II REVIEW OF LITERATURE

2.1 INTRODUCTION

Review of related literature by the scholar enabled her to understand various aspects of previous work that had been done in the chosen area. It helped to develop insight into the problem, methodology and limitations and also provided comparative data for detailed interpretation of the results. This chapter is an attempt in making the survey of literature related to the problem under study.

An increasing sense of urgency on environmental issues became apparent in early 1970’s, and the bulk of literature originated from U.S.A, Canada, Australia and Northern Europe, although some were from Eastern Europe, Japan and India. In schools environmental education was based on curriculum. Knowledge imparted through suitable strategies led to pro-environmental attitude, which ended up in pro-environmental behavior. Research (Meinhold, 2009), confirmed a predilection towards pro-environmental behavior in people who had pro-environmental attitude and hence, the related literature on environmental education is discussed under the following headings:

2.2.1. Literature on Environmental Education Curriculum - India.
2.2.2. Literature on Environmental Education Curriculum - Abroad
2.2.3. Literature on Environmental Awareness, Knowledge, Attitude - India.
2.2.4. Literature on Environmental Awareness, Knowledge, Attitude - Abroad
2.2.5. Literature on Instructional Materials and Strategies of Environmental Education - India.
2.2.6. Literature on Instructional Materials and Strategies of Environmental Education - Abroad
2.2.7. Other Related Researches – India and Abroad
Considering the need for suitable curriculum, for successful implementation of environmental education, many studies were conducted in India and they are reviewed.

2.2.1. LITERATURE ON ENVIRONMENTAL EDUCATION CURRICULUM - INDIA

Some studies analyzed the shortcomings in the existing syllabus and even developed suitable curricula. A few were comparative studies on the coverage of environmental concepts in different streams of education at school level. Effectiveness of infusion of environmental concepts in the existing subjects, the appropriateness of revised text books and the opinion of teachers on the curriculum were the areas of study done in India.

Ehsan (1985) examined the various components of the existing environmental education programs in the primary schools of Bangladesh and found that the objectives had not been explicitly and precisely stated in terms of behavior for classes III to V and most of the objectives stated covered only cognitive domain. Content was not suitable for learner's needs, abilities, interests and experiences. Sequence of arrangement of the units, were not helpful to develop pupil’s understanding. The survey showed the content was balanced for classes II and IV on the other hand little content balance existed in class V syllabus. Hence the researcher developed a new environmental education program, which according to the panel of experts covered all the instructional objectives, up-to-date in content, balanced, and the teaching strategies suggested were feasible and practicable.

Devi (2000) found that environmental curriculum in Andra Pradesh for elementary school children of grade 1 to 5, did not cater to the essential needs of the learners. The curricula neither introduced children to the desired scientific skill and attitude nor did it reflect the stated curriculum objectives. 90 percent of the teachers accepted that environmental education would also develop moral values among the students and they were willing to involve students’ services to protect the environment in and around the school campus. All the teachers felt the need for inclusion of environmental
education in school syllabus. 60 percent of the teachers opined that the methodology of teaching and evaluation techniques adopted for other subjects could not be adapted to environmental education in schools. 10.87 percent of the teachers were confident of creating awareness among the public through environmental education in schools.

Jackson (2001) attempted to assess the impact of environmental education in school curriculum based on NCERT (1987-89) and concluded that the infused material was creating incoherence in the curriculum, and attempts to remove this incoherence were creating confusion. Also, environmental problems were inadequately defined, leaving students with no clear ideas about who was responsible for creating them, who should solve them and how.

2.2.2 LITERATURE ON ENVIRONMENTAL EDUCATION CURRICULUM - ABROAD

Most of the studies done abroad were about methodologies and hence, the only study reviewed was from Uganda.

Acer (1993) who had done research on environmental education in Uganda states that since the mid-1980’s efforts were made to monitor, mobilize and sensitize people about fundamental issues of environmental degradation. Since 1987, environmental and health education had become a major element of school curricula as directed by the National Curriculum Development centre. This gave the children the opportunity to reflect, focus and analyze their own situation and to appreciate the natural environment and ecological conditions in which they live. Environmental awareness and knowledge was supposed to lead a person towards appropriate attitude towards environment and this led to the research on knowledge, awareness and attitude.

2.2.3 LITERATURE ON ENVIRONMENTAL AWARENESS, KNOWLEDGE, ATTITUDE - INDIA

The bulk of environmental education research work done in India fell under this category. The samples were students from primary level,
secondary and higher secondary level, under graduates, teachers of all categories, pre-service teachers, workers, scientists and even engineers. Some studies compared knowledge with attitude and some on the effectiveness of courses offered in teacher training colleges. Most of them were comparative studies based on gender, locality, type of institution and even on family background.

Singh (1978) from his studies on student’s knowledge and attitude towards conservation of natural resources noted that girl students had more knowledge and had a stronger positive attitude than boys.

Bhargava (1981) working on various issues of environment such as pollution, conservation of wild life, forest, sanitation, etc., observed a positive relationship between environmental knowledge and attitude.

After survey on environmental awareness among students carried out in Gujarat, Singh (1984) observed that most of the students were having low level of environmental awareness.

Gupta (1986) compared the attitude of teachers at various levels towards environmental education and found it to be favorable. The order of favorableness was junior college, secondary college and primary teachers. They did have unfavorable attitude towards source issues on the attitude scale which indicated their lack of awareness of interdisciplinary nature of the subject. The teachers pointed out constraints like crowded class rooms, lack of time for proper planning of activities, loss of interest in the absence of follow-up actions, etc., on implementation of EE program.

Shahnawaj (1991) through his study on teachers found that 95% teachers and 94% students possessed positive environmental attitudes and there was no difference between trained and untrained teachers in environmental attitudes and awareness. Teachers had more awareness than students. Girls possessed significantly more awareness of environment than boys.
Singh (1991) studied the attitude of workers in different levels of income, education and occupation towards population education, environmental education, and family planning. For environmental education, educational specialization tended to determine more positive attitude, with the sequence being doctors, engineers, teachers, businessmen and agriculturists.

Praharaj (1991) through his study on pre-service and in-service teachers found that the level of knowledge about environment was low among pre-service teachers, although conceptual knowledge was moderate. Among in-service teachers, knowledge about environment was moderate and factual knowledge about environment was low. Though both the groups had a favorable attitude towards environmental education, the in service group had a higher level of attitude than the pre-service group. There was moderate correlation between knowledge about environment and environmental attitude. Teachers expressed the need to integrate environmental education in social science and science syllabus.

Sahoo, (1992) critically analyzed the concept of environmental education environment in two aspects namely natural and man-made and expressed the view that the relationship between the man and the environment was symbiotic. He is of the opinion that self management and environmental education had to be perceived as life long experience.

Patel (1995) investigating the environmental awareness with the secondary school teachers found that environmental programs had significant effect in enhancing environmental awareness among teachers.

From a survey among scientists and engineers, Pruthi et al., (1999) observed that most of the respondents favored promoting environmental protection. More than 87% of the respondents agreed that environmental protection and economic development could go side by side by selecting appropriate technology.

Dhawan et al (2005) investigated the effectiveness of the syllabus of B.Ed course of Garhwal university and her findings reveal that the pupil
teachers had better environmental knowledge after the training than before. Though the cognitive objectives were fulfilled, it failed to touch the affective and psychometric level or develop positive attitudes, skills and values. The researcher concluded that environmental education should develop insight and skills needed to influence not only environmental attitudes and behavior but also to stimulate their reorientation of values regarding the importance of environmental education. It was the key factor for pupil teachers to become environmental facilitators.

Mary and Raj (2005) investigated the environmental awareness among the high school students of Pondicherry region. The findings of the study reveal that environmental awareness among the high school students was above the average. The medium of instruction in the school and locality of the school influenced the environmental awareness among the students. The gender, types of schools and the type of religions, type of family and the size of the family did not affect the environmental awareness among the students. The caste of the students within the group affected environmental awareness among the students.

Abraham et al (2005) in their investigation on a sample of 624 secondary students of Kerala found that they did not have a high level environmental interest. The boys and urban students had more interest in environmental matters than their rural counterparts.

Madamala (2008) investigated a sample of 400 school students from 19 schools in Kolkata and South Parganas, and the results revealed that environmental awareness might not always lead to environmental action, and the science group as well as suburban students were more active while no difference was found based on gender and academic performance. Mostly environmentally passive students differed in all levels of motivation.

Dhillon and Sandhu (2005) explored the EE awareness among the elementary school teachers from 5 districts of Punjab. Significant difference was found in the environmental education awareness between urban and rural school teachers, with the former having greater awareness than later.
significant difference was found between male and female teachers in environmental awareness. Science teachers had greater educational awareness than both social science and language teachers.

Raju (2007) choose 560 higher secondary students of Cuddalore educational district and found that their environmental ethics was high. Girls and rural students exhibited higher environmental ethics than their counterparts. Community of the students and type of school did not have any influence on environmental ethics.

Gnanadevan (2007) explored the understanding of students about the importance of environment in which they live. In this study, environmental awareness of higher secondary students was found to be high and scores differ significantly with respect to gender, type of school, residential area, parents’ education, parents’ occupation, parents’ income and nature of family.

Maikhuri and Uniyal (2008) undertook a study on 188 graduate students of different types of colleges. This H.N.B. Garhwal University study revealed that the environmental awareness among students did not depend upon the type of educational institution in which they studied. Environmental Education when provided improved their awareness.

Pandiar and Godiyal (2008) did a case study on Environmental Awareness among undergraduate students. Their findings pointed to the fact that science students had clear knowledge about the meaning and concept of environment, knowledge relating to different aspects of pollution and attitude and awareness of practices conducive to the protection of the environment, than arts students.

Sarala (2008) studied the higher secondary schools in Mayiladuthurai Educational District. Size of the sample was 800. It was found that the higher secondary students had sufficient environmental awareness. Girls did not differ from boys in environmental awareness. Students from rural areas had more environmental awareness than the students from urban areas, students from private schools had more environmental awareness than the students
from government schools. The students residing in rental houses had more environmental awareness than the students residing in their own houses.

A study conducted by Dash, Mishra and Satapathy (2008), on 243 pre-service and 207 in-service teachers from Orissa showed that both had a positive attitude for sustainable development. Except arts female in-service teachers, all categories had favorable attitude and there was increase in attitude score with increase in socio-economic condition. Looking into the dimensions of the attitude scale, all pre-service teachers and science in-service teachers were found to have favorable attitude for all the five dimensions of attitude scale namely, economic efficiency, environmental harmony, resource conservation, local self-reliance and equity and social justice. However, in-service arts teachers had positive attitude for economic efficiency and local self-reliance but not for environmental harmony, resource conservation and equity and social justice. Pre-service teachers irrespective of their years of training showed positive attitude. Age and socio-economic status contributed more for the development of attitude towards sustainable development.

Singh (2008) designed a study on primary school teachers and found a significant difference in the attitudes towards environmental education between government and private school teachers. A significant difference was recorded between the teachers of government and private primary schools in the attitudes towards environmental education.

Dixit and Agarwal (2009) explored three District Institutes of Elementary Education (DIET) from Utter Pradesh (U.P) and the data collected from 260 people revealed that the environmental awareness of prospective teachers was on the positive side and there was no significant difference based on gender, locality or caste.

Nagasubramani and Kulasekaraperumal (2010), studied environmental knowledge of 1200 B. Ed students and found it to be significantly high among female, trainees at home, post graduates and science group trainees than male, trainees residing in hostel, graduates, and arts group counter parts.
Similar studies carried out in other countries are discussed in the following paragraphs.

2.2.4. LITERATURE ON ENVIRONMENTAL AWARENESS, KNOWLEDGE, ATTITUDE - ABROAD

Psychometric properties of children’s environmental attitude and knowledge, attitude of students from teacher training colleges, influence of social cognitive variables on students’ interest in carriers related to environmental science and studies on environmental illiteracy were the literature reviewed by the investigator.

Walsh (2005) examined the psychometric properties of the Children’s Environmental Attitudes and knowledge Scale with data from a sample of 338 Irish adolescents participating in a repeated measures design. Results recommended the instrument as reliable but the figures from United States indicated differences in the constituent elements.

Peer et al (2007) explored 765 first year students in three teacher’s-training colleges in Israel and found that though their environmental knowledge was limited, overall attitudes towards environment were positive and there was positive relationship between environmental knowledge and attitude and the level of their mother’s education. Students majoring in environmental related subjects were more knowledgeable and had more environment oriented attitude in comparison with other students.

Quimby et al (2007) examined the influence of social cognitive variables on students’ interest in environmental science careers and investigated the differences between white and ethnic minority students on several career-related variables. The sample consisted of 161 undergraduate science majors. The results of multiple regression analyses showed that self-efficacy, outcome expectations, role model influence, perceived supports and barriers, and environmental concerns contributed significant variance to the prediction of these students’ interest in environmental science. When compared with white students, ethnic minorities perceived greater barriers to
pursuing a career in environmental science, exhibited less concern about environmental problems, and had less interest in environmental science.

Negev et al. (2010) studied environmental literacy in Israel. Most participants specified solid waste or air pollution as the main issues and the perceived solutions were at the government level, including planning, infrastructure, legislation, and enforcement.

Effectiveness of any educational program depended upon the means and modes namely the instructional materials and the strategies employed. Intelligent choice made in these aspects was vital to the success of environmental education. Research findings in these directions would be of great value to the researchers and teachers as well and hence the following research works were reviewed.

2.2.5. LITERATURE ON INSTRUCTIONAL MATERIALS AND STRATEGIES OF ENVIRONMENTAL EDUCATION – INDIA

Effect of curricular intervention using cultural activities, teacher controlled video programs, multimedia packages, eco-club activities, integration of environmental education in other subjects, co-curricular activities for B. Ed students, joyful activities and environmental education program on post graduate students were some of the aspects of environmental education done and reported in India.

Rajput (1988) produced integrated material for environmental education for classes 3 to 5 and strategies for teaching environmental education for classes 1 to 5. He found that out of 14 groups only five groups had significant differences as a result of treatment.

Antonisamy (1989) prepared video program and charts on environmental concepts and made a comparative study of their effects on school drop-outs. Video method was found to be more effective than charts in teaching the concepts.

Amsaveni (1992) prepared an instructional module for environmental science of fifth standard which included drama, discussions, rhymes, and
folklore and used the same in different type of schools. She found the module effective irrespective of the type of school and gender.

Purushothaman and Stella (1994) studied the effectiveness of teacher controlled interactive video for group instruction and found that it yielded better academic achievement as compared to the traditional method pointing to the importance of the presence of teacher which should not be eliminated.

In an experimental study Yadav (1995), used lessons, specially designed for grade V focused on meaning of environment, human dependence on nature and man-made changes to the environment, and the results depicted that the knowledge and awareness level of children participating in the study was positively enhanced.

Singh (1995) developed study material relating to video instructional package for teaching environmental education, used it in three schools in Gujarat, Utter Pradesh and Rajasthan and found it interesting and effective.

Kaswakar (1996) undertook her Ph.D work on construction and use of multimedia package to develop population awareness. She found that it was significantly effective in comparison to conventional method.

Vaijayanthi (1997) took a sample of 90 English medium students of class III, IV and V and found that the curricular intervention in environmental education by suitable activities developed by the researcher showed desirable effect when compared to control group.

Vasanthamani, G. (1996) through her comparative study on different methods found that visual method resulted in maximum mean gain in Physics irrespective of gender and locality. The order of preference was visual, demonstration, traditional and audio method.

Neera (1998) took a study to compare video teaching-learning material, video aided instruction and conventional teaching. His finding was that the
pupils were most favourably disposed towards video teaching-learning material.

Lohani (2000), surveyed the activities taken up by eco-clubs in schools, and found such settings to be effective. The students took tremendous interest in such activities and impact of learning on growing mind was relatively permanent.

Srivastava and Saksena (2002), undertook integration of environmental components in the present curricular subjects in order to enhance environmental awareness through mathematics teaching and through Hindi teaching among the VI grade students.

Verma (2002, 2006) developed guidelines to inculcate creative ideas and skills regarding various methods that could be preferred in the teaching of environmental education, among B. Ed. students, while participating in various co-curricular activities.

Natarajan and Natesan (2004) studied the effectiveness of competency based teaching of environmental science through video to 86 class V students drawn from government schools in Pudukkotai and the results showed that the post-test performance was significantly high and performance and gap closures of experimental groups were greater than those of control group in unit tests as well as criterion test.

Anitha (2004) had prepared a guide in which she introduced definite environmental education program at upper primary level and related it to each chapter in Science and Social studies text books of VI, VII, and VIII in order to enable teachers use local environmental factors, situations, and resources effectively. She conducted routine classes to 195 pupils of four schools every month using stories, songs, field trips, etc and the students were able to relate abstract concepts in their textbooks to their immediate environment.

Chhabra (2005), found a five- day program, comprising joyful activities for learning about environment, to be successful in imparting awareness
about relationship of organisms with environment and role of children in conservation of environment.

Kumar *et al* (2007) explored the effect of an environmental education course using 120 post graduate students of psychology department of Karnataka University, Dharwad. The course had a significant effect on the experimental group and no significant difference was found between male and female students in their attitude towards pollution and related issues.

Although plenty of environmental education activities were carried on in India efficacy of these programs were neither evaluated nor reported. Similar studies conducted in other countries are furnished as follows.

### 2.2.6. LITERATURE ON INSTRUCTIONAL MATERIALS AND STRATEGIES OF ENVIRONMENTAL EDUCATION - ABROAD

Effect of formal and non-formal environmental education, out-door school activities, values and non-values oriented approach, inter disciplinary approach, marine experiences, activity oriented instruction, problem solving module for college students, simulations combined with case studies, laboratory activities and discussions, open ended inquiry instructional materials, programs of environmental education centres, community based projects, participation in conservation activities, issue investigation and action skill training, transfer from children to parents, scuba diving as moderator, residential programs, field based urban ecology programs, e - case study, discussion based dynamic learning, long term effect of field trips, visit to zoos, waste wise school program, teacher education programs, writing essays, application of constructivist theory and emotional discourses were reviewed.

Some of those studies measured not only environmental knowledge and attitude but also skills like analytical, observational and social. A comparative study of participation versus outdoor recreation and another study comparing reasoned choice and cultural norms in the decision making process for buying organic products.
Howie (1974) found that environmental education programs had a positive impact on students’ cognitive environmental growth regardless of formal or non-formal setting.

In one notable 1976 project by Bohl, a national inventory was distributed to over 15000 students. The outcome indicated that at equivalent grade levels, students generally had a poor grasp of factual knowledge, though they tended to express positive environmental attitudes in response to affective questions. These findings were reinforced by two similar national environmental education assessments completed during the same period.

In a descriptive study Supreka and Harms (1977) reported that there was no significant difference between values-oriented and non-values-oriented approaches in a six week environmental education programme on high school students.

In a 1978 study by Hepburn (cited in Lozzi, 1984), attitude change appeared to be greatest when interdisciplinary approaches were used.

Fortner (1978) developed the survey of Oceanic Attitudes and knowledge, of ninth grade students and related those attributes to the students’ marine experiences. State wide, 787 students who participated in the study demonstrated a knowledge level of fifty percent. The results also indicated that their attitudes toward marine issues were moderately positive.

Werling (1979) found that formal and non-formal modes of environmental programs had positive impact on cognitive environmental growth of students.

Bryant and Hungerford (1979) analyzed the effects of environmental instruction on two classes of kindergartners. Bryant simultaneously taught two classes a one week introductory unit basic environmental concepts. For three weeks thereafter, the experimental group received activity-oriented instruction on pollution and soil waste. The conventional curriculum taught to the control group did not involve environmental issues. The treatments were then reversed. The evaluators reported a significant change and suggested that
kindergarten children were capable of forming concepts concerning environmental subjects.

The effects of an environmental unit on upper elementary students’ knowledge about woodlands and associated environmental problems were studied by Gross and Pizzini (1979) and found that it resulted in a more positive student orientation about use and abuse of wilderness.

Andren (1979) used environmental problem-solving module on community college students and the reports indicated that the experimental group discussed economics, law, and transportation issues and population issues to a significantly greater extent than the control group.

Jaus (1982) reported on an experiment with 53 fifth grade students. One Class was given 40 minutes of environmental education instruction during fifteen consecutive school days. Each lesson included lecture, discussion, laboratory activities and homework. The control class of fifth graders at another school did not receive any environmental instruction. The experimental group expressed 22 percent more “positive” environmental attitudes than the control group.

In two studies by Blum (cited in Lozzi, 1984), an open-ended inquiry instructional method was found to have a positive impact on attitude changes.

Ramsey and Rickson cited in Lozzi (1984) investigated knowledge and attitudes associated with pollution issue that increased knowledge about the cause of pollution generates more positive attitudes toward corrective measures. Their study included a stratified sample of 482 twelfth grade students. Results indicated a skewed pattern of responses on the student’s knowledge of ecological concepts.

Euler (1989) examined the effectiveness of environmental education programme conducted by Alley Pond Environmental Center, New York, on sixth grade students and found that both treatment groups—the formal VS the control and the non-formal vs the control—demonstrated significant differences in knowledge and in three attitudes towards nature centers, plants and wildlife.
Robottom (1990) describes a project in Australia in which students and teachers in seven isolated coastal schools participated. They were involved in the study of quality of local fresh water, quality of marine environment and curricular changes. This project demonstrates the importance of working knowledge in redefining curriculum content and critical community based enquiries and innovations, process of positive change in teaching methods and interaction with students.

Kelly and Laine, (1991) are of the opinion that for school children to meaningfully participate in environmental conservation activities, they should posses dynamic qualities gained through environmental education.

Posch, (1991) points out that dynamic qualities are personal qualities of thought, feeling and action which develop in the students through the process of learning in which understanding and action are key features.

Ramsay (cited in 1993) a program called issue investigation and action training was designed to focus on development of responsible environmental behaviour. The principal elements of this programme include: knowledge of environmental issues; values related to the environment; individual and group sensitivity; knowledge of and skills in environmental action strategies; and knowledge of ecological concepts. This method was reported to promote environmentally responsible behavior in populations of eighth graders, when environmental education instruction focused on predictor variables of responsible environmental behavior. Another study was designed by Ramsay (1993) to measure the influence of the issue investigation and action training program. Six interdisciplinary modules provided training. Eight heterogeneously grouped eighth grade classes participated in the study using modified pre-test/post-test design. Four classes received 18 weeks of the experimental instruction, and the other four control classes received standard physical science instruction. The post-test analysis of variance indicated a 0.5 level significance achieved for the five variables. These findings nearly paralleled the results reported by Ramsay and Hungerford (1989) in a similar study with seventh graders.
Culen (1994) reported on an evaluation using the issue investigation and action skills training model to assess the effects of an extended case study on the subject of wetland issues. A modified pre-test/post-test non-equivalent control group design was used with fifteen intact seventh and eighth grade classes. Experimental treatment I (four seventh grade and two eighth grade classes), including four levels of instruction, ran 10-14 weeks. Experimental treatment II (two seventh grade and two eighth grade classes) was completed in four to six weeks only included two levels of instruction. The control group (two seventh grade and three eighth grade classes) received 12 weeks of traditional science instruction. Experimental treatments were presented by four teachers who had participated in investigation and evaluation of environmental issues and action during in-service training. Results indicated that the two instruments were more effective than the control. Full treatment was more influential than the partial treatment in increasing overt environmental behaviour.

Higher level of thinking strategies were emphasized and environmental content was applied during instruction. However, this type of research focused on behavioral outcomes as a result of environmental advocacy-driven instruction, not learning outcomes per se. This did not meet our need to find research that analyze the impact of environmental education methodologies and content in areas throughout the curriculum.

Enigo (1997) undertook Ph.D. work on a study relating to the effectiveness of instructor controlled interactive video. He found that it was significantly more effective than lecture method and also conventional non-interactive video.

Emmons, (1997) in the study on environmental action points out that for participation in environmental management demands that students should be equipped not only with personal knowledge of the environment, leading to affection, but also dynamic qualities that could come only from practicing these attributes in real environmental activities. The positive environmental action model proposed by Emmons (1997) and the operation-environmental model Toili (1996) provide framework in which action research was employed to facilitate this kind of learning.
Bhangoo and Sidhu (1997) studied the impact of selected audio-visual aids on food hygiene knowledge of secondary school students and the results were in favor of audio-visual material.

According to (Bransford, Brown, & Cocking, 1999) the process of transfer was the basis in environmental education. The first factor that influences successful transfer was the mastery of the original ability. Research had indicated that transfer across contexts was especially difficult when subject was taught in a single context. On the other hand, when a subject was taught in multiple contexts, students were more likely to abstract relevant features of concepts and to develop a flexible representation of knowledge.

Chistopher Vaughan et al (1999) examined the hypothesis that children learned and retained conservation principles in school and transferred them to their parents. After the completion of one-month environmental education course on Scarlet Macaw conservation and natural history in Costa Rica, students given a pre-test and post-test demonstrated learning on 71 percent of questions, parents on 31. Percent questions and a control group of adults without children who took a course on none. Comparing pre-test and post-test scores, students demonstrated retention on 67 percent, parents on 52 percent and control group on 29 percent. The authors theorize that children and adults communicated outside the classroom in the village, which may explain the increases in the learning rates of parents.

Ausubel’s (2000) theory of meaningful learning stressed the importance of interplay taking place between emotions, personal relevance, and context when people learn. The one who was learning was actively extending his/her existing concepts or defining new ones. This also meant finding new connections between those already given and the new ones, as well as finding new structures and sustainable theories. This involved what Ausubel called progressive differentiation of conceptual and propositional meanings, resulting in more precise and elaborate ideas.
Bruce (2001) measured endorsement of the New Ecological Paradigm (NEP) in college students following their involvement in a 2-3 week environmental problem module focused on global environmental problems and energy issues. The module included readings, discussion, and a writing exercise, and was presented in there sequential semesters within a course on research design. Students were all tested sequentially in spring 2001. When compared with control data, data from experimental group was significantly greater after 3 semesters, while knowledge from the module showed decrease over time.

Students had difficulties in differentiating between energy and matter in ecosystems. Ideas of consumption of energy were commonly held and the transformation of matter was not commonly understood (Carlsson, 2002).

Ryan and Rudland (2002) reported highly-significant research offering rich and complex analysis of relationship between environmental values, attitudes, knowledge and behavior. This report offered crucial insights into policy and planning imperatives from a uniquely trans-disciplinary perspective, designing and developing environmental education initiatives using physical science (i.e. identifying and quantifying physical pollutants) and social science (i.e. social research and behavioral analysis). This research was carried on two dimensions namely community campaign and commercial campaign.

Community education campaign was conducted using letters, post cards, mails in news letter, activities and parties about storm water pollution. Respondents with internalized values identified their own impacts, took responsibility for addressing them, and were motivated to change. Respondents with externalized values perceived the causes and solutions to be the responsibility of others. Overall there was a statistically significant relationship between attitudes and knowledge. After community education campaigns, environmental knowledge increased with respondents who internalized responsibility scoring higher on total knowledge scale than those who externalized responsibility.
The commercial campaigns were conducted using the personal contact and visits, the posters, and directly addressed letters in two places. Business people in one area became significantly more concerned about the impact they had on the environment, than did those in the other area. The first group became significantly more willing to change business practices to improve water quality.

In a review by Grotzer (2003) it was claimed that understanding and reasoning effectively about ecosystems involved a variety of casual patterns in nature, for instance domino-like, cyclic, or reciprocal patterns between the organisms as well as between organisms and abiotic components. Without a grasp of such patterns, students were likely to impose a simpler linear form to organize new information. In such a linear form there was typically one cause and one effect with a direct and unidirectional relationship. In contrast, the energy flow in food web followed a linear as well as branching pattern involving all the organisms.

Literature concerning secondary student’s explanations and understanding of ecology, and in particular a systems focus on ecology, was reviewed. This body of literature suggested that students did not have a good grasp of the complexity in food webs, of energy flow or of the dynamics and structure of ecosystems (Adeniyi, 1985; Gallegos et al 1994; Grotzer & Basca, 2003).

Work by David Sobel (2004) centered on the premise that child’s understanding of the world was constantly expanding, and environmental education should begin by connecting children with their immediate surroundings, subsequently moving outward. He suggested that educators connect children with a sense of place, local play areas and parks, focusing regional ecology before addressing more global issues such as climate change, ozone, or economics.

Rickinson and Sanders, (2005); Dyment and Reid, (2005); Lee (1990) found that only very few students participated in environmental action through their own personal initiative. This was attributed to schools which emphasized
self – restraint and doing what one was told, thereby killing their desire to learn and work independently. The researchers concluded that whatever structures for participation were established they must allow flexibility for students to explore and develop their actions in ways consistent with their own abilities, interests and cultures. The results revealed that only through genuine participation students could develop dynamic qualities. The researchers were of the opinion that environmental education curriculum should focus on practical problems experienced by students as well as problems and issues related to their own actions.

Hyacinth G Amstrong (2005) felt the importance of preservation and conservation of Tobago Island’s fragile natural resources. This paper examined a pilot program in which staff from Buccoo Reef Trust taught students from 15 primary schools about coral reefs using interactive tools and hands-on methods prescribed in People & Corals: an Education Package for Primary Schools. The pilot programme ran over an eight week period with prepared lesson plans. The lessons were supplemented with a field trip to a coral reef ecosystem. A careful examination of evaluation forms indicated that the students did understand and retain the concepts they were taught.

Sebasto and Walker (2005) explored student perceptions of the residential environmental education program at the New Jersey School of conservation on 2779 students from 31 schools using a qualitative methodology with a grounded theory approach and found that social, personal, and wilderness survival sessions were meaningful while thought orienting environmental science sessions were confusing. They were more interested in learning about more subjects, but they were less interested in social topics than environmental science, safety, or recreation topics.

Thapa et al (2005) explored the role of specialization in scuba diving as a moderator and mediator on the relationship between marine-based environmental knowledge and behavior. Data from 370 scuba divers in the Petersburg revealed that specialization in scuba diving acted as a strong partial mediator but failed to be significant when tested as a mediator. Marine-
based knowledge predicted overall and specific pro-environmental behaviors; however, the level of specialization played a strong role in mediating the relationship.

Gotschi et al (2010) investigated social norms and attitudes of 340 Viennese high school students of age group 14-20 years toward organic products. Theory of Reasoned Action and discriminate analysis were used to explore relations of a number of variables and complex field of factors influencing the shopping behavior for organic products. Key findings included the importance of primary socialization in forming social norms and shaping shopping behavior. Surprisingly, knowledge of organic products did not explain self reported shopping behavior. Cultural pattern seemed to be for more useful to predict behavior and attitude towards organic products.

Randler et al (2005) described a study aimed at enhancing knowledge about amphibian species to 3rd and 4th graders aged 9-11 years through conservation action designated to preserve migrating amphibians. They performed significantly better on achievement test and 4th graders performed better than 3rd graders, even when controlling for prior knowledge as covariate. Major implications were that learning about biodiversity should focus on small number of species, start at primary level, take place outdoors, and be linked with classroom teaching.

Deborah (2006) investigated the strategies which teachers adapt in teaching controversial environmental issues. Three experienced teachers delivering Geography course were selected and studied, along with a specific group of students aged between 16 and 18. The research utilized a multi-site, instrumental case study approach, involving the study of three different cases, each illustrating the research focus in a different school. They were studied over a period of two years, and involved spending a total of 5-6 weeks at each site. Within each case study, a series of lessons was observed and semi-structured interviews carried out with teachers and selected students from each class. In line with much of literature, the findings revealed that these teachers believed they should adapt a neutral or balanced approach to
teaching controversial environmental issues. However, in the reality of the classroom, such an approach proved unsustainable and the teachers experienced significant difficulties in enacting their beliefs. A detailed analysis of classroom interactions demonstrated that the influence of their own attitudes were greater than they either intended or, in all probability, realized.

Barnett et al (2006) developed and implemented a field-based urban ecology science program to engage traditionally under-represented groups, such as minorities and women in real world science and found that it improved student interest in science, supported students in developing a better understanding of scientific methodologies, and improved students’ sense of environmental stewardship when compared with students experiencing traditional instruction over the course of an academic year.

Toili (2007) reported emerging findings from qualitative research in 22 schools of Kenya that 14.4 percent of students in this study had developed the eight dynamic qualities and showed a clear tendency to conserve environmental quality than those who lacked such qualities. The researcher also pointed out the barriers for not developing dynamic qualities and concluded that environmental action by students realized through decree and coercion was pedagogically unsound.

Luis Patron (2007) reported about e-case study method which was a combination of the case study method of teaching and e-learning. The United Nations University (UNU) conducted training to policy and decision makers whose work was related to the environment and development of communities, countries and the world. From the perspective of policy and decision making their study required drawing from different disciplines and are complex knowledge domains, in need for integrated approach to teaching and learning.

The e-case study concept emerged as a result of several research and development lines of inquiry within the United Nations University. A case was a narrative, featuring plot and character, that related situational context, individual or group perspective, and, typically incomplete action. It was a concrete and detailed story, one that brought the vividness and complexity of
the real world into the classroom... like any story, a case presents conflict, typically the tension between alternative courses of action that bring different viewpoints, interests and values into contention and that might be resolved by a decision. In terms of defining, analyzing, or resolving it, the problem offered complexity, having no single answer, but still demanding a response.

It was the discussion - based dynamics of its learning process during class interaction that made the case study method particularly well suited for online delivery. The author had produced a prototype dealing with environmental issues on Western Mexico entitled “Ayuquila River E-Case Study”. Several Latin American Countries had expressed interest in using it. Ideally as the author felt, the academic themselves should be able to create their own e - case studies and publish them to an online library which could be shared for online environmental education purposes.

The findings of Ola Magntorn and Gustav Hellden (2007) from outdoor education on ecosystems revealed that despite lacking knowledge at species level, many students could generalize about functional groups of organisms that they catch in the pond, the knowledge of how to tell whether an animal was a decomposer, a predator or herbivore. They had ideas about what functional groups of organisms they expected to find and how to relate species to functional groups, which the researchers saw as important part of reading new environment and could be considered transferable schemata.

Patrick et al (2007) examined the mission statements of 136 zoos in the United States that the American Zoo and Aquarium Association had accredited, and found that the two prominent themes appeared in their mission statements were: conservation and education. However, most of them did not explicitly identify the relationship between conservation and education.

Winter (2007) had done a case study research on how four student teachers taking part in one - year teacher education program in a university in England translated their knowledge, experiences and beliefs about education for sustainable development into classroom practice in the context of the
Geography curriculum in schools. The research revealed the ethical problems faced by student teachers who, as committed environmentalists struggled to resolve the tensions between the constraints of policy, school culture, school teaching materials and their own values and enthusiasms.

DiEnno and Hilton (2007) applied constructivist learning theory to environmental education to explored high school students exposed to a week-long unit on non-native plant species and found that the constructivist group had significantly increased knowledge scores and attitudes, whereas the traditional group did not. The two groups did not differ significantly on engagement.

Engels and Jacobson (2007) evaluated environmental education program of the Golden Lion Tamarin Association in Brazil by comparing the results of a 2001 survey with baseline data from 1986. Responses of 666 residents and results from focus groups revealed an increase in public support for the tamarin and its habitat and an increase in environmental knowledge. The evaluation identified gaps in knowledge about biology and conservation status of the tamarind and gaps in women’s participation in education program.

According to Bierle and Singletary (2008) the fields of environmental education, outdoor education, adventure education, and experiential education were linked by shared goals, objectives, and characteristics.

Kostova et al (2008) carried out an in depth study of methods of successful learning in environmental education on a sample of 1550 sixth and seventh graders chosen by chance from different towns in Bulgaria. The methods employed were lecture, seminar, expert learning, conference, laboratory investigation, field work related to ecology, excursion, participation in conservation activities, role playing, case studies, out of class activities and out of school activities. Among them studying cases and role playing had the highest impact. The highest correlation was found between student’s ability to construct intellectual maps and their ability to conceptualize knowledge. Correlation between attitude and real life behavior was high.
Stern et al (2008) explored the influence of 3 - and 5 - day residential environmental education programs at the Great Smokey Mountains Institute on participants’ connections with nature, environmental stewardship, interest in learning and discovery and awareness of the park and biodiversity. The authors found significant positive, short - term effects on all outcomes of interest. Three month delayed post - tests indicated retention of significant gains in environmental stewardship and awareness, whereas other gains faded. Longer stays and active engagement of visiting teachers in an on - site instruction enhanced most outcomes.

Dimopoulos et al (2008) designed a conservation module, with 15 activities, for elementary school children of 11-13 years of age. In total 332 students from 15 schools participated in the program. The results indicated a significant effect on knowledge (low pre - test scores), but not on attitudes (high pre-test scores). However, post-test correlations in the experimental group indicated that as knowledge level increased, students’ locus of control and understanding and concern for sea turtle issue became more defensible.

Carrier (2009) in a study that compared activities conducted in schoolyard with traditional classroom activities involving 109 4th and 5th grade elementary school boys and girls. Boys demonstrated significantly greater gain scores in environmental knowledge, attitudes, behavior, and comfort levels due to the outdoor treatment than the traditional curriculum. Boys also scored significantly greater in the treatment group on attitudes and behaviours than did girls in treatment group.

Balgopal and Wallace (2009) made undergraduate elementary education teachers to write 3 guided essays addressing the cognitive, affective, and behavioral domains in response to news articles on hypoxia. Of the 22 students, 64% improved their ecological literacy from the first to the third essay and concluded that writing could be an effective learning tool for increasing ecological literacy and ecological literacy was a continuum and not a discrete state. Authentic learners who could recognize dilemmas and potential decisions were on one end of the continuum.
Curti and Valdez (2009) developed an education program to support the restoration of threatened Happy Eagle populations in Panama. Using teacher training workshops, mass media, and a unique scientific and knowledge exchange, coupled with adaptive management evaluation methods, this program had been able to stem the tide of human destruction of the species in the Panama Canal Water shed area.

Gislason (2009) conducted a three week qualitative case study at the school of Environmental studies, a senior public school with an environmental studies focus, the physical design of which facilitates collaborative, multidisciplinary teaching practices especially suited to the curriculum. The school’s outdoor learning facilities enable students to develop their observational and analytical skills in a field setting. Students consequently felt more socially accepted and better enjoyed their time in the school in comparison with other high schools they attended.

Morgan et al (2009) in their exploratory study on the influence of Brooklyn Botanic Garden’s Project Green Reach for class 8 urban youth found positive effects in participants’ challenging home and school environments, changes in academic and inter disciplinary skills, changes in science and gardening skills, increased environmental awareness, social and personal growth, a positive experience and the cultural significance of the program.

Amy cutter - Mackenzie (2010) reported the effects of Australian waste wise program, through a survey conducted in 2007 of 1015 primary and secondary teachers. The findings reveal a growing sustainability culture in Australian schools and communities.

Reis and Roth (2010) explored on how emotion talk furnished teaching identity claims and mediated instruction about environment using two ethnographic case studies and the findings suggested that rather than just being an outcome of effective instructional models designed to instil environmental consciousness in students, emotion discourses were means to
help account for and concretely realize the pedagogy of environmental education.

Thapa (2010) explored recreationists’ environmental attitude behavior relationship and the impact of outdoor recreation activity orientation as a menter variable on attitude behavior correspondence. Overall, attitudes exhibited stronger direct relationships with behaviors, when compared to the effect of participation on behavior.

Cockerill (2010) developed a 20 minute science based presentation on water resources that was delivered in 14 different venues and found that people understood the science related to water quantity and the key messages in the program were important to their communities.

Other researches were related to environmental education but did not come under the above headings are discussed in the ensuing paragraphs.

2.2.7. OTHER RELATED RESEARCHES – INDIA AND ABROAD

Since the present study is about teaching strategies, those applied in other subjects and studied for their efficacy were reviewed. Comparison of video teaching, video aided instruction, programmed learning, computer assisted instruction, studies on environmental leaders and adults involved in environmental activities and the influence of their childhood experiences on their present status, studies on in-service and pre-service teachers on their ability to construct concept maps on ecological principles and to use multimedia in environmental education and also on computer anxiety among teachers were reviewed. One research was about the perception of students in environmental disciplines towards their jobs.

Agarwal (1995) undertook a study to see the effectiveness of multimedia, programmed learning and traditional method and students’ performance was found to be better when multimedia or programmed learning was employed than traditional method. Further, it was found that these methods were more effective for secondary level than primary level and better suited to teach science subjects than arts subjects.
Agarwal (1998) for his Ph.D. work undertook a comparative study of conceptual understanding by programmed learning and computer assisted instruction and the results pointed to the fact that both were effective; however programmed learning was found to be better for students with lesser IQ and computer assisted instruction for students for higher IQ and also for those from higher economic strata.

Arnold et al (2009) conducted interview research with 12 young environmental leaders to discover the past influences that they perceive would have contributed to their current involvement in environmental action. They met clear criteria including positive environmental attitudes, behavior, initiative and involvement in multiple spheres of action. The main self identified influences were parental, outdoor experiences in childhood, friends, role models, teachers, youth groups and conferences or gatherings. This finding deepened the understanding of the nature and combination of these influences with young people.

Crouch and Abbot (2009) studied if the political affiliation of a state was a predictor of that state’s environmental education classroom curriculum and found that, there were not significant differences between Democratic states and Republican states.

Ernst (2007) used exploratory survey research with a convenience sample of 287 teachers and the results suggested that environmental literacy knowledge and skills and environmental sensitivity were important in teachers’ decisions to use and their abilities to implement environment-based education.

Kumar (1998) through his study found that teachers, by and large, had professional orientation but lacked training in educational media. Most of the teachers had positive attitude towards educational media but a few felt they had poor operating capability.

Mehra (2007) through the study with school teachers of Chandigarh found that they possessed fairly positive attitude towards computer uses but majority of them required training for using computers in instructional settings.
Benita (2008) surveyed 200 students and 30 teachers and had listed the problems faced by both of them due to compulsory environmental education and also the solutions offered to make it successful.

Moseley and Utley (2008) evaluated the environmental teaching efficacy and outcome-expectancy beliefs of elementary pre-service teachers. Participants involved in the Global Learning and Observations to Benefit the Environment curriculum significantly increased in environmental teaching outcome expectancy but not in personal environmental teaching efficacy. However, the control group increased significantly in personal environmental teaching efficacy, but not in environmental teaching outcome expectancy. Ethnicity, defined as Hispanic or non-Hispanic, was not a significant construct in influencing either of them.

Rajesekek et al (2008) in a study on 670 teachers belonging to Cuddalore Educational district, Tamilnadu found that the entire sample of teachers had high level of computer anxiety and the science teachers had higher level of anxiety than their counter parts in arts group.

Taylor (2007) examined student perceptions of the importance of 20 diversity and equity factors in their decisions to accept a job. A national sample of 1239 students in 9 environmental disciplines participated in the study. Although most respondents assigned some importance to diversity and equity factors, large ethnic and gender differences existed in the significance that respondents assigned to each factor.

Vadala et al (2007) described the content and physical and social components of childhood play as recalled by 51 young adults involved in serious leisure and environmental professions related to natural history activities and a contrast group of 10 adults not participating in natural history activities. The authors identified stationary and exploratory play, social facilitation play, play away from home restricted only by distance, fantasy play, creative play, searching and trapping play and play interspersed with outdoor chores. The authors distinguish between playing with nature and playing with friends within nature and discuss implications and further research.
Zak and Munson (2008) assessed 56 pre-service teachers’ understanding of basic ecological concepts when the constructed concept maps describing inter-relationships among 16 ecological concepts. Although there was lack of consistency in associating pairs of concepts, participants often created 2 clusters of concepts: food web cluster and ecosystem cluster. Concepts such as biotic factors and abiotic factors were frequently not used.

2.3 CONCLUSION

From the above literature it was obvious that in the Indian context, some valuable research work had been done to assess environmental education curriculum, attitude, and knowledge at all levels of education including teacher education, but there was paucity of research related to strategy in environmental education at school level. Though plenty work had been carried out to inculcate environmental awareness among school students by various agencies, their effects were not measured scientifically and hence the need for the present study. The next chapter describes the research methodology adopted by the investigator.