CHAPTER – V
SUMMARY AND CONCLUSION

5.1 INTRODUCTION

The concept of Sustainable Development has emerged with Brundtland Commission (1987), which defines that it is “the development which meets the needs of the present without compromising the ability of future generations to meet their own needs”. Education for Sustainable Development (ESD) aims for a sustainable society, which merges the environmental, economical, political and social dimensions. When we analyse how ESD has evolved, it can be observed that Environmental Education was the earlier attempts, followed by Sustainable development, then to Education for Sustainable development (ESD) which aims for a sustainable future.

A core principle behind sustainable development is the idea that economic, social, political and environmental conditions play a major role. Without a proper ecosystem, it is impossible to maintain a better society which is essential for us and future generation. Thus environmental dimension can be regarded as the ultimate boundary for sustainable development. The Social dimension is to meet the basic needs of all people without exceeding the boundaries of the ecosystem. The economic dimension is a means to realize the goal within the limits of a socially and environmentally sustainable manner. So Education for Sustainable Development (ESD) cannot be considered as having link only with environment but with development of social and economic aspects.

Pollution, deforestation, loss of biodiversity, ozone hole and global warming are some of the environmental problems that are faced by the world today. Where did they come from? All the basic resources required for living come from the environment. It is the environment that provides raw materials to industries, food for people, fuel for transport etc. The environment also absorbs the waste that developmental activity creates. The ways people interact with the environment influence its health and well being. Overusing environmental resources causes environmental degradation. Many of today’s environmental
problems have emerged because of this overuse and/ or misuse of our natural resources. All of these problems have an impact on human well being.

Solving these environmental problems and preventing new ones will require an understanding and appreciation of the linkages between environmental well being and human well being. However, many of these linkages are not apparent. To bring environment and development concerns to people’s notice, to enable them to understand the linkages between the two, to encourage them to take appropriate action, and to equip them with the skills necessary for taking the required action, education is necessary for all this (CEE, Ahmedabad, 1999).

5.2 NEED AND SIGNIFICANCE OF THE STUDY

There is a felt need for educational reform that extends beyond the boundaries of individual school subjects and which requires the attention of teachers, educational administrators, planners and curriculum agencies. It is particularly important for national officials to be sensitive towards achieving a high standard of physical, social and cognitive development. In some circumstances these trends will call for intervention in what is seen as an emerging and widespread inability of students to achieve success in a specific part of the curriculum. In other circumstances, the focus will be on the curriculum itself because it may be seen as being in need of revision and restructuring in order to take account of recent research and/or new social and economic conditions. (Somerset & Eckholm, 1990, p.18)

It was observed that in the present situation, there is a lacuna where Environmental Education is introduced in school system. It gives emphasis only with environmental aspect but not with developmental aspect. If it is given importance only to the environment, then it becomes unilateral. Hence there is a need to incorporate social, political and economic aspects which should be considered together within the existing curriculum. It is in the whims of teachers to develop a positive attitude towards ESD and also to integrate ESD meaningfully into the existing curriculum. The prevailing teaching methods are not appropriate for transtracting ESD in order to alter the knowledge on sustainable development.
So, there is a need to integrate ESD along with appropriate pedagogical techniques for attaining knowledge, skills and values related to ESD.

Many sources have indicated that Environmental Education strategy in India should incorporate the infusion of environmental concerns into the existing curriculum. At the National front, NCERT took a pioneering role in introducing EE in its textbooks.

The comprehensive, continuing and interdisciplinary nature of EE is well described in the UNESCO-UNEP Congress (1987) on EE and training. “Environmental Education should attempt to create awareness, transmit information, teach knowledge, develop habits and skills, promote values and provide criteria and standards, and present guidelines to problem-solving and decision making. It therefore aims at both cognitive and affective behavior modification. This is an action oriented, project centered and participatory process leading to self confidence, positive attitudes and personal commitment to environmental protection. Furthermore the process should be implemented through an interdisciplinary process”.

Education should be aimed at empowering learners with the ability and desire to work towards realizing sustainable development locally and globally, which includes, the awareness and knowledge about the environmental development (cognitive); develop willingness, desirable attitude, feelings and values required (affective); also to act with the essential competence and skills (action-oriented). This leads to the critical thinking, commitment, creative problem-solving skills and decision making ability including participatory decision making.

The initial step in launching an ESD program is to develop awareness within the educational community and the public. If government officials or school district administrators are unaware of the linkage between Education and Sustainable development, re-orienting education to attain sustainable development will not occur. Thus the importance of ESD must reach beyond the delegations and permeate the educational community and general public.

Education for Sustainable development (ESD) provides opportunities for learners to participate in democratic discussions about what is important to them.
personally, and for society in the future. It also develops and strengthens the capacity of individuals, groups, communities, organizations and countries to make judgments and choices thus aiming at making our world safer, healthier and more prosperous, thereby improving the quality of life. It includes processes such as critical reflection, greater awareness and empowerment so that new visions and concepts can be explored and new methods and tools developed. Hence, a fundamental principle in learning for sustainable development is the idea of each individual’s involvement, responsibility and commitment to local and global discussions on our common future, which gives democracy a central role.

Children should explore the learning situations and learn the meanings on their own by connecting their knowledge with background experiences and the local knowledge. In the process of learning they attempt to negotiate, share ideas and participate effectively in the group task and in turn develops the inquiry and critical thinking abilities. The scope is to develop the mental processes which will strengthen the capacity to transfer the knowledge to new situations. Thus knowledge would be discovered from their surroundings and not through textbooks.

Knowledge becomes significant to the extent that its pursuit conveys the spirit and method of inquiry. Therefore, the learning should involve an approach that will help the child to think critically and develop various skills like inquiry, problem-solving, participatory decision making ability etc. Inclusion of materials and experiences to develop a conceptual understanding of the phenomenon of change and the problems related to sustainable development in order to develop minds that cope with change and reasonable techniques is the need of the hour. Content and outcomes needs to be in tune with the social and cultural realities of the times. Orientation to cultural and social realities also involves value bearing concepts and experiences which encourage examination of value and value conflicts.

Since ESD is a subject for creating awareness, necessary skills and values, so that the child can take his/her place responsibly in the society for sustainable development of the future, the pedagogical methods to be followed should be different. The pedagogical situations should be created in such a manner in order
to make the child sensitive to the world around him and create meanings from the surroundings and from his own experiences.

Classroom teachers are finding the implementation of various investigatory and inquiry approaches far more difficult than the reform community acknowledges. Mark Windschitl in his article presents a theoretical analysis of constructivism in practice by building a framework of dilemmas that explicates the conceptual, pedagogical, cultural, and political planes of the constructivist teaching experience. In this context, “constructivism in practice” is a concept situated in the ambiguities, tensions, and compromises that arise among stakeholders in the educational enterprise as constructivism is used as a basis for teaching. In addition to providing a unique theoretical perspective for researchers, the framework is a heuristic for teachers, providing critical questions that allow them to interrogate their own beliefs, question institutional routines, and understand more deeply the forces that influence their classroom practice. (Windschitl, 2002)

There is an urgent need on an overall review of the existing approach in the education system with a sharper focus on attaining ESD which can sensitize the knowledge, skills, critical thinking and value issues towards attaining a sustainable development. ESD should be incorporated in the entire curriculum starting from pre-schooling to higher education, which should be transacted in a meaningful manner using appropriate pedagogical techniques. Looking into the researches’ conducted in the past, which were more concerned with creating environmental awareness and studying environmental attitude, and the trend in the world’s concern which is focused on sustainable development, it was intended to research upon ESD. This study attempts to develop an intervention programme by integrating ESD in the Science and Social Science subjects of VII standard, which in turn measures the change in knowledge, critical thinking, problem solving and value preference towards sustainable development as a result of the programme.
5.3 STATEMENT OF THE PROBLEM

The study attempts to attain sustainable development by integrating the components of ESD with the contents of Science and Social Science of VII standard NCERT textbooks and to research upon its effectiveness on some of the dimensions such as knowledge, critical thinking, problem-solving, participatory and performance skill and values preference towards sustainable future. Hence, the study is entitled as; “An integrated approach to Education for Sustainable Development and a study of its effectiveness”.

5.4 VARIABLES OF THE STUDY

Independent variable

An independent variable is the variable that is been manipulated. In this study the experimental treatment through an Integrated approach to Education for Sustainable Development (ESD) in Science and Social Science subjects is taken as the independent variable.

Dependent Variables

A dependent variable is the measured or observed variable. By observing the dependent variable, the effect of the independent variable can be measured. It was to be tested whether the independent variable Integrated approach to Education for Sustainable Development (ESD) would have an effect on knowledge, critical thinking, problem-solving and value preference towards sustainable future. These dependent variables were observed to determine whether the independent variables had any effect.

Intervening Controlled Variables

Control variable is a variable that has the potential to have impact on the dependent variable as well as the independent variable, but its effects are removed or controlled by the research design or statistical manipulation. The variables that were controlled for the experiment to get homogenous groups were: intelligence of the students, classes chosen for the experimental treatment, identified Science and Social Science content and age of the students.
**Intervening Uncontrolled variables**

Those variables that have an unpredictable or unexpected impact on the dependent variable were unable to control. Some of these variables are absence of some students during experiment, socio-economic status, home environment, exposure to mass media on the themes related to sustainable development, education of parents, study habits, academic ability in the subjects, interaction of students with other related sources remained uncontrolled during the treatment.

**Situational Variables**

Situational variables like time, duration of treatment, type of management, subjects to be taught etc. were controlled administratively and through selection of sample, equating the time.

5.5 **OBJECTIVES OF THE STUDY**

In order to study the effectiveness of the integrated approach to ESD on the above mentioned dependent variables, the following objectives were formulated.

1. To develop ESD integrated materials by identifying the content areas and using appropriate pedagogical approaches in Science and Social Science curriculum of VII standard.
2. To study the effectiveness of integrated approach to ESD on the knowledge, critical thinking, problem-solving and value preference towards sustainable development.
3. To study the gender difference in the experimental group on the knowledge, critical thinking, problem-solving and value preference towards sustainable development as a result of the integrated approach to ESD.
4. To study the difference in critical thinking and problem-solving towards sustainable development among students of high, average and low knowledge group of experimental group.
5. To study the value preference to sustainable development of experimental and control group with respect to their high and low value preference.
6. To observe the participatory and performance skills of students undergoing the integrated approach to education for sustainable development.
7. To study the relationship among knowledge, critical thinking, problem-solving and value preference towards sustainable development.

8. To study the predictor variable of knowledge, critical thinking, problem-solving and value preference towards sustainable development

5.6 HYPOTHESES

In order to study the above objectives, the following hypothesis and research questions were formulated:

1. There is no difference between experimental and control group in the pre test performance on knowledge, critical thinking, problem-solving and value preference towards sustainable development.

2. There is a difference between experimental and control group in the post test performance on knowledge, critical thinking, problem-solving and value preference towards sustainable development as a result of experimental treatment of ESD.

3. The experimental group performs better on the knowledge, critical thinking, problem-solving and value preference towards sustainable development as a result of integrated approach to ESD when compared to control group.

4. There is a difference in critical thinking and problem-solving towards sustainable development among students of high, average and low knowledge group of experimental group as a result of integrated approach to ESD.

5. There is no difference in knowledge, critical thinking, problem-solving and value preference towards sustainable development with respect to gender when exposed to integrated approach to ESD.

6. There is a relationship between knowledge and critical thinking; knowledge and problem-solving; knowledge and value preference; critical thinking and problem-solving; critical thinking and value preference; problem-solving and value preference towards sustainable development.
5.7 RESEARCH QUESTIONS

Besides the above formulated hypotheses, the following research questions have been raised pertaining to certain aspects of the study which are as follows.
1. What is the level of participation and performance skills of students exposed to the integrated approach to education for sustainable development?
2. What are the predictor variables of knowledge, critical thinking, problem-solving and value preference towards sustainable development?

5.8 DESIGN OF THE STUDY

The study was a Quasi-experimental study, wherein a control and an experimental group were employed. A non-randomized pre-test post-test design was used. The control and experimental groups were equated on intelligence (using Raven’s Progressive Matrices) and pre-test on students’ knowledge, critical thinking, problem-solving and value issues regarding ESD. A non randomized purposive sampling technique was used to select two divisions of VII standard from different schools which are the intact groups. Quasi-experimental design is different from true experimental design in a way that the samples are not selected randomly from a specified population nor they are randomly assigned to experimental and control group as done in an experimental design. Quasi-experimental design is commonly used in studies of this nature as it has a high internal validity and also ensures the cause-effect relationship of the programme to establish that the programme had a relationship to the dependent variables taken into consideration.

The ESD course developed through an integrated approach as a part of curricular content of VII standard Science and Social Sciences was taught by the investigator to the experimental group. Various pedagogical strategies like inquiry, social learning strategies, and field work that leads to construction of knowledge, necessary skills and values related to ESD was used for transaction in the experimental group. These strategies were followed throughout the treatment where the students with various social and cultural backgrounds have perceived the ‘Sustainable Development’ concepts and issues based on their background
experiences, explored the problems, investigated, discussed, participated, negotiated and shared ideas and arrived at consensus in their groups.

During the experimental treatment, continuous assessment of student’s performance on various activities, projects and group work was assessed. Certain action oriented situations were evolved to develop and assess students skills related to sustainable future. Besides this the students participatory skill, decision making skill, inquiry skill was assessed when they were working in groups. A diary was maintained by the students and a learner’s profile was maintained to know the progress of students.

In the control group the identified content from Science and Social Science subjects of VII standard was taught by the regular teacher using the regular method followed in the school.

5.9 SAMPLE

The population of this study consisted of students of upper primary schools which are affiliated to CBSE. Purposive sampling technique was used wherein the sample was drawn from the two intact divisions of standard VII of Chinmaya Vidyalaya, Taliparamba and Chinmaya Vidyalaya, Payyannur as experimental group and control group respectively. The sampling was of purposive sampling, since it was not possible to employ randomization, which would upset class schedules. The class as a whole in its natural settings was considered for implementing the study.

The students of VII standard who belonged to the age group of 12-13 years were chosen because VII standard is considered as the end of upper primary stage in Kerala, just as some of the states in the country.

Intact groups of 46 students in experimental group and 46 students in control group were initially taken for the study. The sample was reduced to 37 in experimental group and 35 in control group later after eliminating those cases who could not take up the pre and the post tests.
5.10 INSTRUMENTS USED IN THE STUDY

The tools used in the study are Standard Progressive Matrices test (Raven, 1958), Knowledge Test on Sustainable Development (KTSD), Critical Thinking Test on Sustainable Development (CTTSD), Problem Solving Test on Sustainable Development (PSTSD), Observation Schedule for Participatory and Performance Skills (OSPPS), Value Preference Scale on Sustainable Development (VPSSD).

i) Standard Progressive Matrices Test (SPMT)

Non-verbal intelligence of the students participating in the study was measured by administering the standard form of the Raven’s Progressive Matrices Test (Raven, 1958). This test of intelligence estimates the subjects’ ability to discern and utilise a logical relationship presented by non verbal materials. This test is a standardized one and its validity and reliability values have been established. The reliability coefficients as reported by raven (1958) vary from 0.80 to 0.90.

ii) Knowledge Test on Sustainable Development (KTSD)

To measure the entry behaviour and terminal behaviour of the pupils, a Knowledge Test on Sustainable Development was constructed by the investigator based on the integrated concepts of sustainable development. While planning the construction of the knowledge test, the objectives of Science and Social Science was kept in mind so as to include the items coming under cognitive categories like recalling simple facts and figures, recognising, analyzing, applying, interpreting and predicting. the areas that were considered for constructing the tool was agriculture, consumption and production patterns; atmosphere and climatic change; biodiversity and forests; water, fresh water, oceans and seas; land management; energy; disaster reduction and management, desertification and drought; toxic chemicals, hazardous wastes, radioactive wastes and solid wastes; health and sanitation; demographics, human settlement and poverty, international law and international cooperation for enabling environment, decision making.

The test was used as the pre test and post test in order to study the effectiveness of the intervention. Based on the dimensions and the areas been
considered the test items were prepared correspondingly. The items prepared were subjected to scrutiny of subject experts and experienced teachers. The item analysis was carried out based on the guidelines of Ebel and Frisbie (1991). The test was of forty five minutes and consisted of sixty two items. The reliability of the Knowledge Test on Sustainable Development was established using test-retest method. The correlation coefficient of the two sets of scores was calculated by using the Pearson’s product moment correlation. The coefficient of correlation was found to be 0.82. Cronbach’s α (alpha) which is a coefficient of reliability was also used to measure the internal consistency and the reliability coefficient was found to be 0.92.

**iii) Critical Thinking Test on Sustainable Development (CTTSD)**

The Cognitive skills given in the Delphi Report (1990) were adopted for the construction of the Critical Thinking Test on Sustainable Development, since the Delphi report was found to be an authentic document created through a consensus reached by eminent scholars in the field of Psychology, Philosophy, Science and Education. Delphi report contains detailed description of the cognitive skills and sub skills of critical thinking. The Critical Thinking Test on Sustainable Development consists of sixty seven test items which include thirty five multiple choice items and thirty two descriptive items and the duration of the test was for one and a half hours. In this Quasi-experimental study, this Critical Thinking Test on Sustainable Development was administered as pre tests and post test to measure critical thinking on sustainable development in the experimental and control group. The final critical thinking test consisted of nine items from the skill interpretation, seven from analysis, five from evaluation, nineteen from inference, twenty two from explanation and five from self regulation, thus comprising a total of sixty seven items. The reliability of the critical thinking test was established using test-retest method. The correlation coefficient of the two sets of scores was calculated by using the Pearson’s product moment correlation. The coefficient of correlation was found to be 0.78. Cronbach’s α (alpha) which is a coefficient of reliability was also used to measure the internal consistency and the reliability coefficient was found to be 0.88.
iv) **Problem Solving Test on Sustainable Development (PSTSD)**

To measure the problem-solving ability on sustainable development of VII standard students, a Problem Solving Test on Sustainable Development was prepared. Since critical thinking test did not contain items pertaining to problem-solving as such, the investigator felt a need to have a test especially for measuring problem-solving ability on sustainable development. While planning for the construction of Problem Solving Test on Sustainable Development, the investigator has chosen the steps in the problem-solving ability as the dimensions, which include identifying and defining the problem, formulating hypothesis, testing hypothesis by collecting and evaluating data, identifying results, drawing conclusions. There were twenty four multiple choice items which were selected for the final test. The reliability of the problem-solving test was established using test-retest method. The correlation coefficient of the two sets of scores was calculated by using the Pearson’s product moment correlation. The coefficient of correlation was found to be 0.78. Cronbach’s \( \alpha \) (alpha) which is a coefficient of reliability was also used to measure the internal consistency and the reliability coefficient was found to be 0.82.

v) **Value Preference Scale on Sustainable Development (VPSSD)**

Sustainable development intends to develop not only awareness and cognitive skills, but also affective dimension such as attitude and value formation which are very important and play a responsible role in sustaining the environment. If one has knowledge and higher order thinking related to sustainable development, it is very important that he/ she should possess a value which helps the individual to live a sustainable life. Since a tool was not available as such to measure the values on sustainable development, it was intended to develop a Value Preference Scale on Sustainable Development that helps to find out the value preference of each individual participating in the study.

The dimensions for developing the value preference scale were taken from the values prescribed by UNESCO, which are maintain equality towards sustaining environment and resources, maintain solidarity towards environment for sustainable development, observe tolerance in order to attain sustainable
development, develop respect and care for environment and community of life, maintain a shared responsibility for sustaining our environment, attain socio-economic justice for a sustainable society, develop ecological integrity for attaining sustainable development, attain non violence and peace for a sustainable society. Fifty items were selected for the final test. The reliability of the Value Preference Scale on Sustainable Development was established using test-retest method. The correlation coefficient of the two sets of scores was calculated by using the Pearson’s product moment correlation. The coefficient of correlation was found to be 0.86.

vi) Observation Schedule for Participatory and Performance Skill (OSPPS)

In order to provide additional information about the values that are preferred by the students and to identify how much they practice these values, an Observation Schedule for Participatory and Performance Skill was prepared. Though it was impossible to identify all the performance skill, the investigator has selected few of the items which were able to observe and record during the experimental study. The dimensions taken were not prepared initially, but it was evolved during the experimental study. It was a 5-point scale ranging from very good to very poor. Initially there were thirty two items. After the intervention, few items were eliminated which were unable to observe. Hence in the final schedule there were twenty items with a maximum score of one hundred and minimum score of twenty.

5.11 PROCEDURAL DETAILS OF THE STUDY
The study was carried out in the following phases

Phase 1: Developmental phase
Phase 2: Pilot study phase
Phase 3: Follow-up phase
Phase 4: Experimentation phase

5.11.1 Phase 1: Developmental phase
At this phase, the identified ESD components and the appropriate learning experiences were developed and integrated. Concept maps were also prepared for
each unit. Tools like Knowledge Test on Sustainable Development, Critical Thinking Test on Sustainable Development, Problem Solving Test on Sustainable Development, Value Preference Scale on Sustainable Development and Observation Schedule for Participatory and Performance Skills were developed. Hence this phase consists of the following stages:

a) Identify the components of sustainable development that can be incorporated in the contents of Science and Social Science

b) Identifying units in Science and Social Science where there is scope for integrating the concepts of sustainable development

c) Identify the plug points to integrate the concepts of sustainable development

d) Integrating the concepts of sustainable development meaningfully

e) Preparation of concept maps for the selected units

f) Plan the learning activities for the selected units

g) Preparation of lesson plans

Each of the above mentioned stages involves the following procedures.

Identify the components of sustainable development that can be incorporated in the contents of Science and Social Science

The components of Sustainable development that can be integrated in Science and Social Science were identified based on various reviews and the recommendations of the United Nations Division for Sustainable Development. The areas identified falling within the scope of sustainable development are listed below;

- agriculture, atmosphere, biodiversity, biotechnology, capacity-building, climate change, consumption and production patterns, demographics, desertification and drought, disaster reduction and management, education and awareness, energy, finance, forests, fresh water, health, human settlements, indicators, industry, information for decision making and participation, integrated decision making, international law, international cooperation for enabling environment, institutional arrangements, land management, major groups, mountains, national sustainable development strategies, oceans and seas, poverty,
Identifying units in Science and Social Science where there is scope for integrating the concepts of sustainable development

The NCERT Science and Social Science textbooks prescribed for VII standard was used in the present study. As stated earlier the units were identified by consulting with experts and the units Nutrition in plants; Fibre to fabric; Heat; Weather, climate and adaptations of animals to climate; Wind, storms and cyclones; Soil; Water: a precious resource; Forests: our lifeline; Waste water story from Science and units like Equality; Role of the government in health; Environment; Inside our earth; Our changing earth; Air; Water; Natural vegetation and wild life; Human environment-settlement, transport and communication; Human environment Interactions the tropical and the subtropical region from Social Sciences were selected for the integration of concepts of sustainable development.

Identify the plug points to integrate the concepts of sustainable development

In the above selected units, wherever there is a scope of integrating the concepts of Sustainable development, it is further analyzed to find out the exact places where the integration can be done meaningfully. It was done keeping in mind the psychological aspects of the population by consulting with the teachers and experts who are working in the area of education for sustainable development.

Integrating the concepts of sustainable development meaningfully

After analysing the plug points in the selected units, the concepts of sustainable development were integrated meaningfully in the desired places.

Preparation of concept maps for the selected units

For the selected units in Science and Social Science a concept map was prepared for each unit incorporating both the concepts already covered in the textbook as well as those which are integrated.
Unit planning

The learning activities were planned for the selected units of Science and Social Science. It was done by taking the previously developed integrated concepts of sustainable development as well as the textual content. The learning situations were visualized and created by posing several inquiry and problem based episodes that lead to group discussion, exploration activities, and reflection. Several pedagogical strategies that lead to constructing knowledge and analytical abilities were incorporated appropriately for transaction of content.

Planning of a unit included the scope of the unit, issues to be raised, unit questions, learning objectives, resources needed, activities that are planned and the projects if suitable to the unit.

Preparation of lesson plans

A series of lessons were planned for each selected units in which the concepts of sustainable development was integrated. The content in the lessons were organised based on the background knowledge and experiences of the students, following the principles of known to unknown and from concrete to abstract. The lesson plans were made by carefully analysing the activities that are planned earlier and consist of the Objectives, Content, Questions raised, Activities and Evaluation.

5.11.2 Phase 2: Pilot study phase

Some units from Science and Social Science syllabus of VII standard which has the integrated ESD components was tried out in Demonstration School at RIE, Mysore. Hence the try out of the material was done to study the feasibility, time taken and any other difficulties faced.

5.11.3 Phase 3: Follow-up phase

The improvement of ESD integrated materials, the appropriateness of the learning situations and experiences were done based on the feedback of the pilot study. The material was also validated by experts. Based on the opinion and
suggestions from the experts, the material was modified for the final implementation to the experimental group.

5.11.4 Phase 4: Experimentation phase

In the preliminary stage, the integrated sustainable development content, lesson plans and the necessary tools related to variables were developed for the study.

As stated earlier, this study was of quasi-experimental in nature involving pre test and post test, wherein the effects of the treatments were judged by the differences in the pre test and the post test scores. The experimental group was taught by the investigator using the integrated content of ESD in Science and Social Science. The control group was taught the original Science and Social Science content prescribed by NCERT by the regular teacher through regular methods of instruction which are usually followed by teachers in that school. The experimental and control group were equated on intelligence using the Standard Progressive Matrices.

In the Experimentation phase, there were mainly three stages;

a. Administration of pre tests
b. Experimental treatment
c. Administration of post tests

a) Administration of pre tests

The developed/adopted tools were administered as pre test for measuring intelligence, knowledge, critical thinking, problem-solving and value preference on sustainable development. The experimental and control group were equated on intelligence using the Standard Progressive Matrices. The tests were administered to the students belonging to the experimental and control group. Necessary permissions were obtained from the concerned Principals and the subject teachers of the two schools before starting the experimental treatment. Before administering the tests, the students were given necessary directions regarding the tests. After administering the above mentioned tests, it was scored on all the above said variables which served as the pre test scores of the sample students on the respective criterion measures.
b) Experimental treatment

The seventh standard students of division B studying in Chinmaya Vidyalaya, Taliparamba was selected as the experimental group and seventh standard students of division A studying in Chinmaya Vidyalaya, Payyannur was taken as the control group. In the experimental group the integrated ESD content was taught by the investigator using various inquiry approaches and social learning strategies that lead to construction of knowledge related to ESD. The control group was taught the prescribed Science and Social Science content of NCERT by the regular teacher using the regular teaching practices that included more of explanatory methods.

The lessons were taught to the experimental group for eighty four periods of 40-45 minutes duration each. The experimental treatment lasted for five months excluding the vacation and all other school holidays, term-wise examinations and other occasions during which the treatment could not be conducted. Thus the total duration of treatment worked out to be sixty three hours distributed over nearly five months. The experimental treatment was carried out during the school timings according to the time schedule, without disturbing the school schedule. Sometimes the co curricular activity periods were also made use for teaching the experimental group. The researcher also maintained a diary where the daily observations of classroom interactions and certain anecdotes were recorded regularly.

The Science and Social Science teachers of the control group were consulted regarding the duration required for teaching the selected lessons, mode of teaching and assessment that they followed in that group. The teachers who were teaching Science and Social Science in the control group were rated as effective teachers by other teachers and students. Measures were taken to consider all these factors in order to avoid experimenter bias in the study.

Some of the lessons given by the Science and Social Science teachers in the control group were observed to know the mode of transaction, whether the teacher is integrating any concepts of ESD and the strategies followed in that group to teach the selected units. The duration taken for teaching the selected units in the control group was approximately the same as that of the experimental group.
The Integrated approach to education for sustainable development was used in the experimental group for transacting selected units in Science and Social Science subjects. It was a combination of integrated concepts in ESD and also methodology to transact these concepts meaningfully. As mentioned earlier, the developed content and the lesson plans were used accordingly to transact the content. It was also taken care to see that the textual content was not taken lightly, and both the textual content and integrated content were transacted without causing an extra burden for the students of the experimental group. The teachers and experts were also observing some of the classes to verify that the content was transacted as mentioned in the developed material and also according to the lesson plans prepared previously.

The continuous and comprehensive evaluation was followed during the learning process. Tests were conducted at regular intervals to measure the learner’s progress. Worksheets were used as another mode of assessment. During the experimental study, field visits and students participation in cleaning their surroundings were also conducted. Certain anecdotes were collected through these activities. An exhibition was arranged whereby the students of the experimental group were asked to prepare some exhibits which cater for sustainable development and their explanation was also assessed. The exhibits were evaluated based on the creativity, novelty, the extent to which it caters to develop the concept of sustainable development among pupil, how well they explained their exhibits and their knowledge in the specific area. Observation technique was used to measure the participatory and performance skill of students. Science diary was maintained by each student where the activities performed by the students, the assignments given and the projects the students have done were recorded. The investigator also maintained a reflective diary to write the reflective experiences on the various learning episodes visualized and implemented.

c) Administration of post test

Immediately after the experimental treatment was completed, the subjects were administered the post tests for all the dependent variables—knowledge, critical thinking, problem-solving and value preference on sustainable development. Both
experimental and control group were subjected to these post test one by one as per the procedure. Along with this an observation schedule for participatory and performance skill was also filled in by the investigator and few teachers from the experimental school for knowing the participatory skill of the experimental group.

5.12 STATISTICAL TECHNIQUES EMPLOYED

Various statistical techniques were used to analyse the data. Descriptive statistics was used to summarise the pre test scores and the post test scores. They were inspected to determine if the sample showed departures from normal distribution. Cronbach’s alpha was used to establish internal reliability of the tool. ANCOVA, t-test, regression analysis and Pearson’s product moment correlation was employed to test various hypotheses. Percentages were used to analyse qualitative data

5.13 ANALYSIS OF DATA

For analysing the data obtained, the SPSS 11.5 version was used. The effectiveness of the integrated approach to education for sustainable development was analysed with its effectiveness on knowledge, critical thinking, problem-solving, value preference and participatory and performance skills towards sustainable development. It was also studied with respect to gender. The difference in critical thinking and problem-solving towards sustainable development was analysed with respect to high, average and low knowledge group of experimental group. Along with effectiveness, the relationship and predictors of knowledge, critical thinking, problem-solving and value preference towards sustainable development were also examined using correlation and regression techniques.
5.14 MAJOR FINDINGS OF THE STUDY

The major findings of the study has been categorized into i) findings related to knowledge, ii) findings related to critical thinking, iii) findings related to problem-solving, iv) findings related to value preference and v) findings related to the relationship among knowledge, critical thinking, problem-solving and value preference.

i) Findings related to knowledge on sustainable development

The integrated approach to education for sustainable development was effective in improving the knowledge on sustainable development (F=13.365, p<0.01) among upper primary school students when pre test on knowledge on SD and intelligence were taken as covariates.

There was no significant difference in the knowledge on sustainable development among male and female students in the experimental group (F=0.647, p>0.05) when the pre test on knowledge on SD and intelligence was taken as covariate.

ii) Findings related to critical thinking on sustainable development

The integrated approach to education for sustainable development was found to be effective in improving the critical thinking on sustainable development (F=42.258, p<0.01) among upper primary school students when the pre test on critical thinking on SD and intelligence was taken as covariates.

There was no difference in the critical thinking on sustainable development among male and female students in the experimental group (F=0.833, p>0.05) when the pre test on critical thinking on SD and intelligence was taken as covariates.

It was found that there was a significant difference in critical thinking on SD of high, average and low knowledge group of experimental group (F=24.135, p<0.01) when pre test on critical thinking and intelligence was taken as covariates. The students who have performed better in knowledge test were seen to have better critical thinking on sustainable development. It implies that students who
performed higher in Knowledge Test on Sustainable Development also had higher critical thinking on sustainable development.

**iii) Findings related to problem-solving on sustainable development**

The integrated approach to education for sustainable development was found to be more effective in improving the problem-solving on sustainable development \((F=29.281, p<0.01)\) among upper primary school students when the pre test on problem-solving and intelligence was taken as covariates.

It was found that there was no significant difference in problem-solving on sustainable development among male and female students in the experimental group \((F=0.78, p>0.05)\) when the pre test on problem-solving on SD and intelligence was taken as covariates.

There was a significant difference in problem-solving on SD of high, average and low knowledge group of experimental group \((F=10.919, p<0.01)\) when pre test on problem-solving on SD and intelligence was taken as covariates. The students who have performed better in knowledge test were seen to have better problem-solving on sustainable development. It implies that students who performed high or average on Knowledge Test on Sustainable Development also had higher problem-solving ability on sustainable development.

**iv) Findings related to value preference towards sustainable development**

There was no significant difference in the value preference of experimental and control group \((F=3.738, p>0.05)\) when pre test on value preference towards SD and intelligence was taken as covariate.

There was no significant difference in value preference on sustainable development with respect to gender in the experimental group \((F=0.194, p>0.05)\) when pre test on value preference towards SD and intelligence were taken as covariates.

When value preference on sustainable development was analysed dimension wise, it was found that the students in the experimental group had a higher preference in all the dimensions of value preference scale towards SD except for the two dimensions i.e. attaining non-violence and peace for a
sustainable society and maintaining solidarity towards environment for sustainable development.

It was found that 37.84% of students had a very good participation and performance skill to do activities that lead towards a sustainable development. Also 45.94% of the students in the experimental group had a good participation and performance skill. About 16.22% of the students in the experimental group had an average participation and performance skill. There were no students in the experimental group who belonged to either poor or very poor category.

v) Findings related to the relationship among knowledge, critical thinking, problem solving and value preference

There were a positive relationship between knowledge and critical thinking \((r=0.79, p<0.01)\); knowledge and problem-solving \((r=0.82, p<0.01)\); knowledge and value preference \((r=0.61, p<0.01)\); critical thinking and problem-solving \((r=0.83, p<0.01)\); critical thinking and value preference \((r=0.51, p<0.01)\); problem-solving and value preference towards sustainable development \((r=0.67, p<0.01)\).

Critical thinking, problem-solving and value preference are significant predictors of knowledge on sustainable development \((F=49.36, p<0.05)\). Also problem-solving on SD is found to be contributing higher towards knowledge.

Knowledge, problem-solving and value preference are significant predictors of critical thinking on sustainable development \((F=22.53, p<0.05)\). Also knowledge on SD is found to be contributing higher towards critical thinking on sustainable development.

Knowledge, critical thinking and value preference are significant predictors of problem-solving on sustainable development \((F=51.58, p<0.05)\). Also knowledge on sustainable development is found to be contributing higher towards problem-solving.

Knowledge, critical thinking and problem-solving are significant predictors of value preference on sustainable development \((F=16.55, p<0.05)\). Also problem-solving on SD is found to be contributing higher towards value preference on sustainable development.

From the above findings one may conclude that integrating ESD into the curriculum has an effect on knowledge, critical thinking and problem-solving on
ESD. Since ESD addresses issues related to environmental, economical and social dimensions, which are the need of the hour, these can be integrated in the curriculum and transacted meaningfully to bring out the desirable change in the consequence variables.

5.15 EDUCATIONAL IMPLICATIONS OF THE STUDY

1. Since the effectiveness of the intervention programme was observed, it may be used by the teachers in their classroom in order to bring out sustainability, and even the teachers can make attempts to integrate the concepts of ESD wherever possible in the existing syllabus.

2. The policy makers may attempt to integrate ESD into all school subjects so that there can be uniformity in the curriculum in order to address sustainability.

3. ESD may be integrated into the entire curriculum of all levels of education system for attaining a sustainable society.

4. Integration of ESD into the curriculum will help in developing knowledge, critical thinking and problem-solving towards sustainable development. Since ESD addresses environmental, economic and social issues, it can be integrated into the curriculum which is the need of the hour.

5. Integration of ESD and transacting it meaningfully lead towards developing skills related to sustainable development.

6. Integration of ESD into the curriculum may be done based on the local needs; hence the resources can be used judiciously keeping in mind the needs of the future.

7. ESD can be integrated into pre service and in service programmes to empower the teachers with sufficient knowledge, skills, attitudes and values towards SD; also with appropriate pedagogical and assessment procedure to transact ESD in schools in an integrated manner.

8. Environmental Education may be extended to ESD.

9. Integrating ESD can lead towards minimising pollution, protecting biodiversity, agriculture sustainability, etc.

10. Integrating ESD helps in leading an eco friendly life.
5.16 SUGGESTIONS FOR FURTHER RESEARCH

1. Similar study can be undertaken for primary, secondary and higher secondary classes in order to know the effectiveness of integrated approach to ESD.

2. Similar study can be undertaken in higher education institutions like graduate level, post graduate level and in Professional institutions like Engineering, Medicine, Teacher Training institutions, etc.

3. Since many studies have been conducted on the attitude towards Environmental Education and ESD is an emerging trend, study can be undertaken to know the attitude towards ESD.

4. Studies can be undertaken to find the attitude and values of teachers and student towards ESD

5. Studies can be undertaken to study in-depth about the values pertaining to ESD and ways to modify ones values.

6. Studies can be undertaken to find out other variables that could be predictors of critical thinking, problem-solving and values on ESD.

7. Researches can be taken up in specific areas like water management, biodiversity conservation, etc.

8. ESD can be integrated and studied with other subjects like English, regional language, Arts, Maths, etc.

9. A survey can be conducted to know the knowledge on ESD among different stakeholders.

10. Studies can be undertaken to analyse various case studies which have innovative practices on water management, energy conservation, forest conservation, etc.

11. Some of the successful and effective innovative practices pertaining to sustainable development (e.g. rainwater harvesting, making a compost pit) can be undertaken in other institutions.

12. Survey can be undertaken to study the awareness on ESD among different population.

13. Ethnographic studies can be undertaken to study the indigenous practices pertaining to sustainability among various tribal groups.
14. Documents pertaining to sustainability in various areas can be recorded and documented.

15. Studies can be undertaken to analyse how far the recommendations by various committees and commissions on ESD have been put into practice in various parts of the country. If not, a study can be conducted to find out the reasons for not practicing these recommendations.