CHAPTER II

REVIEW OF RELATED LITERATURE

2.0 Introduction

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REVIEW OF RELATED LITERATURE

2.0 Introduction

Survey of related literature provides valuable help in the development of knowledge in research work. It helps the investigator to gain insight into various aspects of the problem area, that is in formulating a framework for the study, developing the methodology, constructing the tool for data collection and planning the analysis of data.

Since the problem under investigation is “Preparation and Testing of Learning Modules in Environmental Science at Higher Secondary level” the investigator tried to collect studies related to learning modules and environmental science. After going through the profuse literature, the investigator has selected only those that are relevant for the present study. The related studies thus examined has been classified as follows.

2.1 Development of Modules: Research Studies.

2.2 Studies related to Modular approach conducted abroad.

2.3 Studies related to Modular approach conducted in India.

2.4 Studies related to environmental education.

Warwick (1987), The Scientific Encyclopaedia (1976)]. In the APEID report (1976) a module was defined as a set of learning opportunities organised around a well defined topic which contains the elements of instruction, specific objectives, teaching learning activities and evaluation.

2.1 Development of Modules: Research Studies

Meyer (1975) had done an analysis of the stages in the development of the concept of a modular course and identified the following stages.

2. Conventional audio-tutorial course (early & mid 1960’s).
3. Sequential modular audio-tutorial course (late 1960’s).
5. Independent modules (early 1970’s).
6. Modular/mini course (Mid 1970’s).

The module emerged as a recent development mainly to effect a whole curriculum shift to learning for all students’ style. The aims include:

1. To encourage change in teacher style in methodology towards practical and experimental learning.
2. To increase student motivation by setting students' short-term realisable goals, and

3. To generate a more relevant curriculum.

In essence, it breaks down the total curricular offering into units very much smaller than teachers have ever felt possible. The use of modules grew rapidly, and currently modular approach is well entrenched as a measure of tailoring instruction to individual needs. Nearly all individualized instruction is based on the use of modules.

At the Lawrance Hall of Science, California University (1972), modules had been prepared for children of the age groups 10-15. At the National Institute for Educational Research, Tokyo, modules had been prepared for children in 1974. Lockard (1977) reported physical science projects like calculus-based physics modules, educational module for science and engineering and intensive modular courses in chemistry. Commercial production of modules have been reported at the teacher education research centre, State University College, New York. The Centre for Vocational Education, Ohio State University, USA (1977) prepared a series of 100 modules as performance Based Teacher Education Packages.

Collagan (1972) constructed certain modules of a programmed course in Astronomy. The specific objective of his research was to develop, through educational technology modules, and to evaluate,
using freshmen non-science majors at the college, a self-instructional course in Astronomy space sciences. Programmed materials like tapes, slides, films, film-loops, filmstrips, videotapes, and audiotapes were used for instruction. Three original four-minute films have been made to illustrate the basic concepts. In addition, commentaries for illustrating the concepts have been taped. The two general objectives were (1) to stimulate a continuing interest in Astronomy and space sciences and, (2) to provide the students with some basic tools of information and techniques with which they may continue a study of Astronomy in formal courses or as a hobby. The success of the general objectives were measured by observing the student's involvement in the behaviour objectives. Additional time is given to develop auto-instructional modules. The evaluation is done through the measurement of level difference between groups by a Z-ratio technique.

Thorton (1971) reported in detail about a project where programmed instruction was used in a module on "Cellular Respiration". The modular format contained instructional objectives, necessary pre-requisites and time required, diagnostic pre-test, key for the test, required materials for the programme, instructions for the use of the programme and self-scored post-test. This module was developed for use in an upper division course in cellular biology. It was preceded during the semester by 19 other modules which
introduced students to the basic structures. The material was tested in two classes consisting of 50 students each. Post-tests of the teacher graded variety resulted in more than 80 percent of the students in both test classes receiving a grade of ‘A’.

Williams and Keilockkar (1973) studied the effectiveness of module and the findings indicated that the teacher acquired the skills of the modules and used these skills in their classrooms. Teacher’s use of the skill had an effect on the learning of the students. Carmigani (1973) through his study proved that learning activity modules are effective in enabling students to learn cognitive and psychomotor driving skills.

Wilkerson (1973) developed and validated modules utilizing five stages of which the first four may be identified as the stages of planning and development. These stages were: (i) exploratory reading and research into the area of the instructional system and attitude; (ii) completion of rough draft and collection of revision data from researchers and reviewers; (iii) revision of the modules and (iv) informal field test.

Cohan (1973) developed and field tested a module to instruct student teacher with respect to critical thinking and the teacher behaviour which promote critical thinking. Findings of the study indicated repertories of behaviour and similarities in the dominant
process, substance, and concurrent critical thinking, teaching
behaviour of most participants after the completion of the module.

A comparative study of teaching psychology through learning
modules and the traditional lecture discussion method by Dale
(1973) showed that students subjectively preferred, the modular
approach to traditional method.

Copie (1973) developed modular methods course in conjunction
with portal schools. The methods course have a dual responsibility;
they provide raw material, ideas and techniques for use in the field of
experience and they have the more important task of helping
students to develop a philosophy of teaching and repertoire of
techniques which extend beyond the field experience. Another goal is
to gain familiarity with a wide variety of programmes, materials,
resources, philosophies and teaching strategies.

Gardner (1973) reported that one way to move toward
integration of the sciences for teaching purposes is through the use
of interdisciplinary modules. Interchangeable instructional modules
can be arranged to emphasize the interrelationships of science and to
open up many flexible options in science curriculum and instruction.
Through interdisciplinary modules, schools can take step closer to
the teaching of integrated science. Gardner points out several
advantages of this approach.
1. Problem of lack of a cadre of college level scientists in the interdisciplinary areas, who see curricular development and teacher preparation for the secondary school levels as among their responsibilities, can be solved.

2. The problem of insecurity of the teachers about their ability to teach in areas where they have no formal preparation can be tackled.

3. The teacher can have a more exciting and rewarding approach where he becomes the senior member of the learning team and, as the most experienced and mature individual in the classroom guides himself and his students new courses or modules in rich learning experience. Interdisciplinary module can be more relevant, more investigative, more student-centred, more relaxed and enjoyable, more flexible and more integrated than existing science programmes.

Instructional module can be developed and used more effectively to train pre-service elementary teachers as reported by Whatley (1973). Stephens (1973) through his study reported that the modules in the content areas of English, Mathematics, Social studies and Science appeared to be effective for increasing knowledge and in promoting more positive attitude towards the content areas.
An experimental study to investigate the effectiveness of the modules, by comparing students who were taught by proficiency modules, with students taught by traditional approach was conducted by Dishner (1973). There were fifty seven students in the two control groups and sixty students in the two experimental groups. In the four of the five units and in the total tests the students taught by the proficiency module performed significantly better than the students taught by the conventional method.

The efficacy of module-wized approach to human relation skill training was investigated by Purinton (1973). The experimental group made higher gains in their ability to use specific human relation skill than the control group. Markle (1974) evaluated the effectiveness of instructional module developed for elementary teachers. This study tried to determine the effect of question location and question level from an activity centred module. He concluded that instructional questions within activity centred module can improve immediate recall and use of information from the module.

Bower (1974) reported that the teacher who experienced the module asked significantly divergent probing and redirecting questions on post-assessment. Based on the ratings of a panel of judges, Stewart (1974) concluded that the module were suitable for inclusion as supplementary materials in supervising courses in Home
Economics Education. Hurst (1974) designed certain learning modules to change elementary teacher trainees' knowledge, skills and attitude towards inquiry teaching. The effectiveness of the modules was compared in classroom settings, individualized, group and control and found significantly different.

Kryspin (1974) reported that self instructional module can be used as an effective teaching learning device in educational psychology course.

The effectiveness of micro unit-teaching modules in Business Education was evaluated by Wagnor (1974). Based on t-test at 0.05 level of significance the investigator concluded that the micro-unit teaching modules are successful vehicles for student teachers to practice strategies of teaching. Brawley (1974) conducted an experiment to evaluate the multi-media instructional modules to teach time-telling to retarded children. The findings revealed that the experimental group made significant gains over the control group.

Effectiveness of modules on Business and consumer mathematics was studied by Davis (1974). He found significant difference in total score of knowledge of the experimental and control groups, favouring the experimental group. Results of the study also indicated that module may be effective in transmitting knowledge to teachers and it was believed that this type of module will be an
effective teaching instrument for use in pre-service and in-service teacher education programme on Business and consumer mathematics.

Bryant (1974) developed a Biology module. The basic text on Biology is chosen and the materials were arranged into various areas or modules, and supplementary materials were added wherever needed. The student formulated his own biology course from the modules. Outlines were prepared for each module, giving the objectives, the topics to be considered, concepts and outcomes anticipated, and noting the chapters in the texts and experiments. Each student is assigned to a biology teacher who becomes his “home base” teacher for the purpose of records. The student remains with his teacher for the first six weeks to study the introductory unit required of all biology students. During this six weeks, the student is given a description of the available modules. He prepares his course of study by choosing the area of special interest to him. The teachers also choose the modules they wish to teach. Reorganizing the available materials into modules and giving the student the opportunity to choose, has been a success with students, biology teachers, counsellors, school administrators and parents. Discipline problems and complaints by both teachers and students have disappeared. The collaborators were student participants and instructors in the three community colleges, who ‘assessed’ the
module in terms of its effectiveness as an instructional aid and made recommendations for revisions. The revised module consists of a diagnostic pre-test, a student laboratory manual with two sections, the common laboratory experiences and the divergent laboratory experiences and an instructor manual. It was indicted that, in general, students preferred this method of instruction to a traditional type of biology laboratory.

Ralph and Harold (1975) developed Process Modules for investigating Environmental Science (PMES). PMES are a series of five modules designed to give middle school students the cognitive skills necessary for independent investigation of environmental problems of their own choosing. The modules also prepare the students to engage in autonomous research. They are based on a behaviourally oriented training hierarchy which introduces students to environmental problems and associated human values. Further the modules give training in the use of secondary sources in investigating environmental problems, i.e., surveys, questionnaires and opinionnaires, as well as the skills needed for logical data interpretation are not new, for there has been a wealth of fine materials available. It is revealed that the module is enthusiastically accepted by students.
Chaiken and Tanner (1975) developed and field tested a series of teacher training modules in order to find out to what extent the module meets its competency based and humanistic performance requirement. Results of the study indicated that it is possible to design modules which are both competency based and humanistic if a systematic developmental process employing prescribed requirements are used to ensure an equal emphasis on competency development and humanism.

Field testing of a module titled ‘Orientation to teaching and to examine its influence upon participants’ was done by Alia (1975). The gains on seven of the nine objectives were found significant at 0.05 level. Students indicated satisfaction with module and its component parts through a questionnaire. Pultorak (1975) developed and tested a self-paced laboratory module in vascular plant taxonomy designed to aid undergraduate biology students in understanding both traditional and contemporary activities of the plant taxonomist.

Melvin (1975) piloted modular materials to be used in the in-service training of the Principals. Findings of the study indicated that out of 36 participants 18 participants reached mastery level (80 percent correct) and 13 scored below mastery level on the second module. Eleven of the participants reached mastery level on the third module.
Modular Activities Programme in Science (MAPS, 1975) combines the best features of time-tested traditional elementary science programmes with the most successful practices of funded curriculum development projects. The result is a programme that is innovative, yet manageable. MAPS allows one to select and to teach lessons at best suits one's situation—pupil abilities, physical facilities, and financial resources.

The effects of modular biology course on attitude towards biology was studied by Anderson (1975). Anderson set out to determine the effectiveness of a student centred modular course of study in general college Biology for improving student attitude towards Biology. The chief objectives were

1. To find out the changes in attitudes as a result of being exposed to a modular course of study.

2. The degree of achievement of students using such a course in comparison to students using a traditional lecture course, and

3. Influence of grouping by sex on achievement.

Windell (1975) from his study with self instructional teacher training module revealed that the modules are effective to produce reliable changes in trainees knowledge and skill in the use of techniques for determining the reading level of the exceptional children.
Heller and Date (1976) conducted a study to compare the effectiveness of instruction using a learning module approach with that of instruction using a traditional lecture-discussion method in an undergraduate course entitled 'Psychology of Exceptional Child'. Packets containing complete instructions and grade expectations based on performance were distributed to the experimental group taught by learning modules. No formal class period or meetings were conducted except for the administration of the pre and post-tests. The control group taught by traditional lecture method was given a course in which 75 percent of the class time spent in lecture and 25 percent allowed for discussion and announcement. The study revealed that it is possible to experiment within a traditional college of educational framework with learning modules. It remains to prove if innovative learning module programme result in significant gain for students. Both approaches could benefit students and a combination of the two might be a viable and a justifiable strategy.

An experimental study to compare individualized and group instructions in the modular form was done by Kronowitz (1976). Findings of the study indicated that the mean gain score on all but the two objectives and on the total test were significantly higher in the group instructed section. Both the groups showed very positive reaction towards module.
Shapiro (1976) conducted an experimental study "Modular Instruction in Non-verbal communications". The results of the study revealed that the experimental group made statistically significant gains in their knowledge of non-verbal communication in comparison with that of control group.

Hill (1977) found that the vocational teachers in the experimental group using module did differ significantly from vocational teachers within the control group and that the modules have measurable effect on the competencies developed by vocational teachers within the experimental group. The investigator concluded that the competency – based module can be a valuable addition to vocational teacher education programme for developing skills in writing student performance objectives.

Preference of modular systems to traditional system was proved by Kazerni (1977). The study reported that experimental groups were satisfied with the modular system.

Dorsey (1977) in his study 'Development and evaluation of instructional module for early childhood educator utilizing selected aspects of the theory of Piaget' revealed that modules are favourably received by teachers in early childhood education.

Kulkarni (1992) states that a module indicates an instructional plan, which is usually larger than a class hour session, but smaller
than a course plan. He proposed that module should contain the following elements.

(a) A prospectus—a broad statement of objectives along with a rationale

(b) List of content, skill

(c) Pre-test used as a description of essential pre-requisite

(d) Resources for learning activities

(e) Specific objectives – unit by unit.

(f) Learning activities

(g) Self checks (formative test)

(h) Post test (summative test)

(i) Feedback on both formative and summative tests.

Givens (1977) employed the following procedures to develop the modules.

1. Identification of the instructional problems

2. Identification of the learner population

3. Collection of relevant instructional materials

4. Formulation of objectives

5. Construction of evaluation instruments
6. Selection of media and supporting staff
7. Writing of the draft modules
8. Field test of modules
9. Analysis of results, and
10. Evaluation

The experimental study to test the effectiveness showed that students preferred modular systems to traditional systems.

Kamm and Hunnicutt (1978) evaluated instructional modules in a secondary competency based teacher education programme for business laboratory at secondary school level. The studies used the pre-test, post-test, control group design. The studies reported significant differences between the experimental and the control groups, favouring the experimental group.

Leach (1978) studied the influences of the occupational survival skills modules on the attainment of skills and attitudes toward employment of selected high school students. The curriculum materials entitled methods and materials for teaching occupational survival skills (OSS) were designed to offer high school students an opportunity to develop skills applicable to a wide range of jobs in the work world and to develop attitudes, perceptions, and motivations toward work. The primary purpose of this study was to describe and
interpret the influence of the OSS modules on the attainment of occupational survival skills and attitudes toward employment of selected co-operative office occupations and special needs.

Amien (1978) conducted a study in an Indonesian school in standard VIII. The control class was taught through a traditional teacher-centred method using a lecture-cum-demonstration approach. The treatment classes were taught through a student-centred method using a modular approach. The findings of the study revealed that in achievement and retention of the treatment classes were significantly higher than the control classes. There was no significant difference in the personality factors between the groups. The correlations between pre-test scores and post test scores revealed no significant differences in the effect of the instructional methods.

Cole (1978) developed and tested physiology modules designed to teach model formulation processes. It was studied at three levels; recall, application and synthesis. Student attitude towards self-instructional modules was also studied. A series of nine self-instructional programmed modules on selected physiology topics were developed. The modules consisted of a learning programme, post-test and an optional model formulation exercise. The model formulation activities were administered to the experimental group only. Pre-tests were administered to the whole sample, as an
assessment of the students' attitude toward the modules. The findings revealed that the experimental group scored high in achievement test. The treatment was designed to affect the outcomes on the synthesis items, but have no effect on the recall or application test items. The attitude of students toward self-instructional modules as an instructional activity was found to be a moderate predicts of physiology achievement.

A teaching strategy for developing appropriate skills required in students for conducting scientific investigations was studied by Adinarayan (1979). The objectives of the study were: (1) to develop competence criteria for the skills in operational terms, (2) to construct learning packages suitable for average children in an ordinary classroom situation, (3) to determine the advantages and effectiveness of learning through the packages by individuals and groups, etc. One hundred students of eleventh class was selected and divided into two equivalent groups. The study was conducted in six phases (1) pilot study, (2) preparation of learning packages, (3) individual and group try-outs, (4) demonstration, (5) extension and (6) laboratory phase. Data were collected and analysed using t-test. The major findings were: (1) at the demonstration phase the performance of the experimental group taught through the learning packages was significantly better than that of control group taught by
the conventional method, and (2) the students had favourable reactions towards the learning packages.

Pagnotti (1979) studied Cognitive Restructuring (CR) module effects on test anxiety. The study investigated both the acquisition of CR in modular form and its effects on test anxiety reduction. Treatment involved 45 students. Whether learning CR in modular form was an effective treatment in the reduction of test anxiety, was tested. Final results of the study revealed that reductions in test and general anxiety showed the module on CR to be an effective counselling intervention.

An experimental study of Teaching Science in standards VI and VII through modules conducted by Mian (1980) included the following objectives:

1. To design and develop modules for teaching science in the standards VI & VII.

2. To study the effectiveness of modules as an instructional method with conventional method and

3. To compare the achievements through modules with high and low achievers, boys and girls, high and low academic motivation.

The results revealed that in some cases of teaching science in standard VI and VII modules were found to be more effective than the
conventional method and in some other cases modules were found to be as effective as conventional method. Besides, modules were much enjoyable to the learners and they thought that the modules were better to meet their individual needs. The study also revealed that the students have favourable attitude towards modules as a method of instruction.

Soedijarto and Khodir (1980) developed a modular instructional system for school mathematics in Indonesia. According to them, there are seven fundamental characteristics of the modular instructional system. They are: an emphasis on active self-instruction, a concern for learning objectives of each lesson in terms of subsequent student behaviour, the utilization of multimedia and multi-methods, the active participation of the learner in all phases of instruction, the immediate feedback to the learner, and evaluation formation and emphasis on mastery learning. The mathematics modular programmes were tried out in eight pilot schools along with four other subject areas social studies, Indonesian language and moral education. The results of the evaluation will constitute a basis for the improvement of the materials and their implementation in the classroom. Both objective and subjective data were collected for each module. The objective data consists of the amount of time spent by students in completing the module, the mean score obtained by students on the test given at the end of the module, and the
percentage of correct responses to every item of the after test. The subjective data consists the difficulties encountered by teachers in using the module, the various types of teaching learning processes employed in the lesson and teacher’s opinion on the adequacy of the printed module.

Achievement test results indicated that student achievement in mathematics is still below the expected level of mastery. In the Junior secondary school the average mastery level attained by grade eight students ranged from 26 percent to 51 percent. Compared to other subject areas, these results are relatively low. However in the senior secondary school, the average mastery level attained by grade eleven students was relatively higher than in the junior secondary school. This ranged from 43 percent to 72 percent. Compared to other subject areas these results are not quite low.

Fantaski (1981) designed, developed and validated two audio-visual in-service training modules for boards of school directors. A system approach was utilized in the design component. Modules were field tested by 50 school board members of Pennsylvania. The conclusions of the study were:

1. Participating school board members demonstrated significant gains in mean attitudes from pre to post testing and
2. The effectiveness of the modules as a medium for the in-service training of school board members was established.

Effect of competency-based modules in vocational teacher education was studied by Sollie (1983). The main purpose of the study was to determine if there were differences in demonstrated competencies of students in teacher education programmes using selected competency-based teacher education modules as compared to competencies of students instructed by traditional methods. The sample included 67 students. The results showed that the experimental group scored high in post-test.

Pankiewiez (1984) studied the effects of a self-designed introductory junior high school organic chemistry module on selected student characteristics. The major purpose of the study was to develop an experimental module and then to assess it in terms of its effectiveness, and applicability. The experimental group used the module while the control group studied in traditional way. The findings of the study revealed that experimental group gained high in post-tests. Sex and IQ were found as not influencing the achievement. Previous achievement was shown as good predictors for achievement in post-tests.

Torres (1984) studied the effect of videotape modules in sensitizing prospective teachers to the problems inherent in the
acquisition of knowledge goal perception of bilingual education and attitudes towards pre-service training. The purpose of the study was to determine the effectiveness of videotape modules in

1. Transmitting adequate knowledge of bilingual education
2. Enhancing attitudes towards pre-service training and
3. Providing an adequate perception of the goals of bilingual education.

The sample included 44 student teachers and 24 students. All students were pre-tested and post-tested. Analysis of variance was utilized to determine pre-test, post-test group mean differences.

The findings of the study were:

1. The level of knowledge acquired by the participants was significantly higher than non-participants and
2. The attitudes toward pre-service training were more favourable in the experimental group.

Ginapp (1985) studied the influence of Teacher Assessment module tapes on student teacher's performance. The student teachers who viewed and analysed Teacher Assessment Module Tapes (TAMT) developed for use in the project will receive high ratings on our observation instrument by their co-operating and university supervising teachers than students who do not view the tapes.
Sample included 80 elementary and secondary student teachers, 80 co-operating teachers and 15 university supervising teachers. Results indicated that students in the experimental group received higher overall ratings by all three ratings groups. Significant difference in ratings between experimental and control groups were found by time of last observation period in the ratings by both groups of co-operating and supervising teachers.

2.2 Modular Studies conducted Abroad

Todd (1972) developed and evaluated a module for individualized self-directed instruction at the college level. The study showed that the students using individualized self-directed module were able to achieve objectives of the course in a manner different from the normal college instruction. In addition, the individualized instructional module was found to be better than the instructor's method in another class.

Donald and Merwin (1973) conducted a study to investigate the effectiveness of a series of self-instructional modules for training social studies teacher trainees to develop and ask higher level questions. Study showed that self-instructional module is superior to conventional methods for developing concepts and skills.

Sasser (1974) made a study of the development, implementation and evaluation of a modularized student centred
general biology curriculum at the college level. The findings of the study were:

1. Highly significant differences in the test score means favoured the students who used modularized student centred general biology curriculum.

2. 't'-test comparison of attitudes showed significant difference between modular group and control group, favouring modular group.

Lamb (1975) developed and evaluated a module designed to train science teachers to ask a wide variety of cognitive question. Three experiments were designed to evaluate the effectiveness of the module. Group I worked through the module and were supervised by co-operating teachers who were module trained. Group II worked through the module and were supervised by untrained co-operating teachers. Group III did not work through the module and their co-operating teachers were untrained. The results of the study showed significant increase in the cognitive variety of questioning for group I and group II and a slight increase for group III.

Kazerani (1977) compared a modular system to a Professor/Lecturer system as a method of proceeding in-service education. An alternative delivery system (development of modules and supporting media with the course taught by a person from
geographical area) was developed and compared with the traditional professor/lecturer method. The students who studied through the alternative delivery system scored significantly higher on the knowledge of the module concept than the control group on each of the eight modules except one.

Ames (1981) developed a videotaped self-instructional complete training module to prepare parents, para-professionals in the use of behaviour modification techniques for work with profoundly, severely and moderately retarded adolescents and adults learning self-care skills, home living skills. The revision committee was of the opinion that such a self-teaching module would be a useful training instrument for persons of retarded persons, college students in human services curricular as well as para-professional technicians and professionals working with the developmentally disabled.

Congleton and Broome (1980) prepared a module in spherical trigonometry to provide fresh challenging and unique topic for high school students and to enrich the mathematical background of the students by exposure to a non-education geometry, the geometry of a sphere.

Madjiman (1982) investigated the implication of peer tutors and module mediated mastery learning. The basic question was: Can teachers using modules and peer tutors apply the mastery learning
strategy? The result showed that modules and peer-tutors were effective mediators of the mastery learning strategy when the students index of learning effectiveness was used to measure achievement. Peer tutor and module mediated mastery learning was more effective than the other strategies in responding to the complexity of learning materials.

Ward (1985) conducted a study on modular access and progression routes support issues and student directed learning. The effectiveness of modularizing access comes provided by the University of Derby were examined for 299 adult students. No significant differences appeared in retention, but the modular approach had increased retention of unskilled and low achieving students. Students with lower entry qualification had higher achievement than similar students did before modularization.

Poecoraro (1982) developed a module on interpersonal skills for home economics teachers and Louisiana and valued it in two teaching modes. The study involved two phases. Phase I consisted of the development of the module and phase II consisted of the implementation of workshops in ten parishes at which the module was tested and evaluated. Cognitive and affective pre-tests and post-tests were administered to both groups. Analysis of data involved 't' tests and analysis of co-variance. There was a significant difference at
the 0.05 level of confidence between the mean cognitive and affective adjusted post-test scores of the teachers when the groups were compared. Results indicated that completion of the module in each mode produced significant differences in the cognitive and affective development of teachers.

Greenberg (1984) did the study on effectiveness of a multimedia functional reading module. The use of the videocassette lesson with computer practice was compared to videocassette use with paper and pencil practice. The module focussed on the functional reading skills. There were significant scores favouring the computer treatment in response to a question about enjoyment of the follow-up practice.

Lampe (1984) developed and evaluated five self-instructional modules to provide basic knowledge on the identification and correction of reading difficulties. The modules were used for diagnostic prescriptive reading instruction, word recognition skills, the informal assessment of reading difficulties and the correction of reading difficulties. Results from the evaluation showed that the modules were suitable for the intended purpose.

Hansberry (1985) developed and evaluated an independent learning module that a nursing instruction can use as an adjunct teaching aid for teaching the exchange system for meal planning in a
medical surgical nursing course. Findings revealed that the experimental group performed better in the post cognitive examination than those taught in a regular medical surgical nursing class.

Hopper (1982) made an experimental study in the use of modular approach for teaching biology in standard XI. The major objectives were:

(i) To design and develop instructional modules on selected units in morphology, physiology and ecology for higher secondary classes.

(ii) To find out the relative effectiveness of three modular approaches involving self-learning, peer group learning and peer group learning with teacher intervention with reference to the cognitive objectives.

(iii) To find out the effect of different modular courses of study on the academic motivation of students.

Tools used for the study included cognitive entry behaviour test and module reaction, opinionnaire developed by the investigator.

Merwin and Donald (1972) conducted an experiment to find out the effectiveness of self-instructional modules in preparing secondary school social studies teacher trainees. The study found significant
differences between the control group learning through conventional method and the experimental group learning through self-instructional module on the acquisition of knowledge and skills essential in planning, questioning and testing for higher cognitive process, favouring the experimental group. The experimental group found the module to be an enjoyable and effective device for developing understanding and skills in planning, questioning and testing.

An experimental study to investigate the feasibility of the modules, by comparing students who were taught by proficiency modules, with students taught by additional approach was conducted by Dishner (1973).

2.3 Modular Approach – Studies Conducted in India

Sharma (1982) conducted a study on developing instructional materials in civics at 10+2 level for pre-service and in-service teachers. The main findings of the investigation were (i) 99 percentage of student teachers obtained distinction marks after studying modules I and II whereas 85 percentage of them reached distinction level after studying module II. (ii) A majority of the student-teachers expressed favourable opinion about the different aspects of the modules (iii) The mean achievement scores of
experimental group differed significantly from that of the control group.

Al-Quattan (1989) developed, implemented and evaluated a science course in accordance with Modularized Individualized Instruction principles in Kuwait Secondary Schools. The Modularized Individualized Instructions was found to be significantly effective in producing overall achievement in the first grade pupils at secondary schools when compared with traditional instruction. It was also found that both modularized and traditional instructions were not effective in introducing favourable attitude toward science in the pupils. A remarkable decline was observed in their attitudes.

A comparative study was conducted by Dhamija (1985) on the effectiveness of three approaches of instructions – conventional, radio-vision and modular approach on achievement of students in social studies. The major findings of the study were

(i) The students achieved highest total, knowledge and comprehension achievement scores and retention in Geography when taught through radio-vision, in the Civics when taught through modular approach and in History when taught through conventional approach.

(ii) The involvement of students in the classroom was maximum when taught through the radio vision approach.
(iii) Self confidence among the students increased when they were taught through the modular approach.

Kumar (1990) conducted a study on the Effect of Teacher assisted Modualr Approach in testing Physics in Secondary schools of Kerala State. The study concluded that the Teacher Assisted Modular approach is more effective than Textbook approach in teaching physics.

Madhu Mohan (1990) conducted a study on the effect of Teacher Assisted Modular Approach in teaching Chemistry, at secondary schools of Kerala. The study revealed that the Teacher-assisted modular approach is more effective than text book approach in teaching chemistry.

Hazeena (1995) conducted a study on the comparison of modular approach and traditional text book approach in teaching Physics in standard IX. The major findings of the study were:

(1) The Modular approach was more effective than traditional textbook approach.

(2) The modular approach and textbook approach seems equally good for developing the objective- Knowledge.

(3) The modular approach is more effective than the traditional method in developing the objective – Understanding.
Binumon (2000) conducted a study entitled “Effectiveness of three approaches in instruction -modular, lecture cum modular and conventional lecture in learning the topic Fisheries” at Plus two level. The study concluded that modular approach is more effective than the other two methods such as lecturer-cum-modular and conventional lecture method.

Mukhopadhyay (1981) studied on microteaching vs. modular approach. The objectives were:

1. To study the development of selected teaching competencies through microteaching and modular approaches, and

2. To compare the effectiveness of microteaching and modular approaches in developing selected teaching competences.

It was hypothesized that there would be no significant difference in the performance of the groups trained through microteaching and modular approaches. The study was conducted on 24 teacher trainees. Random sampling was done. Post-facto analysis was done to match the two groups. The self-learning modules, one each on questioning, and reinforcement, were developed and used for one group. The other was trained through microteaching. At the end, both groups appeared for a performance based post-test. The major findings of the investigation were:
1. Investigating ten from each group satisfied the criterion referenced test, whereas in reinforcement nine from microteaching group and seven from the modular approach group satisfied the criterion referenced test, and

2. Both the treatments were equally effective.

Gabriel and Pillai (1981) conducted a study which reports an attempt to modularize learning at collegiate level in India. A difficult unit in Biology was identified and modular learning material was developed, using local resources. The effectiveness of this approach over the traditional teaching approach in terms of learning efficiency, learning time and mastery level is reported. The students who experienced modular scheduling were found to be superior in understanding of concept and retention of concept. Time taken by the modular group as a whole to gain 80 percent mastery, as compared to the control group was found to be in the ratio of 2:5. It was also found that the students preferred individualized learning, and more number of and different types of multimedia approaches rather than the usual classroom lecture.

"Preparation and comparison of supervised study module with text book approach in the teaching of Biology in the High Schools of Kerala State", a study by Justus (1981) included the following objectives:
1. To determine the effectiveness of supervised study module in teaching Biology and

2. To compare effectiveness of supervised study module over textbook approach in the teaching of Biology.

The main finding of the study was that the supervised study module is more effective than traditional approach in the teaching of Biology in high schools under the categories of objective knowledge, application, skill and comprehension.

Dyer (1982) developed an art curriculum design using curriculum modules as a means of improving instruction in urban schools. Using instructional modules as a mechanism, this design attempted to provide more scientific guidelines for art instruction. Three self-contained modules were designed and presented. The respondents expressed satisfaction towards the new instruction.

Mohammad (1988) developed and evaluated a modularized individualized instruction science course in Kuwait Secondary Schools. The purpose of the study was to develop, implement, and evaluate a science course in accordance with modularized, individualized instruction principles. Sample included 497 pupils and 16 teachers. Both treatment groups were administered pre-test, post-test, achievement and attitude tests. Major finding of the study
was that modularized individualised instruction was significantly effective in producing overall achievement.

Anitha (1989) conducted a study on “Preparation of Modules for Teaching the Topic ‘Analysis of Basic data’ in Basic Mathematics for Standard VIII”.

The main objectives of the study were:

1. To prepare a module for teaching the topic ‘Analysis of Basic Data’.

2. To find out the effectiveness of modular approach in teaching mathematics and to compare the effectiveness of modular approach with the traditional method of teaching.

The findings showed that the modular approach is more effective than traditional approach.

Santhoshkumar (1990) conducted an experimental study on the effectiveness of Teacher Assisted Modular Approach in teaching Physics in secondary schools of Kerala state. The study intended to find out the effectiveness of modular approach in teaching physics. The findings showed that the Teacher-Assisted Modular Approach is more effective than Textbook approach for student achievement in teaching physics.
Sansanwal and Joshi (1990) studied the effectiveness of instructional strategy in terms of higher mental ability. An experimental study has been conducted to study the impact of specially designed instructional strategy on higher mental abilities of school children. The specially designed instructional strategy consisted of six components, namely programmed learning materials, experimentation, assignment, discussion, etc. Sample consisted of 109 class IX students divided into two groups, experimental and control. Post-test results were compared and found that the instructional strategy developed under the study was found to be significantly superior to the traditional approach to teaching in terms of development of power of application, analysis, synthesis, evaluation and overall higher mental ability in science.

Arunachalam (1991) developed an instructional module in learning of history for students of standard X. The major objectives were to develop the module and comparison of effectiveness of module over traditional approach in history. 300 pupils formed the sample for the study. Two groups were equated on their achievement available. The experimental group learnt the topic using the module and the control group in the conventional way. Achievement test was administered to both groups and the scores were compared. The results showed that the experimental group served high in achievement test. As far as the total group is concerned the use of
instructional module definitely improves their learning of history. Same result is obtained when the objectives knowledge, comprehension, application and skill are tested. The study revealed that instructional module is superior to the traditional approach for it contributes to the attainment of knowledge, comprehension application and skill.

2.4 Studies on Environmental Education

Joy (1985) made a study on the extent of High School pupil's awareness of environmental chemistry and its effect on their achievement. The findings of the study were:

(i) There are a number of concepts in chemistry which have direct association with the environment and daily life situations.

(ii) There are a number of environmental situations around where chemistry is applied. The study implied that the prevailing practice of rote memorization of abstract concepts and principles in chemistry will degenerate the science education and therefore much emphasis should be given to the applied aspects of science. Chemistry should be taught in an interesting way by taking examples from daily life.

Rani (1987) conducted a study on student's awareness of productivity orientation to the concepts learned in Botany up to PDC with a view to prepare an alternate instructional strategy. The finding
is that students' awareness in theory cannot be considered good because sufficient learning experience drawn from life situations to develop concepts meaningfully in the students are not provided in the classroom and provision for proper demonstration and field trips is found lacking.

The main objective of the study carried out by Sreedevi (1985) was to test the students' awareness of productivity-oriented aspects learnt in biology. It is evident from the analysis that majority of the students are unaware of the productivity oriented aspects of the concepts learnt in biology. It is also evident from the study that teachers were giving less importance to the effective learning experiences of the knowledge they gain.

Deopuria (1984) conducted a study to compare the environment awareness and attitude of students when they are taught by the traditional method and environmental approach. It is found out through the study that students who have gone through the environmental approach showed considerable improvement towards environmental awareness than those who studied through traditional method.

Aykkareth (1998) conducted a study on utility awareness of students of IXth standard towards the concepts learnt in economics and arrived at the conclusions that students have an average
awareness in theory as well as utility in the concepts learnt in economics. This may be due to

➢ Theoretical concepts are very difficult
➢ Students are less interested to study the theories
➢ Knowledge imparted in classroom is not linked with life situations

Alexander (1995) conducted a study to find at the extent of IX\textsuperscript{th} standard students’ awareness of application of theories in physics. The objective of the study was to compare the students’ awareness in theory with that in application in relation to their knowledge in theories of physics. He found that there exists significant difference between the means of awareness in theory and that in application. The awareness in application is lower than that in theory.

Bindhu (1995) attempted to find out the utility awareness of students towards the concepts learned in various subjects. They found that there exists a significant difference between the means of awareness in theory and that in utility.

The study of Meena Kumari (1990) was to find out the extent of 10\textsuperscript{th} standard students’ awareness of applied electronics. She concluded that while teaching theory when importance is given for its application teaching appears to be more or less text oriented.
Saxena (1981) have developed and standardized an environmental awareness test for children of grades 3, 4, and 5. The sample for the study was 275 children. They divided the physical environment into different categories - universe, air, water, weather, rocks soil, housing and clothing, plants and animals and abstract concepts.

Scaria (1984) conducted a study to identify the extend of awareness among secondary school students regarding plants of food value in general and their uses and also to analyse curricular potentials of selected local plants of food value etc. The findings revealed that majority of students are lacking practical utilization of knowledge about the commonly available local food plants.

Study conducted by Joseph (1976) found that fields and agricultural farms are present near almost all schools. Only very small number of teachers use these environmental resource for teaching science. From the analysis it is seen that many teachers and students show their unawareness about many of these resources, which may be due to the ignorance about the use or presence of these materials.

Simpson (1995) studied the purpose of (i) increasing students' awareness of nature and environmental issues, (ii) providing an interdisciplinary curriculum for environmental issues, (iii) encouraging
students to use a variety of current non-fiction sources for research activities and (iv) encouraging students to work together in small groups. Each of 20 units corresponds to one environmental topic. Topics include the earth, the atmosphere, water, energy, seas and oceans, island and coral reefs, ponds and wet lands, rivers and lakes, rain forests, forests and wood lands, mountains, grasslands, deserts, polar region, urban environments food and farming, waste management, endangered species and environmental awareness.

Nat (1990) conducted a study on the environmental education to develop an awareness of and responsibility for the environment at present and in future. He concluded that this could be achieved by bringing environment to school as well as school to environment.

The Central Institute of Educational Technology (CIET) of the NCERT has produced a multimedia package on environmental education. The package is in the form of videotapes, slides, and posters that deal with such issues as air pollution, water shortage and pollution, destruction of forests, soil erosion etc. The film “The Great Thrust” reveals that present drought was not due to the failure of rain alone. The non-availability of ground water has particularly worsened the situation. The film shows that productive soil is disappearing due to erosion by wind and rain. Soil erosion has increased 400 times on account of large scale deforestation. The nine
minute film "Portrait of a City" underscores the message of atmospheric pollution caused by industries and powerhouses set up around cities. Although these are essential for a growing society, few have installed vitally important pollution control system.

The instructional materials developed by Hungerford and his associates include six modules, "Environmental problem solving", "Issue Investigation", "How to gather information", "Investigation of issues" and "Environmental Action Strategies" (Hungerford et al, 1988). An additional set of instructional materials were presented on educational case study dealing with municipal solid waste.

Shoemaker and Hugh (1975) compared the performance of Secondary school students on the ecological concepts and knowledge test before and after completing the field experiences. The conclusions were

- Ecological concepts can be presented effectively at the secondary level through field experiences.
- Students who participated in the field studies exercise have better understanding of ecological concepts than those who do not.

A study conducted by Sutherland (1966) showed the dominance of the integrated agro biology course. The study conducted in California high schools, where students were given agro
biology course showed greater gain in identification and biological principles, than the control group.

Exemmal (1974) surveyed the practices and potentialities in learning the revised school syllabus in Botany from the point of view of environmental and other resources.

The major conclusions were

1. Even though the teachers have conducted excursion, the percentage of teachers using life situations for teaching Biology is 21.4%

2. Only a very small percentage of teachers use the knowledge about certain institutions. The investigator recommended that pupil should be encouraged to make use of natural resources.

Iyer's (1961) approach was directed towards formulating the principles of construction of a syllabus in general science for schools of Kerala. While formulating the principles, the investigator found out that the present elementary science curriculum is not based on problems of living and social needs. It is not based on environmental factors and there is almost total lack of co-relation between various sciences.
Rajput, Saxena and Jadhoa (1980) conducted a study in environmental approach of teaching at primary level. The objectives of the study were:

i) To study the existing awareness towards the scientific and social environment in children.

ii) To identify the community resources which can be gainfully utilized for teaching.

The study revealed that

i) Only one of the 4 groups was significantly different on environmental awareness at the present stage.

ii) Experimental groups were significantly better than the control group and

iii) The difference between control groups on a traditional achievement test was not significant.

Treagust (1985) discusses the need for including noise pollution in the science curriculum and describes 10 activities for improving students awareness and understanding of a concern for noise and its effects.

Vollk (1983) conducted a study to perceive Environmental Education (EE) curriculum needs in the United States. The results showed that
Professional environmental educators believe that there exists considerable discrepancy between the desired and existing system of environmental education.

It was perceived that Environmental Education goals were not being met with existing curriculum.

Need for inservice teacher education for Environmental Education curricula was perceived at all academic levels.

Simmons (1989) noted that "environmental education has not been infused within the curriculum, but tends to be treated mostly as an enrichment of the science program". The danger is that scientific literacy is typically built on a disciplinary model, whereas environmental literacy is based on interdisciplinary model.

Iozzi (1984) states that the preponderance of research studies in environmental education had, to that point, dealt with attitudes and values rather than with cognitive knowledge. This is still true and continues to make Environmental Education different from other educational areas of study, where educational researchers have focused more heavily on factors related to cognition. Iozzi attributed this difference to a need for establishing a descriptive baseline for environmental education. He also commented that environmental educators attach importance to teaching that would develop positive attitudes and values, implying that they believe the education,
focusing on their promotion, will lead to the fostering of responsible environmental behaviour.

Jenifer (1996) has emphasized environmental studies as an interdisciplinary subject which includes socio-economic, political, natural, biological, anthropological, economic, aesthetic and cultural aspects of human life. Hence it intends to control and design environmental problems according to human necessities. It is often remarked that environmental topics should be a subject of study in the school.

A study by Yogamoorthi (1992) stressed the need for environmentally trained teachers for environmental education. In India though we do have in service programmes for teachers to reinforce their skills and knowledge in their concerned subjects like mathematics and science to make the process of teaching/ learning meaningful and up-to-date, such in service courses do not include anything substantially on Environmental Education.

Ravindranath, Sowrirajan and Nair (1996) studies the use of computers in the teaching of Environmental Education. The main objective of the study was to find out how computers could be effectively used in schools to support the teacher with the necessary information on the local environment and how instruction could be made locally specific. The main conclusion of the study is that with
the availability of sophisticated gadgets like computer, classroom, instruction could be made more creative and challenging.

Jans (1978) and Gupta (1986) conducted studies on the attitude of teachers towards environmental education. The findings of the studies were that the mean attitude score for all the groups of teachers showed a favourable attitude towards environmental education.

Analysis of research on variables related to the fostering and demonstration of environmentally responsible behaviour has led to the design and testing of a set of instructional materials. Hungerford (1993), stresses a hierarchical approach involving four levels of activities.

1. Ecological concepts: This goal level attempts to provide the learner with the ecological knowledge that will permit him/her to make ecologically sound decisions with respect to environmental issues.

2. Conceptual awareness: This goal level attempts to develop a conceptual awareness of how individual and collective behaviours influence the relationship between quality of life and quality of environment.

3. Issue investigation and evaluation: This goal level attempts to develop the knowledge and skills needed to permit learners to
investigate environmental issues and evaluate alternative solutions for resolving these issues. It also provides opportunities for students to investigate and evaluate real world issues.

4. Environmental action skills - training and applications: This goal level attempts to develop those skills needed for learners to take positive environmental action for the purpose of resolving or helping to resolve environmental related issues.

Data from research studies consistently indicate that behavioural changes generally will not occur if students are exposed only to the first two goal levels. Data also indicate that behaviour will change, if students are thoroughly exposed to the third and fourth goal levels, in addition to the first two.

Wilson (1994) conducted a study on the importance of environmental education at the early child level. It discusses guidelines to provide developmentally appropriate environmental education experience for young children. Guidelines include i) keeping children actively involved (ii) beginning with simple experience, (iii) encouraging use of the senses, (iv) focusing on developing relationship and (v) demonstrating enjoyment of nature
Gupta (1986) conducted a study on attitude of teachers towards environmental education and found that teachers showed a favourable attitude towards environmental education.

Osaki (1992) conducted a study on the forces influencing teachers attempt to use students environment experiences in the teaching of school Biology and found that environmental education and other approaches of science teaching are unlikely to succeed at classroom level.

Ravindranath (1996) visualizes the role of DIETS in planning, organizing and implementing a comprehensive programme of the environmental education at the district level. He further cautions that the statutory effects of efforts made by different agencies will not be sustained unless these are accompanied by appropriate curricula, teacher training and a mechanism for sustained implementation and follow up of the programme.

In India, recent introduction of ten year school curriculum envisages teaching of environmental studies from the beginning of school education (NCERT, 1975). The concept of environmental studies though not alien to the field of education yet has specific purpose during the present period of environmental crisis and deterioration. The primary education being the terminal point for most of the children of our country, the main objective of
introduction of environmental studies in school curriculum is to develop an awareness and understanding of environment and problems related to it. Through understanding of environmental crisis children will develop both skills and attitudes for better adjustment with environment.

The issue of environmental education has been discussed at length in several International and National conferences and seminars. The deliberations of Founex (1971) and later at Stockholm (1972) followed by the workshop on Environmental Education at Belgrade (1975) and these at the Inter Government Conference as the subject at Tbilisi (1977) organized by UNEP and UNESCO are some of the notable academic gatherings on environmental education.

Palmer (1992) conducted a research study on the development of personal concern and individual commitment for the environment. Without doubt he found out that the single most important category of responses at all levels is experience outdoors and particularly at a young stage.

The Department of Education of the university of South Africa has acknowledged the need to increase the focus on environmental education within formal education. The National Environmental Education Programme for General Education and Training was
established to advance environmental education within the curriculum (Wagiet, 2002).

Serious environmental problems that range from familiar issues such as pollution, loss of biodiversity due to land degradation and waste management are experienced worldwide and environmental education is seen to be a key response to these problems (United Nations, 1992, UNESCO, 1997).

Saxena (1986) observes environmental education as a process to promote the awareness and understanding of the environment, its relationship with man and his activities. It is also aimed at developing responsible actions necessary for preservation, conservation and improvement of the environment and its components. According to him there are three concepts of environmental education: (a) about the environment, (b) from the environment and (c) for the environment. Education about the environment is to acquire the understating of the total environment. When the environment is used as a vehicle for gathering concepts, knowledge and skills related to specific academic disciplines, it is learning from environment. And finally the development of attitudes skills and evaluation abilities for the proper use and the development of environmental education is education for the environment.