make it possible. On the other hand, there were those that anticipate new and different readings of the environmental educative task. So environmental education aimed at being “human” and “sustainable” from a pedagogical, ecological and social point of view.

Maher (2005) studied deep mapping the biome: the biology of place in don gayton’s “the wheat grass mechanism” and John Janovy Jr.’s “dun woody pond”. He found that “deep map” was the invention of William Least Heat-Moon, whose extended essay “Prairy Erth (a deep map) “has given definition to this form. Deep map writing was marked by its inter textual, interdisciplinary, and multivocal nature. It was also self- consciously cartographic, presenting maps, following maps, and redrawing maps. This textual achievement had provided an emerging form of environmental writing, created an alignment among essayists experimenting with intercalated form, and inspired Heat-Moon’s contemporaries to attempt their own deep maps. Scientists had experimented with the deep map genre, and dived into biological mechanisms of place, presenting the interaction of natural forces upon flora and fauna.

Lambie (2005) found at risk students and environmental factors. This study helped school professionals to understand and respond appropriately to the family’s socio-economic status, history, and ethnic and cultural patterns. It
was found that the socio economic factors had impact on children and the family. The “Ethnic Differences” focused first on the general life strategies of various ethnic groups, then on the cultural values of Hispanic, African, Asian and Native Americans, and ends with a discussion of differences in cognitive styles prevalent in each ethnic group. It concluded by describing activities and programs that can be used for achieving greater understanding of ethnic differences on affirming diversity and promoting equity.

**Tal (2005)** studied implementation of multiple assessment modes in an interdisciplinary environmental education course. It was found that environmental education promotes the use of higher-order thinking skills, encourages informal experiences in school as well as outdoors and brings together children and adults in order to make a contribution to the environment. A complex assessment method that encompassed pre, in- and after-course assessments and incorporated instruments that assessed knowledge, reasoning, decision-making and the active involvement of 27 senior pre-service science and technology teachers who participated in an environmental education course. Findings indicated that the multiple assessment modes employed expressed a wide range of learning in the course. The team investigation project was found to be most suitable for developing environmental awareness, as well as inquiry skills. Self and peer assessment enhanced critical thinking and continuous discussion. The assessment framework introduced included aspects of environmental knowledge as well as awareness, skills, attitudes, values and practical involvement and addressed most of the courses basic ideas and components.

**Baumgartner and Zabin (2006)** studied visualizing zonation patterns. It was a great way to introduce students to basic ecological concepts by the study of “Zonation”, the distribution of plants and animals into distinct spatial
Introduction

areas. Students conducted methodical, quantifying surveys of zones in areas as diverse as mudflats, beaches, forests, wet lands. Students collected data from these areas with field ecology techniques such as transects and quadrats, which allowed students to estimate how many different kinds of organisms exist in an area or to describe relative abundance. Students gained an understanding about quantitative sampling techniques and how to effectively evaluate which methods work best for different surveys or in different types of areas. It was found that zonation mapping was an easy and powerful way for students to put their field experience into a larger scientific context, while also provided a concrete example of ecological concepts.

Spector (2006) investigated a methodology for assessing learning in complex and ill-structured task domains. He found new ways to think about and implement learning environments due to new information and communications technologies and research in cognitive science. Among these was an interest in and emphasis on complex subject matter (e.g. complex and dynamic systems involving things such as crisis management, environmental planning, social policy formulation, etc.). Consistent with the notion that learning involves observable changes in abilities, attitudes, beliefs, knowledge, mental models, and skills was the requirement of development methods to assess progress of learning in these complex and ill structured task domains. A framework for assessing learning and performance was presented along with findings from its application in three complex task domains: biology, engineering design and medical diagnosis.

Fitzhugh (2006) studied celebrating Saudi Arabia: using the five fundamental themes of geography in order to discover Saudi Arabia. He designed this unit for elementary students, provided a text, questions, mapping skills, and fun activities. Students read about Saudi Arabia to gain insights and
an appreciation of Saudi Arabia and to make comparisons with the geography and culture of their own neighbourhoods.

**Haigh (2006)** examined in promoting environmental education for sustainable development; the value of links between higher education and non-governmental organizations (NGOs). In this case study of a community-based land reclamation research project, supported jointly by the NGOs Earth watch and Oxford Brookes University, analysis of the motivations and experiences of project volunteers showed that their aims include making a personal contribution to enhancing the quality of the environment and networking with likeminded individuals, and that they expected to carry their new understanding back into their everyday lives to influence other people in their work place. NGOs may provide the best hope for helping to change the destructive aspects of modern society but they are vulnerable through financial dependency on sponsors, volunteers and donors.

**Malandrakis (2006)** explored learning pathways in environmental science education: the case of hazardous household items. The present study drew on environmental science education to explore aspects of children’s conceptual change regarding hazardous household items. Twelve children from a fifth grade class attended a 300 hour teaching module of environmentally oriented science activities aimed at assessing their awareness about the environmental concepts.

**Harris (2006)** studied environmental perspectives and behaviours in China: Synopsis and bibliography. This study was conducted to know world’s most profound environmental changes and the underlying forces of environment related behaviours at all levels in China. Various variables by summarizing findings of Chinese-language surveys conducted in China to measure environmental awareness, attitudes, and behaviours were found.
People in different parts of China had differences in perceptions and behaviours. The snapshot depicted environmental destruction and rampant resource exploitation that is likely to continue for decades to come. However, by understanding this trend it may be possible to find ways of eventually slowing it and thereby mitigating long term environmental damage.

Pruneau et al (2006) investigated when teachers adopt environmental behaviours in the aim of protecting the climate. Teachers participated in a climate change education course to voluntarily demonstrate new environmental behaviour. They were interviewed and described the process of change. Facilitating professional development activities were participation in a community of change, construction of knowledge of climate change, a solo activity in nature, and a continuum of values. Organizational skills, personal advantages, and ease of chosen actions were facilitating factors. Participants experienced positive feelings in their process, except for guilt when they forgot to do the new actions.

Chinn (2007) in study decolonizing methodologies and indigenous knowledge: the role of culture, place and personal experience in professional development reported findings from a 10 day professional development institute on curricular trends involving 19 secondary mathematics and science teachers and administrators from Japan, Malaysia, Indonesia, Thailand, Korea, Philippines, U.S and People’s Republic of China. Participants explored the roles of culture, place, and personal experience in science education through writings and group discussions. Findings suggested critical professional development employing decolonizing methodologies articulated by indigenous researchers. An implication was the development of a framework for professional development able to shift science instruction toward meaningful,
Introduction

culture, place, and problem based learning relevant to environmental literacy and sustainability.

Alsop et al (2007) studied teacher education as or for social and ecological transformation: place based reflections on local and global participatory methods and collaborative practices. This study has offered reflections on two transformative teacher education projects. The first a global communities module was set in a university in Vancouver and utilized the lens of social ecology to examine the roles of teachers in bringing an awareness of local/global issues to their students learning experiences. The second, Canadian International Development Agency (CIDA) teacher education project located in rural Peru, involved the collaboration of universities in Canada, Mexico and Peru. The projects were united in their use of “critical place based” transformative teacher education agendas and democratic participatory methods.

Quimby et al (2007) studied social cognitive predictors of interest in environmental sciences: recommendations for environmental educators. They examined the influence of social cognitive variables on student’s interest in environmental science careers and investigated differences between white and ethnic minority students on several career-related variables. This study was conducted on sample consisted of 161 under graduate science majors (124 white students, 37 ethnic minority students).

Chu et al (2007) studied korean year 3 children’s environmental literacy: a prerequisite for a korean environmental education curriculum. The purpose of this study was to investigate korean children’s environmental literacy levels and the variables that affect their environmental literacy. An instrument, the Environment Literacy Instrument for Korean Children
(ELIKC), was developed that measures four different dimensions (knowledge, attitude, behaviour, and skill).

O’ Brien (2007) studied raising children who care for our world. People were being forced to confront their relationship with the environment after a scary new report from scientists studying climate change. Environmental issues have become a much higher national priority, schools and colleges are buzzing with “green” initiatives, and even major corporations are coming to grips with the reality that the current energy resources are finite and are being depleted rapidly. Parents were given tips and offered to raise children to support environmental awareness and sustainable living.

Van Petegem et al (2007) explored conceptions and awareness concerning environmental education: a Zimbabwean case-study in three secondary teacher education colleges. They reported a baseline survey, designed to collect information on students’ and teachers’ conceptions on environmental issues and their involvement in three Zimbabwean colleges of secondary teacher training. It was found that students perceived the environment mainly in terms of biophysical issues whereas teachers also related the environment to social, economic and political issues. Both students and teachers of environment related subjects were significantly more concerned about the environment and were more involved than their fellow students and colleagues of other subjects.

Hart et al (2007) analyzed SES and CHAOS as environmental mediators of cognitive ability: a longitudinal genetic analysis. This study examined shared environmental influences on the longitudinal stability of general cognitive ability, as mediated by socio economic status and chaos in the home, using 287 pairs of elementary school age twins drawn from the Western Reserve Reading Project (WRRP). General cognitive ability was
evaluated at two annual assessments using the Stanford-Binet Scale of intelligence.

Mary and Raj (2007) examined effectiveness of concept mapping as a strategy to enhance the performance of B.Ed. trainees in environmental studies. The study was conducted on 98 students of B.Ed trainees selected from a college at Namakkal Distt. affiliated to the Periyar University in Tamilnadu. They found the effectiveness of concept mapping strategy enhances the performance of B.Ed trainees in environmental studies. There was no significant relationship between pre-test and post-test scores of the B.Ed. trainees in environmental studies. There was no significant differences between post-test scores of the B.Ed trainees in terms of (a) domicile, (b) educational level (c) group and (d) gender. It was discussed in study that the teaching of environmental studies through concept mapping strategy will be helpful to the students in enhancing the retention rate, the intensive of reading, stimulating creativity among the students. It also helps in motivating the level of interest, especially encourage high-level critical thinking, which is so important in meaningful learning and reducing anxiety on learning.

Magntron and Hellden (2007) conducted a study on reading new environments: student’s ability to generalise their understanding between different ecosystems. In this study a teaching sequence was designed in order to develop a class of secondary students’ ability to read nature in a forest ecosystem. After instruction they were taken to another ecosystem, a pond where they were applied to read the new environment. The main goal was to follow to what extent they can transfer their understanding from one ecosystem to another. The study is based on recorded interviews, field work, and classroom activities, and it shows the importance of learning general patterns in nature and relating them to functional groups of organisms in an ecosystem.
Merlo et al (2007) examined parental nurturance promotes reading acquisition in low socio economic status children. Findings of this research were: children required cognitive skills (e.g., phoneme awareness, verbal intelligence) and environmental resources (e.g., stimulation, print exposure) to acquire reading. This study investigated the additional contribution of parental nurturance to literacy development during the transition from preschool.

Sabharwal (2008) reported in a news-tree is equal to ten sons. In this report emphasis of trees during vedic period is explained. THE MATSYA Purana says, 'Ten sons are equal to a tree'. In other words one tree gives you the comfort and support that 10 sons are, capable of giving in their lifetime. ‘A Yajur Veda mantra says that for the protection of the country from all sides, the forests have to be well protected by the forest keepers. Our Vedas prohibit the wasting and polluting of "water and natural resources. They want villages and towns to be surrounded by cluster of trees. These clusters protect us from storms 'and keep a check' on the growth of deserts. The Vedic anxiety about environment is 'well reflected in those ancient Indian books.

‘There are several references' to the forests, trees and charming gardens (vatikas) in the epics; too (Mahabharat and Ramayana). Our Rishis loved to live far from the madding crowds in their forest ashrams. It is, believed that they reared the trees as their own sons. Trees absorb harmful gases 'like carbon dioxide and emit life-giving oxygen (pran-vayu) for the benefit of human beings. Thus trees are the lifeline' (pran) of all life on this earth. In Indian customs, purposeless destruction' of the banyan, peepal, mango and tulsi is prohibited. ’ Man was meant to live in harmony and communion with prakriti (nature). There was hardly any action to disturb the environment.

Our Vedic Rishis seem to have foreseen the environmental degradation that is now worried over by environmentalists. Besides the overall attitude of
respect that they taught, they even thought of certain yajnas to purify the air. They never allowed imbalance in environment.

It is incumbent on our industrialists and politicians to minimize, damage to environment. Over the years our rivers have been extensively polluted and if this trend continues, drinking water, the very basis of life, will be a serious problem. Products produced out of polluted land are poisonous and as a result there is an increase in the incidence of many diseases.

God cannot be kind to those who go 'against the laws of nature and spread pollution.

Uzunboylu et al (2009) explored in using mobile learning to increase environmental awareness. This study investigated the use of integrating use of mobile technologies (m-learning), data services, and multimedia messaging systems to increase student's use of mobile technologies and to develop environmental awareness. Data was collected using "usefulness of mobile learning systems" questionnaire from a sample consisting of 20 male and 21 female under graduates enrolled in computer education and instructional technologies classes at the Near East University in North Cyprus. Students voluntarily participated in a six-week program using mobile telephones to transmit photographs of local environmental blights and to exchange pictures and observations. Participants learnt ways to maintain clean environments and increased their awareness of environmental concerns. Responses on questionnaire differed significantly based upon gender and grade.

Tribune (2009) stated that CO$_2$ emission rate has tripled this decade. These findings were published in the current issue of Nature Geoscience (Washington). This report has found that the annual carbon dioxide emission rate has more than tripled this decade, compared to the nineties, according to an
international consortium of scientists. The emissions increased at a rate of 3.4 per cent year from 2000 to 2008, as compared to one percent each year over the previous decade, scientists from the Global Carbon Project report.

The team comprises some 30 researchers from around the world, including Scott C. Doney, Senior Scientist at the Woods Hole Oceanographic Institution (WHOI) and Richard A. Houghton, Senior Scientist and acting director of the Woods Hole Research Centre (WHRC).

Since 2000, the scientists documented an overall increase of 29 percent in global carbon dioxide emissions. They attributed the rise to increasing production and trade of manufactured products, particularly from emerging economies, the gradual shift from oil to coal and the planet’s waning capacity to absorb the gas that is the main cause of global warming. Doney led a team that developed ocean-model simulations for estimating the historical variation in air-sea carbon dioxide fluxes.

“Although the emissions of CO$_2$ from deforestation accounted for only about 15 percent of total CO$_2$ emissions over the period 2000-2008, reducing deforestation is one of the activities that could contribute significantly to stabilizing the concentration of CO$_2$ in the atmosphere”.

Gupta and Chauhan (2009) reported in the news- The carbon bomb. They stated that a conference in Denmark will decide the course of India’s economy, its global role and the fate of our fastest growth industry. To understand the perils and multi-billion dollar premises of living in the age of climate change, start amid the bus-high piles of garbage in a municipal compost plant in the south Delhi suburb of Okhla. Egrets and crows dodge backhoes that rake the rotten vegetables, plastic paper and glass into romantically named “windrows” what the piles of garbage are called. Over six
to eight weeks after some spraying, sieving and packing the garbage is turned into fine grained fertilizer and trucked out to farmers in northern India. Turning garbage into compost is a fine idea, except there’s no money in at. At Okhla, the sale of fertilizer covers 60 percent of costs. So why is one of India’s leading infrastructure and finance companies, through a subsidiary called IL&FS Ecosmart, wading into Delhi’s unprofitable garbage? Why has it started 17 such operations across India in the last 24 months. The answer lies in Germany, where executives at its second largest electricity producer RWEAG, are keen to Okhla project works, so they can keep their giant coal fired power plants running. The Okhla business model sounds easy. Make fertilizer from garbage, Save the earth from a greenhouse gas (and clean up Delhi as well). The composting prevents the emission of methane, one of the gases responsible for warming the globe. For every tonne of green house gas India can keep out of the air, there’s $10 (Rs. 470/-) to be made. Its been nearly twenty years since international leaders accepted that earth’s temperature is on the rise, and that human industrial activity is to blame. New projections by leading researchers show climate change will affect every aspect of modern life. Agricultural production will plunge as erratic weather shifts sowing seasons and monsoon rains. The melting of Himalayan glaciers- which many say is already taking place at double the rate elsewhere- will lead to challenges in the water supply. Rising sea levels, brought about by glacier melt, could submerge islands and coastal towns. In India, where flood and drought already affect more than 400 million people, the results could be catastrophic. Close to 68 percent of India’s great plains are vulnerable to floods, which account for 50 percent of our natural disasters. The cost of floods and droughts is as high as Rs. 15600 crore over five years, according to the Planning Commissions 11th five year plan. This money is enough to provide free food to a third of India’s
300 million poor for a year. Indian policymakers have said for years that rich nations created global warming by burning fossil fuels to fire industrialization. Even now, although India is the world’s fourth largest emitter of greenhouse gases, its per capita emissions are just over \(\frac{1}{20}\)th that of the US. The first National Action Plan Climate Change, issued in 2008, says that any international agreement on climate change must “allow each inhabitant of the earth an equal entitlement to the global atmospheric resource”. India has maintained that line in international negotiations, insisting that rich nations pay up, and that India won’t accept binding cuts on its greenhouse gas emissions because the cuts might limit economic growth. Much of the recent talk about international negotiation focuses on “co-benefits”, or measures that India would want to implement for its own reasons and not just because of International pressure. Some of these measures-increasing the efficiency of power plants, investing in public transport-carry costs, but they are opportunities. The debate hinges on the United States, the World’s second largest greenhouse gas emitter and the seventh largest per capita emitter. The US signed the Kyoto Protocol but never ratified it, which means it doesn’t have to cut emissions, and it can’t buy carbon credits.

**Chauhan (2009)** reported in a news- religion comes to environment’s rescue. Islamic leaders from over 50 Muslim countries, including heads of States of Turkey, United Arab Emirates and Kuwait will meet in Istanbul to sign an agreement on environment conservation. An announcement is expected on Haj Pilgrimage becoming green from next year and environment studies being included in religious schools. Already, a mosque in Leicester, Britain has become the World’s first green mosque. Sikh Council on Religion and Education (SCORE) signed a pledge with UNDP, the 1st Indian Religious
group to do so, for an initiative called Eco-sikh. Pope Benedict XVI is also expected to issue an encyclical - a statement - on environment in few days.

Kohli (2009) reported in the news – a lonely struggle for the Iceman.

According to the United Nations Intergovernmental Panel on Climate Change (IPCC) about 7 percent of the ice of the Himalayan Glaciers is melting away each year. The report predicts that these glaciers may disappear entirely as early as 2030. The ramifications are immense. Half a billion people in the Himalaya- Hindukush Region (which includes parts of seven other countries), and a quarter billion people further downstream rely on glacial meltwater for irrigation, domestic supply and even hydropower. "In Ladakh alone, at least 80 per cent of the largely agrarian population depend on the glacier meltwater. Less snowfall and meltwater are already affecting the lives of farmers here." Receding glaciers means the groundwater table is not getting recharged, and springs are drying up. Added to this are erratic rains and snowfall, leaving villagers to fight it out for the little water available for the villages' crops. Glaciers have attracted a lot of attention in recent months because they serve as one of the primary indicators of Climate Change. Glaciers in Antarctica, Greenland and the US have all diminished in recent years. A UN report has suggested that India's glaciers may disappear altogether by 2030. There are an estimated 9,000 of them in the Himalayas alone, most at an elevation of over 4000 meters. Policymakers have called for more research. Around the world, countries are uniting in the effort to stall, or at least accurately monitor the retreat of the glaciers.

CHEWANG NORPHEL (74), a Ladakhi, is a former Civil Engineer with the Jammu & Kashmir government. From 1960 to 1996, he was incharge of constructing small tanks fed by natural glacier meltwater, part of a government project to supplement water supply in the region. In 1996, Norphel
joined the Len Nutrition Project as project officer of the Watershed Development Programme, supervising the construction of canals and reservoirs in and around Leh. It was while he was in the field, watching meltwater flow down a mountainside, that the idea of trapping water and creating artificial glaciers first occurred to him. Norphel is also called ‘Iceman’ by locals, built his first glacier in 1987 and has since constructed nine others in and around Leh. He is currently building five more, partly with funds he has received from the government. He is also planning to train Villagers with instruction CDs. In recognition of his work, Norphel received the Far Eastern Economic Review’s Gold Asian Innovation Award in 1999. He has also been featured in several international publications and journals, including Time magazine.

STUDIES RELATED TO CONCEPT MAPPING

Gold and Coaffee (1998) studied lakes of the city: understanding urban complexity through the medium of concept mapping. They described the use of concept mapping in teaching complex notions in urban geography and discussed the nature and characteristics of concept mapping, course context, three experimental exercises, and student responses in evaluations. Findings included that concept mapping techniques increased student’s understanding. They emphasized the continuing potential of this technique.

Cox et al (1998) investigated pre service teachers’ construction of professional knowledge: teacher learning about literacy education. Concept maps were used to reveal important changes in the knowledge base of preservice teachers. It was found that preservice teachers in a school-based, three-course “literacy block” constructed richer, more professional, and more complete concept maps (relating more literacy teaching and subject matter
ideas together with logically appropriate connectors) than the university-based group with fewer hours in the elementary school.

**Trent et al (1998)** investigated using concept maps to measure conceptual change in preservice teachers enrolled in multicultural education/special education course. Concept maps were used to trace conceptual change in 30 pre-service teachers enrolled in an introductory multicultural/special education course at Michigan State University. Results indicated significant quantitative and qualitative differences between pre-and post-measures. Students constructed post-concept maps at included more concepts, were more specific, and were more integrated.

**McClafferty and Artiles (1998)** studied learning to teach culturally diverse learners: Charting change in preservice teachers’ thinking about effective teaching. Concept maps and surveys were used to assess the effects of a multicultural education course on preservice teachers’ cognitions. It was found that Group B students’ conceptualizations of effective teaching increased after the course, but other indicators showed that they did not actively reorganize their re-conceptualization. Group A students exhibited the opposite pattern. Each group emphasized a distinct view of teaching.

**Vanleuvan (1998)** investigated by using concept maps of effective teaching as a tool in supervision. There was changes in beliefs regarding teacher effectiveness as students progressed through student teaching. Participants created maps at the beginning and end of their practicum, which enabled them to examine their beliefs and were helpful to their supervisor. Post map, but not pre-map, characteristic moderately correlated with components of teaching performance.
Schacter and others (1998) studied feasibility of a web-based assessment of problem solving. This feasibility study explored the automated data collection, scoring, and reporting of children’s complex problem-solving processes and performance in web-based information-rich environment. Problem solving was studied using realistic problems in realistic contexts demanding multiple cognitive processes in the domain of environmental science. Sixty-nine middle school and high school students completed pretest and post test concept maps, a relevant bookmarking measure, and a met cognitive survey. Process data was collected using computer trace data. Student performance from pretest to post test for concept mapping scores did improve, but more exploratory information seeking behaviour did not predict higher scores. Extracting relevant information from the web resulted in higher final concept mapping scores, but high scores on meta cognition did not predict high scores on the relevant book marks and final concept maps. There were no significant results for the use of feed back contributing to higher final concept mapping performance or a greater number of relevant book marks.

Rye and Rubba (1998) investigated an exploration of the concept map as an interview tool to facilitate the externalization of students’ understandings about global atmospheric change. They found the effectiveness of two different types of interviews: one that embedded a concept map, and one that did not embed a concept map in order to elicit post-instructional understanding. This study had focused on students’ understandings of chlorofluorocarbons and their role in global atmospheric change. Data was collected from 8th grade physical science students and their teacher using open-ended interviews. Findings indicated an interview that embedded a concept mapping process did not affect statistically significant changes in the externalization of student’s conceptual understandings. Another finding was that PFNSI had predictive validity for
performance in the interview on the measure of ACCORD and proved to be a reliable confirmatory measure of the degree to which students held an ideal post-instructional understanding.

**Mehta and Henderson (1998)** investigated by exploring notions of schooling: using concept maps for a high school integrated curriculum programme assessment. They found that the concept mapping, a student-driven assessment tool, was used to compare student attitudes toward conventional school and the Community Environmental Leadership Programme (CELP), an integrated out-door semester for 11th graders that developed community skills, environmental awareness, leadership, and responsibility. Although pre-CELP concept maps reflected cross-spectrum negativity, post-CELP maps reflected a sense of promise and empowerment.

**Butler (2001)** studied preservice music teacher’s conceptions of teaching effectiveness, microteaching experiences, and teaching performance. He investigated music education major’s concept maps that focused on teacher effectiveness. It was explained that the students created the concept maps after two microteaching. It included the quantitative and qualitative findings from the study. Combination of concept maps and microteaching was found to be beneficial.

**Grow-Maienza et al (2001)** reported mathematics instruction in korean primary schools: structures, processes and a linguistic analysis of questioning. A collaborative study of mathematics instruction in 1st and 5th grade students in korea was done. Lessons consisted of sequences of highly organized, systematic patterns of instruction dominated by teacher questions that included higher level procedural and conceptual questions. Observations have implications for educators interested in why Asian students perform so well on mathematical tests.
Thompson and Mintzes (2002) explored cognitive structure and the affective domain: on knowing and feeling in biology. They found the structural complexity and propositional validity of knowledge about and attitudes toward sharks and the relationships among knowledge and attitudes. Concept mapping and Likert-type attitude inventory for assessment was used and involved participants (n=238) from 5th, 8th and 11th grades and college-level and senior citizens. They reported significant differences among subject groups on knowledge structure variables and attitudes.

Nietfeld (2002) described in beyond concept maps: using schema representation to assess pre-service teacher understanding of effective instruction. He found schema representation, an authentic summative assessment tool for assessing preservice teacher’s mental models for teaching. It required students to integrate and synthesize what that had learned in class and created a representation of how they planned to use their new knowledge in the classroom. They elaborated on the utility of concept mapping by allowing for more creative formats and by adding a personal dimension.

Carroll and Timpson (2002) found concept mapping: a tool for teaching, training, technical. It was suggested that concept mapping can help learners to develop metacognitive skills and make educators aware of instructional principles. The Instructional Map, Experiential learning Model, and Logic Model are useful concept mapping tools for informal adult education.

Lawson (2003) explicated the nature and development of hypothetico-predictive argumentation with implication for science teaching. He suggested a pattern of scientific argumentation in which scientists responded to causal questions with the generation and test of alternative hypotheses through cycles of hypothetico-predictive argumentation. These arguments were employed to
Introduction

test causal claims that existed on at least two levels. The ability to construct and comprehend hypothetico-predictive arguments was necessary for the construction of conceptual knowledge because such arguments were used during concept construction and conceptual change. It was suggested that science instruction that focuses on the generation and debate of hypothetico-predictive arguments should improve student’s conceptual understanding and their argumentative/reasoning skills.

McConnell et al (2003) suggested assessment and active learning strategies for introductory geology. They found that instructors can foster the growth of thinking skills and promoted science literacy by incorporating active learning strategies into the classroom. They described situations in which a variety of learning strategies were incorporated into large earth science courses for non-majors. Improvement in student achievement, retention and logical thinking skills were documented.

Brown (2003) explained high school biology: a group approach to concept mapping. Concept mapping was used as an instructional method in cooperative learning environments and investigated the effectiveness of concept mapping on student learning during a photo-synthesis and cellular respiration unit. There was positive effects of concept mapping in the experimental group.

Gahr (2003) evaluated cooperative chemistry; concept mapping in the organic chemistry lab. This study integrated concept mapping into the chemistry laboratory and required students to construct a concept map for each experiment. Reports found a decrease in student questions concerning set up and procedure. This study recommended use of computer software such as chemsketch 5.0 which is free and available from the internet.
Brinkmann (2003) studied mind mapping as a tool in mathematics education and presented the technique of mind mapping and pointed out its special fitting as a pedagogical tool for mathematics education. It was discussed that possible applications of mind mapping in mathematics education together with their advantages and limitations.

Lim et al (2003) developed reflective and thinking skill by means of semantic mapping strategies in kindergarten teacher education. This study examined some of affective outcomes for teacher educators and student teachers resulting from use of semantic webbing/mapping as a strategy for facilitating reflective and critical thinking skills in kindergarten teacher education programme in Hong Kong. Interviews of a random sample of participants and an analysis of their mind-maps revealed a change in perspectives and attitudes toward subject matter content and teaching curriculum.

Dobbs (2003) examined using reading strategies to reduce the failure rate in the content area. Subject: social studies. Grand level: 6-7-8. It was found that there was a high failure rate in the social studies content area because children had problems in understanding text material, poor study skills, and lack of motivation. It was suggested that strategies can help teachers to participate in as well as facilitate students’ learning. Teacher should become familiar with leaning styles of students, since knowing how students learn can help the content area teacher plan instruction to help student to improve their comprehension and learning.

Preszler (2004) studied cooperative concept mapping: improving performance in undergraduate biology. It was found that many students failed to integrate biological knowledge into larger conceptual framework. The biological knowledge did not seem to be connected with concepts in a manner
that allowed them to develop explanations of phenomena or to use their knowledge to support an argument. So students had retained less and did not apply scientific knowledge, after characterized as a decline in scientific literacy. Effectiveness of methods was tested that might contribute to a solution to this crisis in science education. He evaluated the use of cooperative concept mapping to encourage students to incorporate biological information into larger conceptual models. Thus, the results of this study indicated that the processes associated with constructing concept maps in a cooperative learning format improves student’s abilities to access answer it to answer challenging questions.

Robinson et al (2004) reported using community in human ecology. They found community asset mapping was one approach to community assessment. The assets, capacities and resources embedded in a community led people to take responsibility for and ownership of rebuilding and renewing their community.

Koppang (2004) invented curriculum mapping: building collaboration and communication. It had explored the application and use of curriculum mapping as a tool to assist teachers in communicating the content, skills, and assessments used in their classrooms. Curriculum mapping assisted both special and general education teachers in meeting the needs of students in the classroom. This process of mapping was equally effective at the elementary and high school levels.

Carnine and Carnine (2004) found the interaction of reading skills and science content knowledge when teaching struggling secondary students. It described an innovative approach to integrating the teaching of middle school science content and reading skills to increase levels of student success with content area text books. This approach featured carefully selected vocabulary,
word reading instruction, oral and silent reading and explicit instruction on comprehension strategies, such as retelling, concept mapping and summarization. Six aspects of instruction on design that were discussed such as identification and teaching of big ideas, the systematic instruction of vocabulary, a review and integration of core concepts, visual displays of how core concepts were integrated, mnemonics for core concepts, and structured hand-on activities.

Bryce and MacMillan (2005) encouraged conceptual change: the use of bridging analogies in the teaching of action-reaction forces and the “at rest” condition in physics. Twenty-one 15 years old students were involved in the investigation with subgroups previously exposed to different information regarding forces, weight and the accepted cause of the reaction force, in simple physical arrangements, including objects on tables. In-depth ‘think aloud’ interviews were used to track each student’s conceptual status. The findings showed that the bridging analogies were effective in engaging students with the idea of action-reaction forces; students were adept in mapping each of the analogies to the target concept. There was evidence to suggest that, for some students, bridging analogies were more effective in bringing about conceptual change than didactic teaching.

Suzuki (2005) studied social metaphorical mapping of the concept of force “CHI-KA-RA” in Japanese. A tool based on metaphor, to interpret student thinking in learning scientific topics was developed. “Social Metaphorical mapping” was used to interpret a dialog between two grouping of junior high school students with different epistemological paradigms with regard to the concept of force in the learning environment of a computer simulation. It was found after comparison between two types of forces that
Buridanian concept of ‘force’ resembles the Newtonian concept of “momentum”.

**Mac Gregor and Lou (2005)** investigated web-based learning: how task scaffolding and web site design support knowledge acquisition. This research was designed to obtain a better understanding to how to enhance the pedagogical effectiveness of Web Quests and of how students interact with the various features inherent to informational websites. A major objective was to examine the effect of providing instructional scaffolds to support 5th grade students’ web questioning experiences. The findings indicated that concept mapping templates coordinated with the research tasks enhanced students’ free recall and application of acquired knowledge.

**Chan (2005)** explored perceived multiple intelligences and learning preferences among Chinese gifted students in Hong Kong. This study examined the relationships between self-perceived multiple intelligences and five learning preferences among 604 Chinese gifted students in Hong Kong. In predication the file learning preferences, personal intelligence generally emerged as common and significant predictors, suggestion that reflection and interpersonal skills contributed substantially to these learning activities. Students who reported having a greater number of learning preferences also gave themselves higher ratings on personal intelligences and verbal linguistic intelligence.

**Rao (2005)** studied effective multicultural teacher education programs: methodological and conceptual issues. Various multicultural teacher education programmes to prepare pre-service teachers are introduced with the objective of changing belief, attitudes, knowledge base, and pedagogical skills. Studies reported effectiveness of these programs used to measure such as port folio assessment, interviews survey and questionnaires, concept mapping, case
studies, and dialogue journals. Scare data on generalizable findings existed. Conceptual and methodological issues contributed to lack of generalizable findings. This study discussed the issues and proposed a model for multicultural alliances, efficacious practices, generalizable findings, and effective outcomes for all students.

Cheung (2006) explored a constructivist approach to design computer supported concept mapping environment. The use of concept maps to support teaching and learning of various knowledge disciplines with range from science to language subjects was found. Forty tow in-service secondary school teachers studying a post graduate diploma in a local university were selected. This involved four weeks of the collaborative lesson planning and concept mapping activities. Mind-net enhanced collaboration among participants. However it is still early to know how the participants interact with such as environment, what cognitive and social factors are conducive to effective knowledge co-construction. It was suggested that further research on examining the entire process of knowledge construction is necessary.

Maloney and Simon (2006) experimented mapping children’s discussions of evidence in science to assess collaboration and argumentation. They reported that the development of children’s skills of interpreting and evaluation evidence in science. This study was conducted in the UK, involved four collaborative decision-making activities to stimulate group discussion, each carried out with 5 groups of four children (10-11 years old). Research showed how the children evaluated evidence for possible choices and conclusion or the rejection of alternative conclusions. A mapping technique was developed to be developed to analyse the discussions and identify different “levels” of argumentation. The researchers concluded that suitable collaborative activities that focused on the discussion of evidence could be
developed to exercise children’s ability to argue effectively in making decisions.

**Chuang and O’Neil (2006)** attempted to find in the role of task-specific adapted feedback on a computer-based collaborative problem-solving task. This study helped to research the role of feedback on a computer-based collaborative problem solving task by extending computer-based collaborative knowledge mapping study. One hundred and twenty college students (60 groups) participated in the main study. Result showed that task-specific adapted knowledge of response feedback was significantly more beneficial to group outcome than adapted knowledge of response feedback. This study confirmed that computer based performance assessment in collaborative problem solving was effective. The use of computers to assess and report group interaction and students’ thinking processes was proven to be more inexpensive a less time consuming than other alternatives.

**Mok et al (2006)** noted self-assessment in higher education: experience in using a meta cognitive approach in five case studies. This study described the use of meta cognitive approach for self-assessment of teacher education students. It comprised five case studies undertaken in five teacher education programmes. Analysis indicated that students found the meta-cognitive approach supportive of their learning and self-assessment. Students were more aware of their learning and thinking process at the end of the study. Further, teachers involved in the project found the method demanding yet generating useful feedback which enhanced their teaching.

**Coffman and Riggs (2006)** studied the virtual vee map: A template for internet inquiry. These maps proved successful in promoting student learning in the areas of inquiry and data analysis using resources and date available on
the internet. A post survey found that a majority of students enjoyed collecting and interpreting the data to find an answer to their own inquiry question.

**McLaughlin and Simpson (2007)** studied the common first year programme: Some lessons from a construction Science Course. The new curriculum was adopted at RMIT University, Melbourne to provide students with a broader depth of knowledge and experience across all study areas and to provide greater skill enhancement for graduates. This study examined how one of these large first year classes (construction Science) was conducted to address some of the learning issues arising from a common first year. It described how students were encouraged over the semester to electronically build and create a classroom resource of e-reference material on construction science topics, which was the basis for classroom discussion, interaction and assessment. The result was an electronic reference folder on CD that provided students with both a starting point for assignments, class interaction and assessment, and the development of vital information technology literacy skills.

**Coffey (2007)** explored a meta-cognitive tool for courseware development, maintenance, and reuse. The use of concept maps as meta-cognitive tools that help people to think about thinking. This work described a network-enable meta-cognitive tool based upon extensions to concept maps that can be used to help course designers visualize and plan course organizations. This tool permits the user to create a novel type of course description based on the idea of an advance organizer. Course arrangements created by this method do not have the arbitrary linear sequences of topics typically found in traditional course at the college level.

**Dollman et al (2007)** studied improving social skills through the use of cooperative learning. It involved 95 students, 95 parents, and 200 teachers. The strategies like role-playing, Jigsawing, think-pair-share and graphic organizers.
Introduction

The study was conducted for twelve consecutive weeks. Researchers advocated the implementation and use of cooperative learning in order to increase student achievement and social skills development.

Papafragou et al (2007) studied when we think about thinking: the acquisition of belief verbs. It was found that mental-content verbs such as “think”, “believe” and “hope” were hard to grasp and therefore their acquisition might await relevant conceptual development. It was needed for identifying them for the contexts in which appear. The experiments reported here to explore the implications of these proposals by investigation the contribution of observational and linguistic cues to the acquisition of mental predicate vocabulary. The findings supports the efficacy of false belief situations for increasing the saliency of mental state descriptions, but also showed that syntactic information was a more reliable indicator of mentalistic interpretations than even the most cooperative contextual cues. Findings supported the position that the informational demands of mapping, rather than age-related cognitive deficiency could bear much of the explanatory burden for the learning problems posed by abstract words.

Moore (2007) revealed concept acquisition and confidence using a spatial probability measure instrument. In this study it was found that instructional strategies for teaching concepts had no relation with learner’s level of confidence and certitude in their knowledge based upon exposure to these instructional treatments. As instrument referred to as the spatial probability measure to solicit levels of confidence.

Swensen et al (2007) investigated processes of language acquisition in children with autism: evidence form preferential looking. Two language acquisition processes were examined in 2 and 3 year old children (n=10) with autistic spectrum disorder and in typically developing 21 month olds (n=13).
Inter modal preferential looking was used to assess comprehension of subject-verb-object work order and the tendency to map novel words onto objects rather than actions. Results demonstrated significant comprehension of word order in both groups well before production. Comprehension preceding production and the noun bias appeared to be robust processes of language acquisition, observable in both typical and language-impaired populations.

**Sharp and sharp (2007)** studied in beyond shape and gravity: Children’s ideas about the earth in space reconsidered. He found children’s important Earth attributes were neglected or overlooked. Findings form a quasi-experimental study of knowledge acquisition and concept learning in astronomy among 9 to 11 year olds attending a single primary school in England was presented which not only began to address the situation but challenged some of the common assertions in this field. The processes of work and radical knowledge restructuring and conceptual extension as well as conceptual change were exemplified.

**Vogten et al (2008)** used the personal competence manager as a complementary approach to IMS learning design authoring. TEN competence was presented as a framework for lifelong competence development. The relationship between the TEN competence framework and the IMS Learning Design (LD) specification was explored. TEN Competence provided an alternative bottom-up approach to LD authoring via its first implementation: the Personal Competence manager (PCM). This allowed the ad-hoc designs of the PCM to be captured in a unit of Learning (UOL). These UOLs could be enhanced and eventually fed back into the PCM, thereby closing the edit cycle. This editing cycle allowed for gradual integration of bottom-up ad-hoc designs with more formal top-down designs introducing LD in a gentle fashion.
Singh (2008) studied implication of dialogue mapping as evaluation tool in learning technology. Research has found that dialogue map was helpful in clarifying mazy thoughts and easy to capture the objective of activity with less intervention. Discussing the linkage of the map with others group members helped student teachers integrating their thoughts after repeatedly generated dialogue maps several times. Student teachers agreed that the relationship among concepts were like bridges to connect and combine different levels of ideas, and to make teaching procedure smooth. There was substantial correlation between concept mapping ability of students and their performance in dialogic thinking exists. So, dialogue mapping is useful in integrating students’ thinking and make learning meaningful.

Kwon and Cifuentes (2009) investigated the comparative effect of individually-constructed vs. collaboratively-constructed computer-based concept maps on middle school science concept learning. 161 students completed the entire study. Using prior science performance scores to assure equivalence of student achievement across groups, students were assigned to three groups: a self-selected study strategy group, an individual-concept mapping group, and a collaborative pairs-concept mapping group. Collaboratively and individually-constructing computer-based concept maps had equally positive effects on seventh grade middle school science concept learning as measured on a comprehension test. However, the students who collaboratively constructed concept maps created significantly higher quality concept maps than those who individually constructed concept maps indicating deeper conceptual understanding.

Kevin (2009) found in an investigation of concept mapping to improve that reading comprehension of science texts. In this study he investigated how well 74 6th-grade science students represented text structures from a 900-word
textbook chapter on soil conservation, given a concept map template with four superordinate terms and 24 unsorted concepts. Findings suggest students were more successful at classifying pre-selected terms under given superordinate categories than they were at fully identifying relevant concept sets and articulating three different relationship types between terms. No significant differences were noted in the mapping performance of students at different reading levels. About two-third of students indicated they enjoyed concept mapping and would prefer to both read and map rather than just read without mapping. Students also expressed a strong preference for mapping in pairs or small groups compared to mapping alone. Multiple recommendations are provided for improving the relational thinking of students tasked with concept mapping expository science texts, including bridging to more open-ended maps, embedding mapping in longer-term inquiry projects, and leveraging collaborative and tool-based scaffolds.

Tzu-Chien et al (2009) revealed in identifying senior high school students' misconceptions about statistical correlation, and their possible causes; an exploratory study using concept mapping with interviews. They found that correlation is an essential concept in statistics however, students may hold misconceptions about correlation, even after receiving instruction. This study aimed to elucidate (1) the misconceptions held by senior high school students about correlation, using the tool of concept mapping along with interviewing, (2) the possible causes of these misconceptions, and (3) the effectiveness, advantages, and limitations of the adopted concept mapping using an interviewing technique for identifying student misconceptions. Twenty-five grade-12 students who had received tuition on correlation were the subjects of this study. Concept mapping through interviewing was used to collect and analyze data in order to identify the subjects' misconceptions, and their possible
Introduction

causes. The major study results are as follows. (1) Seven misconceptions about correlation were detected. Of these seven misconceptions, five were newly discovered by this study, while the other two are similar to those found by previous studies. Each of the seven misconceptions was held by 20-68% of the subjects, showing their prevalence and significance. (2) Four major factors related to the development of misconceptions about correlation were identified: learning materials, language, daily-life experiences, and existing mathematical concepts. (3) The concept mapping through the interviewing technique adopted in this study was effective in detecting misconceptions about statistics, especially in revealing new misconceptions, and it was also helpful in exploring their possible causes. However, tremendous effort and the time consumed are the major limitations of this technique. (4) The paper concluded by providing some recommendations for researchers and educators.

Yavuz (2009) explored in paper-based and computer-based concept mapping: the effects on computer achievement, computer anxiety and computer attitude. This study was purposed to compare the effects of paper-based and computer-based concept mappings on computer hardware achievement, computer anxiety and computer attitude of the eight grade secondary school students. The students were randomly allocated to three groups and were given instruction on computer hardware. The teaching methods used for each group were the conventional method, paper-based concept mapping and computer-based concept mapping. At the end of a 4-week instruction, posttests were administered to assess computer hardware achievement, computer anxiety and computer attitude of the students. The findings indicate that paper-based and computer-based concept mapping strategies produce better results than the conventional method. However, the
effects of paper-based and computer-based concept mapping strategies were not significantly different.

Sabine and FranzX (2009) studied concept map structure, gender and teaching methods: an investigation of students' science learning. This study dealt with the application of concept mapping to the teaching and learning of a science topic with secondary school students in Germany. Purpose: The main research questions were: (1) Do different teaching approaches affect concept map structure or students' learning success? (2) Is the structure of concept maps influenced by gender? (3) Is the concept map structure a reliable indicator of students' learning success? Sample: One hundred and forty-nine high-achieving 5th-grade students from four German secondary schools participated in the study. The average age of participants was 10.5 years. Gender distribution was balanced. Students produced concept maps working in small, single-sex groups. Design and methods: There were two teaching approaches used: one based upon teacher-centred instruction and one consisting of student-centred learning. Both were followed by a concept-mapping phase. Student groups experienced either one or the other teaching approach. Concept map structures were analysed using of the method of Kinchin, Hay and Adams. We defined three different possible types of concept map structure: spokes, chains and nets. Furthermore, for assessing a student's short- and longer-term learning success, we constructed a multiple-choice knowledge test applied in a pre-, post-, retention-test design. Parametric tests, such as MANOVA, one-way ANOVA and t-tests were used to identify any differences in gender, teaching approach, number of nets per concept map and their interactions. Results: Type of teaching approach had an effect on concept map structure but not on students' longer-term learning success. Students of the teacher-centred approach produced more net structures than those students who participated in the hands-
on instruction. Subsequent analyses showed in total more net structures for female groups. The interaction of gender and number of nets per concept map showed a significant effect on students' longer-term learning success. Conclusion: The study suggests that Kinchin's classification scheme for assessing concept map quality may be a good indicator of students' learning success when applied in combination with a knowledge test.

Pei-Lin et al (2010) explored in the effects of a computer-assisted concept mapping learning strategy on EFL college students' English reading comprehension. The purpose of this research was to investigate the effects of a computer-assisted concept mapping learning strategy on EFL college learners' English reading comprehension. The research questions were: (1) what was the influence of the computer-assisted concept mapping learning strategy on different learners' English reading comprehension? (2) did the computer-assisted concept mapping learning strategy affect learners' use of other English reading strategies? One hundred ninety-four freshmen who were enrolled in the English course were divided into low-level and high-level groups according to their English proficiency. A computer-assisted concept mapping learning strategy was introduced to the learners in the experimental class to improve their reading ability. Through two-way ANOVA analysis, it was found that the computer-assisted concept mapping learning strategy had greater reading benefit for the low-level group than for the high-level group. In addition, the results of independent sample t-test analysis indicated that the computer-assisted concept mapping learning strategy enhanced learners' use of other English reading strategies – listing, enforcing, and reviewing.

STUDIES RELATED TO ACHIEVEMENT MOTIVATION

Gardner et al (1998) indicated towards a full model of second language learning: an empirical investigation. They investigated numerous individual
difference measures to determine their underlying dimensions, to contrast their predictive validities and to valuate their contributions in a causal model of second language acquisition. Findings indicated that substantial links exist among affective measures and achievement.

Ayishabi and Kuruvilla (1998) studied achievement motivation of secondary school children of working and non-working mothers of Kerala. It was found that achievement motivation a strong determinant of academic performance, was found to be unaffected by maternal employment.

Verma and Sheikh (1998) explored the extent to which personality traits and personality needs facilitate academic achievement on sample of adolescent girls of class X of Kashmir and found that out of ten personality needs only two needs viz n-Ach and n-Aggression have been found to be significantly related to academic achievement.

Coco (1999) evaluated instructional scaffolding intervention and concept mapping outcomes among diverse learners in a pre-service educational psychology course: a mode for developing expertise in writing expressions of conceptual understanding. Participants were 60 preservice teachers from two universities who were enrolled in one of three introductory psychology courses. One course was used as the experimental group, and the other courses became the comparison groups. A three-group, multivariate repeated measures design was used to compare the knowledge structure and short essay responses of students in both conditions. Results indicated that students’ declarative and procedural knowledge, as well as meta-cognitive skills, developed. The expert – novices had a more developed knowledge of subject matter content, they knew how to represent their knowledge when engaged in a concept mapping task, and they were more aware of the task demands and the audience when engaged in a writing task.
Introduction

Chakravarty (1999) found high, positive, significant correlation between scholastic achievement and achievement motivation among the students of catholic mission schools. Most of students of Catholic mission school showed high achievement motivation.

Ruth (1999) in “Information seeking and achievement motivation in middle childhood and adolescence: The role of conceptions of ability”. It was found that the students who had acquired the concept of ability responded to the task condition with striving to learn. Further, request for information relevant to acquiring mastery and to the ego condition with strivings to outperform others and requests for normative feedback were also found.

Clark (2000) studied effects of teaching high school chemistry with dynamic particle models on student achievement and conceptual understanding. With the assistance of seven high schools chemistry teachers, data related to the effects of teaching chemistry with dynamic particle models was collected in fourteen high school chemistry classes. Analysis of interview video did not show evidence of significant differences in conceptual understanding between the two groups.

Marios (2000) examined the effect of feed back for achievement of a goal on intrinsic motivation. The results of the study indicated that motivation increased with assignment of complex motor and negative effects of negative feedback on perception of competence.

Hodge (2001) examined social indicators, dysfunctional career cognitions, and career decision making self-efficacy in work role participation of welfare recipients. This study was conducted on 104 welfare recipients profiles in Georgia. Three instruments were administered the Career Thought Inventory, the Career Decision Making Self-Efficacy Scale-Short form, and the
demographic profile and participation scale of the Salience Inventory to determine how well race, education etc.

Neeraj (2001) compared family environment, achievement motivation and self-esteem of students of vocational and academic streams. He reported significant differences in vocational and academic streams between boys and girls with respect to achievement motivation. The high academic achievement of the academic group students have high achievement motivation where as low academic achievements of the vocational group students have low achievement motivation. Achievement motivation was positively related with academic achievement.

Norris (2001) indicated that achievement motivation requires a belief in one’s ability to achieve as well as the skills of coping with obstacles. Unfortunately, by the time many ADHD children are diagnosed and treated, their sense of competency has been undermined by years of criticism from adults and testing from peers. They do not believe in their lives. In short, they need to be empowered. They need to cultivate a sense of self as competent.

Bou Jaoude and Attiesh (2003) revealed the effect of using concept maps as study tools on achievement in chemistry. They investigated the correlation between 10th grade students mastery of concept mapping skills and their achievement in chemistry, and gender differences in using concept mapping as a home work tool. This study provided significant results concerning its different effects on different sex groups where females achieved higher score than males on chemistry tests. The results also showed that concept mapping helped low achievers to achieve higher in chemistry. Students exhibited positive attitudes towards using concept maps in chemistry.
Chularut and De Backer (2004) analysed the influence of concept mapping on achievement self-regulation, and self-efficacy in students of English as a second language. They investigated the effectiveness of concept mapping used as a learning strategy with students in English as a second language classrooms. 79 ESC students participated in this study. A randomized pre-test post test control group design was employed. The findings showed a statistically significant interaction of time, method of instruction, and level of English proficiency for self-monitoring, self-efficacy, and achievement. The concept mapping group showed significantly greater gains from pre-test to post-test than the individual study group. The findings have implications for both practice and research.

Wang and Dwyer (2004) found effect of varied concept mapping strategies on student achievement of different educational objectives. This study attempted to examine the instructional effects of three concept mapping strategies used to facilitate student achievement of different educational objectives. One hundred fifty-six college level students were randomly assigned to one of the four treatment groups. There were statistically significant differences found between the control group and the concept identifying mapping strategy group in all criterion tests. There were no statistically significances found among the three concept mapping strategy group. The significant differences were also found between the control group and the student generated mapping strategy group in the identification, terminology and total criterion tests.

Thuneberg and Hotulainen (2006) explored contributions of data mining for psycho-educational research: What self-organizing maps tell us about the well-being of gifted learners. This study examined the applications of the Self-Organizing Maps method (SOM) to psycho educational data, the
psychological well-being, self-regulatory and motivational styles of pupils at elementary and middle school (N = 795). The results showed that high academic achievement was related to anxiety, as well as to external and internal pressure, in some gifted subgroups. The SOM method was a convenient method used to identify and study exceptional sub groups and non-linear correlations, as well as to examine theoretical assumptions.

**Bidyadhar (2006)** evaluated achievement motivation among secondary school tribal and non-tribal students. This study was conducted on 600 secondary school tribals and non-tribals students studying in class-X from three districts of Orissa state. In present study non-tribals have scored better than tribal counterparts on achievement motivation scale. This may be due to factors like social background, religious background, sex, caste status, areas of residence, socio-economic status, child rearing practices, mother’s education. In the case of non-tribal students, their higher level of achievement motivation might be influenced by the presence of various powerful forces in their family like parent’s own high achievements parents' high expectation from their children, interest etc.

**Dollman et al (2007)** investigated improvement of social skills through the use of cooperative learning. The purpose of this action research project was to improve student social skills through the use of cooperative learning, in order to develop a positive classroom environment conducive to learning. The project would involve 95 student, 95 parents, and 200 teachers. Teacher researchers would improve students social skills through role-playing, jig sawing, think-pair share and graphic organizers. Study was conducted for twelve consecutive weeks. Improved social skills helped to create a positive learning environment and increase student achievement. With implementation
Introduction

Cooperative learning strategies, these teachers researchers helped to improve the social skills of their students. Appended were:

1. Teacher observation check list;
2. Teacher survey;
3. School-wide faculty survey;
4. Student survey and;
5. Parent Survey.

Seikkula-Leino (2007) reported CLIL learning: achievement levels and effective factors. This study found how successfully pupils had learned content in content and language integrated learning (CLIL) and to assess pupils’ affective learning factors, such as motivation and self-esteem, in CLIL. Learning was presented in terms of achievement level, which was described as the relationship between measured levels of intelligence and school success. The study indicated that there were no major differences in learning, whether the language used in instruction is the pupils’ mother tongue or a foreign language; pupils of different intelligence levels had similar chances to succeed in both cases. In terms of the affective factors, the study indicated that CLIL pupils had a low self-concept in foreign language although pupils had a strong motivation to learn.

Tickoo (2008) investigated relationship between sense of deprivation and achievement motivation among school students. It was revealed that as the sense of deprivation increases achievement motivation decreases. The study was conducted on 600 students studying in tenth standard in high and higher secondary schools of Jammu city. The results revealed significant and inverse relationship between home deprivation and achievement motivation. This showed that perceived deprivation regarding food, medicine, clothing facilities,
parental love, affection and encouragement developed emotional instability, psychic imbalances among the children. They experienced anxiety, irritation, doubt, conflicts which ultimately led to low achievement motivation. It might be asserted that unexpected, unfavourable and undesirable behaviour of the teacher developed the feeling of deprivation among students resulted in low achievement motivations.

**Fan and Zhang (2009)** examined the relationship between thinking styles and achievement motivation among Chinese university students. The thinking styles Inventory-Revised and the Achievement Motives scale were administered to 238 Chinese university students from Shanghai, the People's Republic of China. Results largely supported the hypothesis that the more creativity-generating and complex thinking styles were positively correlated with achievement motivation to approach success (MS) and negatively correlated with achievement motivation to avoid failure (MF). Results partially supported the hypothesis that the more norm-favouring and simplistic thinking styles had negative correlation with MS, and positive correlation with MF. The study also found that the situation task-dependent thinking styles were positively correlated with MS, and negatively correlated with MF. Implications for educational practice were discussed.

**Assor et al (2009)** examined identified versus introjected approach and introjected avoidance motivations in school and in sports: The limited benefits of self-worth strivings. They found on the basis of self-determination theory (Ryan & Deci, 2000), the authors examined whether 2 different types of introjected motivation—an avoidant type aimed at avoiding low self-worth and an approach type aimed at attaining high self-worth—are both associated with a less positive pattern of correlates relative to identified motivation—acting because one identifies with the value of the action. Two studies focusing on the
academic and sports domains (N=1, 222) showed that children and adolescents differentiated between the 2 types of introjected motivation. Although introjected avoidance motivation was associated with a more negative pattern of affective and performance correlates than was introjected approach motivation, identified motivation was associated with a much more positive pattern of correlates than both types of introjected motivation. Furthermore, being high on introjected approach motivation did not yield any benefits even when combined with high identified motivation. Results suggest that past findings portraying introjected motivation as being less desirable than identified motivation cannot be ascribed to the avoidance component of introjected motivation. Findings were consistent with the view that even an approach-oriented introjected motivation has very limited benefits when compared with identified motivation.

STUDIES RELATED TO COGNITIVE STYLE

Peterson and Synder (1998) studied use of mind maps to teach social problems analysis. They identified five difficulties in teaching the analysis of social problems, and preferred “mind maps” a concept that refers to the ways in which students create a visual representation of their thinking patterns, as a possible solution. In constructing mind maps, especially for a social problems course, the following four steps are recommended: (1) Preparation – students must do back ground reading and research on a social problem of interest to them; (2) brain storming-students write down all the causes and consequences related to the social problem they’ve chosen to investigate, then identify the ones central to their topic; (3) revision – students revise their initial drafts and continue to gather data; and (4) presentation-students present their mind maps to others for understanding and evaluation. So mind maps require active
learning, improve memory and learning skills, encourage creative thinking and problem-solving and honor different learning styles.

**Huai (1998)** described concept mapping in learning biology: theoretical review on cognitive and learning styles. In this study the current situation of teaching and learning in China and the features of biology science; reviews existing theories of cognitive and learning styles as well as concept mapping were explained. A concept mapping training course was outlined which incorporated concept mapping into biology learning. Student’s different cognitive styles were taken into account in the course design.

**Ansari (1998)** studied misconceptions concerning genetics and evolution in biology at high school level in relation to formal reasoning ability, cognitive style and achievement. There was significant inverse relationship of formal reasoning ability, cognitive style and achievement with number of misconceptions concerning genetics and evolution in biology. The field-dependent, intermediate and field independent groups of cognitive style did not differ significantly in the number of misconceptions in biology.

**Kirk (2000)** investigated the relationship of attitudes towards science, cognitive style, and self-concept to achievement in chemistry at the secondary school level. Results indicated that field independence was significantly correlated with problem solving, academic, and laboratory achievement. It was also true that better attitudes toward the social benefits and problems that accompany scientific progress were significantly correlated with higher achievement on all three academic measures in chemistry.

**Bahar and Hansell (2000)** explored the relationship between some psychological factors and their effect on the performance of grid questions and word association tests. It was reported that (i) the relationship between certain
Introduction

psychological factors (i.e. field dependence/field independence, convergence/divergence and working memory capacity); and (ii) the effect of these factors on the performance of the grid type of questions and of word association tests in biological concepts. A total of 101 pupils of higher grade biology (age 16-17) from four different secondary schools in the central belt of Scotland and around 300 first year biology students at Glasgow University participated in this research. The result showed: (i) There is likely to be an overlap between the field independence, high working memory capacity and a divergent thinking style and between field dependence, low working memory capacity and a convergent thinking style. (ii) In terms of grid questions (where the data are presented in a numbered grid from which students selected the appropriate boxes for each question), overall performance of the field-independent pupils in the grids was better than field-dependent pupils. Pupils/students who had a divergent thinking style had higher scores on grid questions than the pupils/students who had a convergent thinking style. In terms of Word Association Test (WAT) responses, only the convergence/divergence dimension of cognitive style showed a significant relationship with the WAT. That is, students who had a divergent thinking style gave a larger total number of responses and a wider range of responses to the keywords in the WAT than the students who had convergent thinking style. When individuals are confronted with new information, they have different ways of selecting, perceiving and processing that information. This is related to what they already know and to their style of learning. This study aimed to reveal the relationship between three psychological factors-field dependence/field independence (Witkin, 1974) and convergent/divergent dimensions of cognitive styles (Hudson, 1966), and working memory capacity and their effect on word association tests responses as well as grid questions.
Budd (2004) described mind maps as classroom exercises. In this study it was found that a mind map is an outline in which the major categories radiate from a central image and lesser categories are portrayed as branches of larger-branches. He described an in class exercise in which small groups of students each create a mind map for a specific topic. This exercise was another example of an active and collaborative learning tool that instructors can use to move beyond “chalk and talk”. This can also help to incorporate activities for diverse learning styles into economics courses and can reenergize a course in mid semester. He provided idea for mind map topics for a wide variety of economics courses.

Graff (2005) suggested differences in concept mapping, hypertext architecture, and the analyst intuition dimension of cognitive style. He found that the degree to which hypertext or web-based instructional systems facilitate recall of information appears to be contingent on an individual’s cognitive or information processing style. In this study, 55 participants were assigned to one of three hypertext condition and were required to recall information and produce maps of the hypertext. The findings confirmed earlier research that individuals possessing different cognitive styles differed in recall performance when using different hypertexts. Further more, the concept maps produced by participants with different cognitive styles differed between architecture conditions.

Sze (2005) reported math and mind mapping: Origami construction. This study intended to help to solve the mystery of math concepts through origami construction, a hands-on activity. Students were involved in constructing and deconstructing concepts by folding and unfolding a piece of paper which eventually led to a three dimensional product. Good teaching practice afforded students the opportunity to learn with in a constructivist
framework. Origami, as an ancient paper art form, activated prior knowledge as well as encompassing hands-on learning, step by step instruction, schema building, spatial reasoning and logical concept mapping.

Heller et al (2006) determined competence based knowledge structures for personalized learning. Competence-based extensions of knowledge space theory were suggested as a formal framework for implementing key features of personalized learning in technology-enhanced learning. The approach linked learning objects and assessment problems to the relevant skills that were taught. It was shown that the approach induced structures on the assessment problems and learning objects, respectively, that could serve as a basis for an efficient adaptive assessment of the learners’ skills, and for selecting personalized learning paths.

Hudson (2006) examined the development of future time concepts through mother-child conversation. He studied that relationship between characteristics of mothers’ talk about future events and young children’s ability to contribute to naturalistic conversations about future events. Results indicated that three maternal style factors were related to 2.5 and 4-year-olds’ contributions: elaborative/advanced language, general and past reference, and repetitive prompts and preferences. These findings indicated that the maternal style variables affecting children's contributions to conversations about future events were different from those found in research on mother-child talk about past events. Mothers’ use of conventional time terms was also related to 4-year-olds production of temporal terms, suggesting that maternal time references contributed to children’s understanding and use of temporal terminology.

Danili and Reid (2006) evaluated cognitive factors that can potentially affect pupils’ test performance. The two cognitive styles, ‘Field dependent/field
independent’ and ‘convergent/divergent’, were explored in relation to three formats of assessment in five classroom chemistry tests. The study was conducted in Greece with the participation of Grade-10 pupils (age 15-16). The field dependent/ field independent characteristic correlated with pupils’ performance in all the tests, and in almost all the formats of assessment. The convergent/ field divergent characteristic correlated with pupils’ performance in assessment where language was an important factor. It seems that, in relation to the convergent/ divergent characteristic, the chemistry content and presentation of the test is a factor affecting the type of questions being asked. This study suggests that some of the factors that affect pupils performance might be: (a) the content and presentation of the test, (b) the format of the test, (c) the psychology of the individual.

Brown et al (2007) studied cross-cultural learning approaches in students from the USA, Japan and Taiwan. This study examined the relationship between approaches to learning and locus of control of students from the USA, Japan and Taiwan. The results showed that students from the USA utilized more rote memory learning compared to students from Japan and Taiwan, while students from Japan were more likely to be “Achieving” learners than peers from either the USA or Taiwan. “Deep Approaches” to learning, however, were similar across the three groups. Students from both Japan and Taiwan exhibited higher levels of external orientation than did students from USA. Although cultural characteristics were reflected in students’ locus of control orientation, there were no differences in students’ deep processing understanding strategies as all students displayed low levels. The mediating role of cultural context in learning must be considered for individual students in order to implement appropriate and effective teaching strategies, techniques,
and methods that promote deep level understanding for learners with differing cultural backgrounds.

Walsh et al (2007) investigated using restriction mapping to teach basic skills in the molecular biology lab. In this study open-ended, investigative laboratory exercise in plasmid restriction mapping allowed students to gain technical expertise while simultaneously exploring the utility of gel electrophoresis and restriction mapping. Because of its interpretive nature, this study also provided data suitable for a written report, and can thus be used to reinforce lessons on figure presentation and science writing skills.

Komis et al (2007) examined by comparing computer supported dynamic modeling and “paper and pencil” concept mapping technique in students’ collaborative activity. This study highlighted the collaborative activity of two high school students (age 14) in the cases of modeling the complex biological process of plant growth with two different tools: the “paper and pencil” concept mapping technique and the computer, supported educational environment “models creator.” This objective of the study was to highlight the ways in which the collaborating students were engaged in the plant growth modeling activity in the two cases and also identified the activity’s similar and different aspects in each one. Results shown that four major “modeling actions (analysis, synthesis, testing-interpreting, technical and cognitive support)” performed through a plethora of “modeling operations” defined the steps of the modeling process in both cases, while specific qualitative difference could be actually identified. Finally, the student’s conceptualizations of the biological aspect of the modeling task in the two-case was analyzed in regard with their capability of shifting reasoning between macro-and micro-levels, while educational implications were also discussed.
Mannion and Ivanic (2007) explored mapping literacy practices: theory, methodology, methods. The “Literacies For Learning in Further Education” (LFLFE) research project had been funded for three years as part of phase 3 of the teaching and learning research programme in the UK. The project involved collaboration between two universities and four further education (FE) colleges. Student’s everyday literacy practices were investigated and explored ways of mobilizing these to enhance, their learning on college courses. A central concern for the project was to understand how the literacy demanded of college life and being a student related to students’ other literacy practices. This study also explored the methodological debates in planning and operationalizing this mapping.

Jackson and Allen (2007) found using narrative informational book circles, connection charts, and notebooks to showcase science as a human endeavor. They found that making connections is an emerging education theme of the 21st century. Science teachers were encouraged to connect new learning with prior knowledge, learning with student interests and experience and classroom activities with the history and nature of science. They explored the use of narrative informational book circles, connection charts, and notebooks to show case science as human endeavor. Narrative informational book circles provided a flexible structure that encouraged students to engage in critical thinking and reflection as they read, discussed, and responded to carefully chosen non fiction science trade books. A connection chart helped students to focus discussions and organize ideas. Story pyramids demonstrated comprehension of important story elements and science note books provided opportunities for personal reflection. These were used as formative assessments.
Derbentseva et al (2007) reported concept maps: experiments on dynamic thinking. Experiments were conducted to examine the effects of map structure, concept quantification, and focus question on dynamic thinking during a concept map (C Map) construction task. The first experiment compared cyclic and hierarchical structures. The second experiment examined the impact of the quantification of the header concept in the map. The third experiment explored the effect of the focus question on the map. The content of the C Maps was assessed for the number of dynamic propositions and the number of quantified concepts. The results showed that the cyclic structure, the quantification of the header concept, and the focus question “How” significantly increased dynamic thinking.

Libresco (2007) reported a test of high-order thinking. This study was conducted on three fourth grade teachers in New York. Observation of three teachers during every unit of social studies and all of their social studies staff development sessions, including test – grading and curriculum mapping was done. Formal and informal interviews were conducted with the teachers, their principals, and the K-12 director for social studies. This case study suggested that mandated, thoughtful state elementary social studies assessments, combined with a concerted effort by professional development programs to deconstruct the tests, and ongoing staff development along the lines of the lead teacher model, could foster upper-level social studies instruction and effective, inspired teaching.

Jones (2007) explained project–based learning and early learning standards: making the connection. He presented steps in the process of using a project–based approach to meet the standards. The first step in designing a project was to choose a topic to investigate. Next, was to create a topic web, After identifying subtopics and determining the value of the topic as a project,
the teacher would begin to form ideas and activities for the project. Then, teacher introduced the project to the children. Finally, teachers assessed not only if the children enjoyed the project, but also ensured that the goals and standards were met.

Brown et al (2007) determined developing the health care work force: A comparison of two work-based learning models. Two approaches to work based learning (WBL) were used to develop the knowledge and skills of health care staff with different levels of experience and educational attainment with in the Deptt. of Nursing and the Deptt. of Allied Health professions at UCLAN and to enable two models to WBL to be differentiated, for the purposes of curriculum development. Two models were mapped and compared using a curriculum frame work, in order to illustrate differences in ethos, teaching, learning and assessment strategies between the two approaches. Two approaches to WBL met health and social care employers’ work force development needs and supported the learning of diverse groups of staff, both those entering the health and social care services and those who were experienced and professionally qualified.

Roberts and Joiner (2007) revealed the efficacy of concept mapping with pupils with autistic spectrum disorder. It was found that pupils with autism often present significant challenges to teachers. They seem to have real strengths in visual processing but a cognitive style that encourages them to focus on detail rather than the overarching connections between concepts. They reported the out comes of a naturalistic experiment in which they investigated the utility of concept mapping as an educational strategy with pupils diagnosed with an autistic spectrum disorder (ASD). A tutor group of ten pupils with ASD, aged between 11 and 14 years, took part in this study. Concept mapping tasks were integrated with in national curriculum science lessons in
collaboration with the school’s science teacher. The findings: increase in pupil performance in subject specific questionnaires was nearly four times greater in the concept mapping condition than after a more conventional teaching intervention.

**Novak et al (2007)** examined facilitating online learning communities: the collaborative design of an online support resource. A web-based hypermedia learning solution was investigated by the identification of an opportunity to recreate a learning environment online. An analysis of the proposed client resulted in the identification of an ideal solution concept. The concept was further entertained through the exploration of the metaphoric domain of the solution. The output was a blended web-based learning solution for an online course in online facilitation, enabling users to discuss, learn, collaborate, reflect and derive meaning.

**Hay and Kinchin (2008)** explored using concept mapping to measure learning quality. In this study a method of teaching was described that was based on Novak’s concept mapping technique. It showed how concept-mapping can be used to measure prior knowledge and how simple mapping exercises can promote the integration of teachers and students understandings in ways that are meaningful. Findings were: The concept-mapping method facilitates quick and easy measures of student knowledge-change so that teachers can identify the parts of the curriculum that are being understood and those that are not. This is possible even among very large student groups in the 50 minute slots that are allocated to so much teaching in higher education. It showed that concept mapping makes learning visible so that the actual quality of the learning that has occurred can be seen and explored. Using concept mapping in the course of teaching means that learning is an observable phenomenon.
Karen et al (2008) found in study the performance on middle school geometry problems with geometry clues matched to three different cognitive styles. This study investigated the relationship between 3 ability-based cognitive styles (verbal deductive, spatial imagery, and object imagery) and performance on geometry problems that provided different types of clues. The purpose was to determine whether students with a specific cognitive style outperformed other students, when the geometry problems provided clues compatible with their cognitive style. Students were identified as having a particular cognitive style when they scored equal to or above the median on the measure assessing this ability. A geometry test was developed in which each problem could be solved on the basis of verbal reasoning clues (matching verbal deductive cognitive style), mental rotation clues (matching spatial imagery cognitive style), or shape memory clues (matching object imagery cognitive style). Straightforward cognitive style–clue-compatibility relationships were not supported. Instead, for the geometry problems with either mental rotation or shape memory clues, students with a combination of both verbal and spatial cognitive styles tended to do the best. For the problems with verbal reasoning clues, students with either a verbal or a spatial cognitive style did well, with each cognitive style contributing separately to success. Thus, both spatial imagery and verbal deductive cognitive styles were important for solving geometry problems, whereas object imagery was not. For girls, a spatial imagery cognitive style was advantageous for geometry problem solving, regardless of type of clues provided.

Zheng et al (2009) investigated style matching or ability building? An empirical study on FD learners' learning in well-structured and ill-structured asynchronous online learning environments. The present study investigated (1) the impact of cognitive styles on learner performance in well-structured and ill-structured learning, and (2) scaffolding as a cognitive tool to improve learners' cognitive abilities, especially field dependent (FD) learners' ability to thrive in
Introduction

an ill-structured learning environment. Two experiments were conducted with 116 college students recruited from a large research 1 university in the west of the United States. Experiment 1 (n = 42) employed the group learning strategy to match learners' cognitive styles in asynchronous online learning. The results showed that the style matching strategy failed to yield expected gains in ill-structured asynchronous learning for FD learners. Different from the style-matching strategy, experiment 2 (n = 74) used a scaffolding model proposed by Cazden (1988) to improve FD learners' cognitive abilities in asynchronous online learning. Results indicated that focusing on learners' cognitive abilities proved to be more effective than style-matching strategy for FD learners in both ill-structured and well-structured asynchronous online learning. Implications of the findings were discussed with suggestions for future research.

Yilmaz-Soylu et al (2009) found the effect of learning styles on achievement in different learning environments. In this study it was investigated that every learning environment may attempt to raise successful students, but will not achieve the desired results if several essential elements are not considered in the instructional design process. These elements can be classified interior and exterior conditions. Learner characteristics, items of the interior conditions such as learning style, age, maturity level, interest are essential in designing learning environments process. The purpose of this study is to investigate the effect of learning styles on students' achievement in different learning environments which were designed according to principles of Generative Theory of Multimedia Learning. Research was conducted in the framework of single group repeated measures experimental design model and three different learning environments (text based, narration based and computer mediated (narration + music + text + static picture) were planned and study group studied in these environments at different times. The two instruments were used to collect data for this study. The pre-posttest designed to identify
students' achievement score and Kolb's Learning Style Inventory to measure students' learning style. As a result, it has been clarified that the type of the learning style was not significantly effective on students' achievement in different learning environments.

Pektas (2010) investigated the effects of cognitive styles on 2D drafting and design performance in digital media. It was found that interactions between design students' cognitive styles, as measured by Riding's Cognitive Styles Analysis, and performance in 2D drafting and design tasks in digital media. An empirical research revealed that Imager students outperformed Verbalisers in both drafting and creativity scores. Wholist-Analytic cognitive style dimension was found to be independent from drafting and design performance. The study suggests that examining the cognitive styles of students in Computer Aided Design (CAD) education deserves further attention and may facilitate for improvements in learning processes.

O'Donnell et al (2010) investigated interparental conflict, parenting and childhood depression in a diverse urban population: the role of general cognitive style. It was found that the research on the mechanisms by which interparental conflict (IPC) affects child depression suggests that both parenting and children's conflict appraisals play important roles, but few studies have explored the role of general cognitive style or included both parenting and cognitions in the same design. Moreover, the effects of IPC on minority children are not well understood. In this longitudinal study, parenting was examined as a mediator of the relation between increasing IPC and change in depression. General cognitive style was included as a moderator. The combined influence of parenting and cognitions was also explored. A racially and ethnically diverse sample of 88 fifth and sixth graders from two urban schools reported their cognitive style, depressive symptoms, and perceptions of conflict and parenting at two time points separated by one year. Parental warmth/rejection mediated the relation between IPC and depression, and
Introduction

general cognitive style acted as a moderator. Parenting, cognitive style, and IPC did not significantly interact to predict change in depression over time. Findings indicate that both parenting and children's general cognitive style play a role in understanding the impact of increasing IPC on children's well-being.

SUMMARY OF THE REVIEW OF RELATED LITERATURE


This study would attempt to find acquisition of environmental awareness through concept mapping in relation to achievement motivation and cognitive style.

EMERGENCE OF THE PROBLEM

In past two decades, there has been a proliferation of research activities on exploring the use of concept maps to support teaching and learning of
Introduction

various knowledge disciplines which range form science to language subjects (Cheung, 2006). The students’ conceptualization of the biological aspect of the modeling task in the two case activity is analyzed in regard with their capability biological aspect of the modeling task in the two case activity is analyzed in regard with their capability of shifting reasoning between macro- and micro-levels, while educational implications are also discussed (Komis et al, 2007). The concept maps offers broad, practical strategies for teaching science and environmental education concepts and describes a learning environment that helps students to comprehend the nature of science and environment concepts, understand science concepts, and solve problems in science courses. It helps students to critically reflect, collaborate, and solve problem, students gain a better understanding of science as a connected structure of concepts (Kalman, 2006).

The concept map has emerged as a versatile and promising tool in the area of science education, especially in research that seeks to investigate students conceptual understanding (Good et al., 1990: Markham et al, 1994 Novak 1990; Wandersee et al., 1994) In the literature, many studies indicate that concept maps as a tool to facilitate learning effective and robust. However, there is limited research on the appropriate use of concept mapping strategies regarding their effectiveness in facilitating the achievement motivation and cognitive style. This study attempts to examine the instructional effects of concept mapping strategies used to facilitate student achievement regarding various educational objectives and environmental awareness concepts. So concept map is used as meta-cognitive tool that helps students to think about thinking. This work describes a network-enabled meta-cognitive tool based upon extensions to concept maps that can be used to help course designers to visualize and plan course organization (Coffey, 2007). It is still early to know how the participants interact with such an environment, and what cognitive and social factors are conducive interact with such an environment, and what
cognitive and social factors are conducive to effective knowledge co-construction. The researchers suggest that further research on examining the entire process of knowledge construction is necessary. Cognitive style as related to total education system for development of cognitive, affective and physiological traits that are relatively stable indicators to how learners perceive, interact with and respond to the learning environment. Environmental Awareness is an important segment of total environmental education system (Keefe, 1979). Cognitive style generally covers knowing, perceiving, imaging, remembering, conceiving, judging, reasoning, understanding and problem solving models for acquisition of a concept regarding environment awareness. It is also concerned with intellectual growth of individual by acquisition of emotional and social skills which have long term effect on student’s achievement motivation regarding environment concepts social and emotional factors, anxiety and motivation all effect both the development of intelligence and level of achievement of students (Wood, 1990).

The level of achievement motivation can be increased in an organization where (1) goal setting behaviour is encouraged (2) personal responsibility for task accomplishment is demanded (3) performance feedback is given to students (4) students are allowed to make moderate risks and (5) rewards are given according to their performance (Stinger, 1996).

In order to create environmental awareness, values and behaviour, concept map will be more beneficial to explore individual’s construction of concept regarding environmental problems. It would also affect on cognitive style and achievement motivation of students regarding environmental awareness concept. It will lead to improve student’s achievement, retention and logical thinking skills and explore student’s conceptual thinking by examining the extent and complexity of their concept identification and organization regarding environmental awareness.
This had fascinated the investigator to explore acquisition of environmental awareness through concept mapping among students in relation to achievement motivation and cognitive style in Indian context. The study might prove helpful for developing new dimensions and for forwarding innovative steps in related field of work. It might benefit students to acquire the knowledge, values, attitude, skills and provide opportunities need to product and improve the environment.

**STATEMENT OF THE PROBLEM**

ACQUISITION OF ENVIRONMENTAL AWARENESS THROUGH CONCEPT MAPPING AMONG IX GRADERS IN RELATION TO ACHIEVEMENT MOTIVATION AND COGNITIVE STYLE.

**DELIMITATIONS OF THE STUDY**

1. The study was restricted to the government schools of Chandigarh only.
2. The present investigation was conducted on the sample of IX graders students only.
3. The study was conducted on 400 students only.

**OBJECTIVES**

1. To develop and validate concept mapping as instructional material for teaching environmental awareness.
2. To study the effect of instructional strategy (concept mapping/ conventional method) on acquisition of environmental awareness among IX graders.
3. To study the effect of achievement motivation on acquisition of environmental awareness among IX graders.
4. To study the effect of cognitive style on acquisition of environmental awareness among IX graders.
Introduction

5. To study the interaction effect of instructional strategy (concept mapping/conventional method) and achievement motivation on acquisition of environmental awareness among IX graders.
6. To study the interaction effect of instructional strategy (concept mapping/conventional method) and cognitive style on acquisition of environmental awareness among IX graders.
7. To study the interaction effect of achievement motivation and cognitive style on acquisition of environmental awareness among IX graders.
8. To study the interaction effect of achievement motivation, cognitive style through instructional strategy (concept mapping/conventional method) on acquisition of environmental awareness among IX graders.

HYPOTHESES

The following hypotheses were formulated and tested:

H₀₁ There will be no significant effect of instructional strategy (concept mapping/conventional method) on acquisition of environmental awareness among IX graders.

H₀₁ₐ There will be no significant effect of instructional strategy (concept mapping/conventional method) on acquisition of environmental awareness among boys of IX grade.

H₀₁₈ There will be no significant effect of instructional strategy (concept mapping/conventional method) on acquisition of environmental awareness among girls of IX grade.

H₀₂ There will be no significant effect of achievement motivation on acquisition of environmental awareness among IX graders.

H₀₂ₐ There will be no significant effect of high achievement motivation on acquisition of environmental awareness among boys of IX grade.
H02b There will be no significant effect of low achievement motivation on acquisition of environmental awareness among boys of IX grade.

H02c There will be no significant effect of high achievement motivation on acquisition of environmental awareness among girls of IX grade.

H02d There will be no significant effect of low achievement motivation on acquisition of environmental awareness among girls of IX grade.

H03 There will be no significant effect of cognitive style on acquisition of environmental awareness among IX graders.

H03a There will be no significant effect of convergent cognitive style on acquisition of environmental awareness among boys of IX grade.

H03b There will be no significant effect of divergent cognitive style on acquisition of environmental awareness among boys of IX grade.

H03c There will be no significant effect of convergent cognitive style on acquisition of environmental awareness among girls of IX grade.

H03d There will be no significant effect of divergent cognitive style on acquisition of environmental awareness among girls of IX grade.

H04 Interaction effect of instructional strategy (concept mapping/conventional method) and gender will not be significant on acquisition of environmental awareness among IX graders.

H05 Interaction effect of instructional strategy (concept mapping/conventional method) and achievement motivation will not be significant on acquisition of environmental awareness among IX graders.

H06 Interaction effect of achievement motivation and gender will not be significant on acquisition of environmental awareness among IX graders.
Introduction

H₀⁷ Interaction effect of instructional strategy (concept mapping/conventional method) and cognitive style will not be significant on acquisition of environmental awareness among IX graders.

H₀⁸ Interaction effect of cognitive style and gender will not be significant on acquisition of environmental awareness among IX graders.

H₀⁹ Achievement motivation and cognitive style do not interact significantly on acquisition of environmental awareness among IX graders.

H₀¹⁰ Interaction of achievement motivation and gender through instructional strategy (concept mapping/conventional method) will not be significant on acquisition of environmental awareness among IX graders.

H₀¹¹ Interaction of cognitive style and gender through instructional strategy (concept mapping/conventional method) will not be significant on acquisition of environmental awareness among IX graders.

H₀¹² Interaction of gender, achievement motivation and cognitive style will not be significant on acquisition of environmental awareness among IX graders.

H₀¹³ Interaction of achievement motivation, cognitive style through instructional strategy (concept mapping/conventional method) will not be significant on acquisition of environmental awareness.

H₀¹⁴ Interaction of gender, achievement motivation and cognitive style through instructional strategy (concept mapping/conventional method) will not be significant on acquisition of environmental awareness.