Chapter Three
Research Design & Methodology of the Study

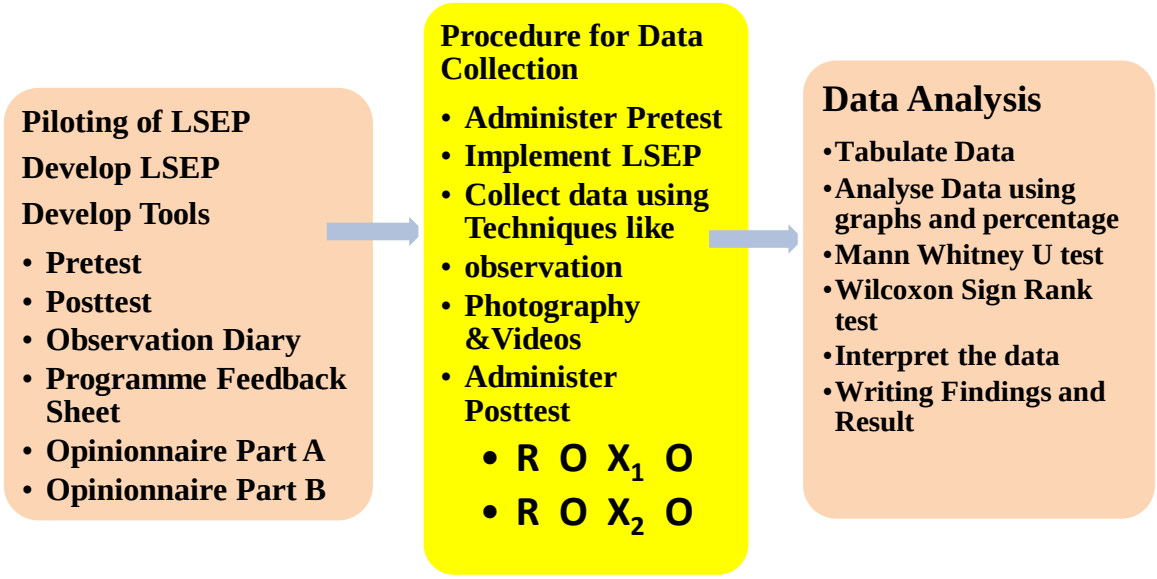
3.1 Introduction

Chapter III of the present study gives clear idea about how this study was planned and which steps were followed to conduct the planned design of the study. This chapter deals with the methodology adopted by the researcher. It includes description of participants, instruments, design of the study, procedure to collect data and data analysis done for interpretation of the results. The purpose of the present study on "Development of Life Skills through Teaching of Science" is to prepare and standardize Life Skill Education Programme and tools to study existing status of Life Skills, implement the LSEP and study its effectiveness on students of class IX of English Medium, grant-in-aid school. The data collected from the control group and experimental group were in quantitative form. The investigator adopted experimental method for collecting the data. "Development of Life Skills through Teaching of Science" is a Quasi Experimental study.

3.2 Research Design of the Study

Design of the present study was developmental and experimental that was in accordance with objectives of the study as mentioned in Chapter One. Developmental refers to development of life skills in one academic year through Life Skill Education Program (LSEP); and experimental refers to study of effectiveness of LSEP on development of life skills. To study the effectiveness of LSEP on thinking skills various tools were designed and were validated by experts. Life Skill Education Program was designed in the form of activities based on scientific concepts learnt in science class that gave scope to develop life skills like thinking skills. This LSEP was tried on the batch of 2011-12 of Jeevan Sadhana English Medium High School. After its validation by the students and experts in the field of Life Skill Education it was ready for implementation on the experimental group of class IX students of 2012-13. Data for this developmental and quasi experimental study was collected in phases as described in the Procedure for data collection (Lorraine, 1997)

Figure_3.1 Diagram of Research Design

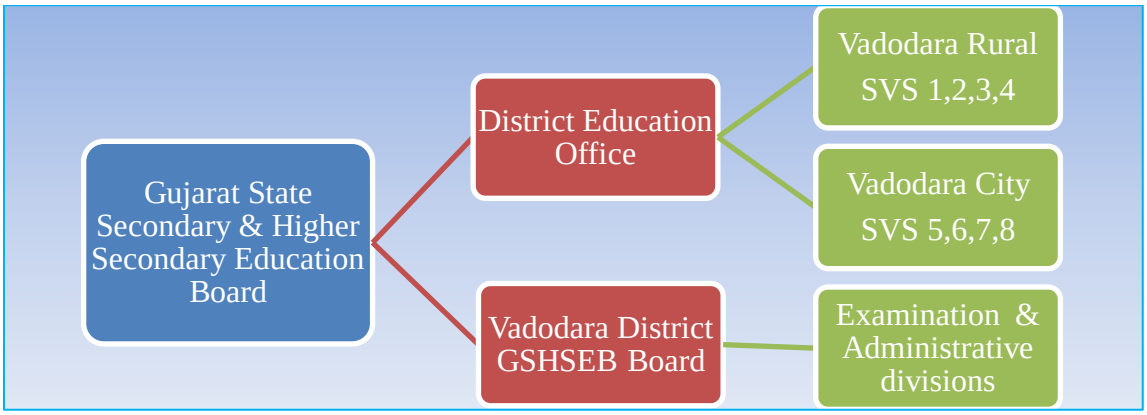


3.3 Population for the Study

All the students enrolled to class IX of Grant-in-aid Secondary schools of Vadodara district of the state of Gujarat for the academic year 2012-2013 were considered as population for the study. The state of Gujarat is located in the western part of India. It has thirty three districts. Vadodara district is positioned in central Gujarat as shown in the map towards East of Anand district. Researcher has considered class IX of English Medium schools that uses the textbooks prescribed by Gujarat State Board of Secondary and Higher Secondary Education named as "Science and Technology".

The Vadodara district of the State of Gujarat is one of the 33 districts located in central Gujarat.

Figure_3.2 Administrative Division of District Education Department in 2012



The Secondary schools in Vadodara district are distributed over EIGHT Shala Vikas Sankul. Following table shows their distribution. These schools are located in 8 directions of Vadodara district and are distributed over eight Shala Vikas Sankul.

Table_3.1 Details of SVS And Total Schools

Sr. No.	SVS no.	Name of SVS	Total no. of grant-in aid schools	Total no. of non grant-in aid schools
01	**SVS 1**	Dr. Vikram Sarabhai Shala Vikas Sankul	50	08
02	**SVS 2**	Dayaram Shala Vikas Sankul	54	08
03	**SVS 3**	Premanand Shala Vikas Sankul	45	11
04	**SVS 4**	Dr. Ambedkar Shala Vikas Sankul	56	11
05	**SVS 5**	Maharshi Arvind Shala Vikas Sankul	13	11
06	**SVS 6**	Dr. C V Raman Shala Vikas Sankul	10	15
07	**SVS 7**	Dr. Madhubhai Buch Shala Vikas Sankul	22	10
08	**SVS 8**	Sir Sayajirao Gaekwad Shala Vikas Sankul	31	34

Out of 281 Grant-in-aid schools, twenty one schools are English Medium while 260 schools have Gujarati as medium of instruction. Out of 108 non grant-in-aid schools forty two schools are English medium while sixty six schools are Gujarati Medium schools.

Table_ 3.2 English Medium Secondary schools in Vadodara City

Type of English Medium School in Vadodara City	Affiliated to GSHSEB syllabus
Grant-in-aid	21
Non Grant-in-aid	32
Total	53

(Source: Sampark Setu, 2012, District Education Office – DEO, Vadodara)

Thus the population of the study is fifty three schools affiliated to Gujarat Secondary and Higher Secondary Education Board.

3.4 Sample and Sampling Technique

The English Medium School of experimental group selected for the study falls under Grant-in-aid group that belongs to SVS: Eight 'Sir Sayajirao Gaekwad Shala Vikas Sankul'. Class IX students enrolled for the academic year 2012-2013 in Jeevan Sadhana English Medium High School located in Nagar Wada, Navi Dharti area of the city of Vadodara was selected as experimental group sample for the study. The sample comprised of sixty three students; twenty seven girls and thirty six boys initially. Three Students remained absent very often so only sixty students were considered for data collection. The English Medium School for the control group was Vidyut Board Vidhyalaya under SVS Six which is located six kilo meters away from the school selected for experimental group that could assure reliability of the tools used and Intervention Program. Sixty students of class IX-A were considered as Control group sample. The investigator adopted purposive sampling technique considering the following requirements and criteria to select the Experimental Group and the Control Group.

3.4.1 Criteria for the selection of Experimental Group

The Experimental group was selected purposively with the following criteria,

- The school management which is ready to grant permission for the whole academic year (2012-2013) to conduct pre test, post test and intervention program named as Life Skill Education Program (LSEP).
- Good infrastructure facilities available in school needed to conduct the intervention program and tests.
- The investigator has experience of teaching in the same school and had knowledge of their achievement scores of the previous years

3.4.2 Criteria for the selection of Control Group

The control group was selected purposively with the following criteria,

- The school which is ready to grant permission twice during the whole academic year (2012-2013) to conduct pre test and post test.
- Good infrastructure facilities available in school needed to conduct the tests.

- The students of control group and experimental group are found to be similar with respect to their socio-economic background, SSC board results of last five years, achievement scores of class VIII.
- They are also found to be similar with respect to diversity in culture and lingual background of students, funds supplied by the government, financial support of the managing trust, exposure given to the students.
- The schools of experimental group and control group are geographically six kilometres away from each other and both the schools have grant-in-aid structure.

3.4.3 Description of the School of Experimental Group

School management and Managing Director of Jeevan Education Trust were contacted for permission through proper channel (Appendix_3.1). On seeking the permission to conduct the study required data about the school was collected from the Principal through semi structured interview of the principal (Appendix_3.2). Jeevan Sadhana English Medium High School was established in 1956 in the area named Navi Dharti – Nagar Wada located in the eastern part of Vadodara city (Appendix_3.3) under Shala Vikas Sankul SVS-Eight. With the mission '**to educate all'** it adopted grant-in-aid structure for secondary and higher secondary sections of Gujarati and English Medium school. English Medium Secondary School was established in the same building in1975. English Medium School works in the morning while Gujarati Medium works in the afternoon shift. In 2012-2013 there were 780 students studying from Nursery to Higher secondary section of English Medium School. The school has spacious classrooms, large playground, computer room with internet connection, open air auditorium with projector and screen, and adequate toilet facilities for girls and boys, clean and cold drinking water facilities, separate classroom for each grade, three separate laboratories for chemistry, physics and biology. Each grade has only one division with average strength of sixty. All the teachers are professionally trained.

3.4.4 Description of the School of Control Group

School Principal of Vidyut Board Vidhyalaya was contacted for permission through proper channel (Appendix_3.4). On seeking permission to conduct the study required data about the school was collected from the Principal through semi structured interview

of the principal (Appendix_3.2). The Vidyut Board Vidhyalaya popularly known as GEB School (Appendix_3.5) is located on Old Padara Road in the western part of Vadodara that falls under Shala Vikas Sankul (SVS) Six. Vidyut Board Vidhyalaya is a grant-in-aid school like Jeevan Sadhana English Medium High School, where the salary of secondary and higher secondary staff is paid by the Department of Education of Gujarat State Government. The management of Vidyut Board Vidhyalaya runs primary, secondary and higher secondary sections of English as well as Gujarati Medium schools in the same building during morning session and afternoon session respectively. The school has large classrooms, big playground, well equipped auditorium, a library, a laboratory, computer laboratory with internet facility and all other basic amenities. All the teachers are professionally trained.

3.5 Sources of Data

Data were collected from students of control group and experimental group and principals of both schools by using various tools and techniques. Data pertaining to life skills were obtained from students. Data related to profile of school was collected from Principals of both schools. Data with regard to effectiveness of Life Skill Education Program were obtained from the sampled students of control group and experimental group and Principal of experimental group.

3.5.1 Tools and Techniques employed for Data Collection

To collect data related to development of life skills following tools and techniques were employed,

Tools used for data collection

1. Semi Structured Interview
2. Situation based pre test
3. Situation based post test
4. Observation Diary
5. Opinionnaire – Part A, Part B
6. Programme Feedback Sheet

Techniques for data collection

1. Observation: This technique has proved very useful in this study as the researcher has observed the sampled students as a participant observer. This technique has provided broad and deep knowledge about the students of experimental group. Keeping in mind the limitations of participant observer, researcher has noted existence and change in the status of thinking skills of each student of the sample with the help of observation diary in the initial five activities, later five activities and last five activities respectively.
2. Videography & Photography: The investigator used photography and Videography as a technique to note and observe the activities of Life Skill Education program conducted by the sampled students of experimental group. The videos assisted the investigator to note the use of indicators of various life skills by the students.

3.5.2 Tools Construction

Six tools as mentioned above were constructed by the researcher. Description of each tool is mentioned below.

3.5.2.1 Semi Structured Interview Part A and Part B

Semi structured Interview Part A was constructed for the principals of control group and experimental group to collect the data regarding profile of school and validation of pretest and posttest.

Semi structured interview Part B for both the Principals was designed to know impact of LSEP on the sample. It contained open ended questions related to pretest, posttest and effectiveness of intervention programme.

3.5.2.2 Situation Based Pre Test for each Life Skill

The study of the literature related to the Life Skills helped to list the indicators of the life skills like **critical thinking, creative thinking, decision making and problem solving skill** Vashistha (2006). The existence of life skills can be evaluated by counting certain number of indicators used by the student needed to answer the questions based on the real life situation Subasree (2010). The investigator prepared a draft of the pretests to know the existing status of life skills present in the students which was examined by the experts (Appendix_3.6) in the field of educational psychology, educational technology, and

educational administration and by research scholars of the department of Education and Psychology of the Maharaja Sayajirao University of Baroda and NUEPA. Pretest to study the existing status of each life skill in modified form is shown in (Appendix_ 3.7, 3.8, 3.9, and 3.10) Major suggestions were related to language of questions and some were related to situations. Test items showing indicators feebly were eliminated. Care was taken to evaluate existence of each indicator of each of the five indicators of thinking skills. Changes were made in the tool after suggestions from experts.

Table_3.3 Depicting changes in Pre test tool after Validation by experts

Sr. No.	Life Skills	No. of Situation			
		Before validation	Deleted after validation	Added after validation	For actual study
1	Critical Thinking	3	1	3	5
2	Creative Thinking	2	2	5	5
3	Decision Making	6	1	0	5
4	Problem Solving	4	3	4	5

3.5.2.2.1 Pre Test to study existing status of critical thinking skill

There were 33 items in this tool (Appendix_3.7). The pre test consists of the questions that are based on the situations which would need to use various indicators of the thinking skill existing in the student. The indicators of critical thinking skill are,

1) to analyze the information by identifying the components of information
2) to be able to categorize or classify the components of the information
3) to be able to challenge the assumptions behind the components of information
4) to be able to judge or evaluate the authenticity and accuracy of information
5) To be able to systematically arrange the components to arrive at conclusion.

The researcher has identified five real life situations which occur around the adolescents or they have read in the form of short stories. Multiple choice questions were framed on each situation. No choice is right or wrong, the number shown in front of each choice shows the number of indicators needed to select that particular choice. First four choices are answers pertaining to the question which are close to each other. The fifth choice is a statement that gives freedom to the student to answer the way one wants. While writing the multiple choice statements, it is ensured that one would need one to five indicators of the thinking skill to think of the answer in that particular way. If the choice selected does

not show any connection with thinking then it is assumed that no indicator of thinking skill is shown means zero indicators are used. Here it is assumed that critical thinking skill should ultimately lead the individual to classify between **facts** and **myths**, hence the last question posed to the student in this tool is about classification of given statements into facts and myths. Discussions with the researchers who have worked in the field of life skills or science education guided to modify the test to final form. Experts' (Appendix_3.6) valuable suggestions were considered and the Pretest was redesigned. The suggestions were regarding identification of the indicators of critical thinking skill from sample's answers, the thinking pattern of adolescents, evaluation of close ended and open ended multiple choice questions for each situation.

3.5.2.2.2 Pre Test to study existing status of Creative Thinking Skill

To study the existing status of creative thinking skill five different activities were given to the students. Four activities need indicators of creative thinking skill. Fifth activity has items that make them think about creative thinking skill (Appendix_3.8). The indicators of Creative thinking skill are,

1) to be able to think differently than others
2) to incorporate all aspects to generate new ideas
3) to generate more innovative ideas
4) to be confident while presenting own ideas
5) to change ways of performing task as per the requirement
6) To get bored with the monotony of work.

Discussions with the researchers who have worked in the field of life skills or science education guided to modify the test to final form. Experts' (Appendix_3.6) valuable suggestions were considered and the Pretest was redesigned. The suggestions were regarding identification of the indicators of creative thinking skill from sample's creative work, the thinking pattern of adolescents, evaluation of close ended and open ended multiple choice questions for each situation.

3.5.2.2.3 Pre Test to study existing status of Decision Making Skill

"By teaching young people how to think rather than what to think, by providing them with the situations or experiences for solving problems and making decisions by

engaging them in participative methodologies, skills development can become a means of empowerment" NCERT (2005). Science education is not only for its application to make human life easy and comfortable but to adopt scientific attitude while facing any situation in our life that helps one to take right decision. The indicators of decision making skill are,

1) a person should be able to list relevant choices
2) to identify potential consequences of each choice
3) to assess the likelihood of each consequence actually occurring
4) to determine the importance of these consequences
5) to combine all this information to decide which choice is the most appropriate

This tool has Twenty Five items (Appendix_3.9). To study the existing status of Decision Making Skill five situations from adolescent's life were identified and five questions were framed for each situation. The researcher has identified such situations in their life where they have to choose between **bad-desirable** or **good-undesirable**. While framing questions and statements of multiple choices, care has been taken to see that the process of attempting the test itself will make the students think about their own thinking process. Discussions with the researchers who have worked in the field of life skills or science education guided to modify the test to final form. Experts' (Appendix_3.6) valuable suggestions were considered and the Pretest was redesigned. The suggestions were regarding identification of the indicators of decision making skill from sample's answers, the thinking pattern of adolescents, evaluation of close ended and open ended multiple choice questions for each situation.

3.5.2.2.4 Pre Test to study existing status of Problem Solving Skill

Life Skills like Critical thinking, Creative thinking, Decision making and Problem Solving skill are necessary for adolescents to actively participate in their own process of development and the process of constructing social norms" Mangrulkar (2001). Vashistha (2006) defined the problem solving skill as the process of understanding a problem and coming out with a solution. Helaiya (2010) listed the indicators of problem solving skill as,

1) to be able to recognize that the problem exists and problem solving process is a worthwhile experience

2) to define the problem i.e. to think about how the current situation is different than what it ought to be
3) to think of as many possible alternatives as one can, even if some of them may seem to be unrealistic
4) to verify the result of the solution
5) To verify the process attempted to solve the problem.

There are twenty five items in this tool (Appendix_3.10). The researcher has put five situations before the sampled students which appear as problems in their school life. Discussions with the researchers who have worked in the field of life skills or science education guided to modify the test to final form. Experts' (Appendix_3.6) valuable suggestions were considered and the Pretest was redesigned. The suggestions were regarding identification of the indicators of problem solving skill from sample's answers, the thinking pattern of adolescents, evaluation of close ended and open ended multiple choice questions for each situation.

3.5.2.3 Situation Based Posttest

To study the effect of intervention program on the thinking skills of the sample, a rough form of **Posttest** equivalent or parallel to the Pretest was designed for critical thinking (Appendix_3.7), creative thinking (Appendix_3.8), decision making (Appendix_3.9) and problem solving (Appendix_3.10). Each of these tools had twenty five items. Expert's valuable suggestions were considered and the Posttest was redesigned. The suggestions were regarding the design of situations based on the concepts of science, evaluation of thinking skills after treatment, expected thinking pattern of adolescents after treatment, marking of close ended multiple choice questions and evaluation of items in the tool for creative thinking skill. The final form of Posttest to study the existing status of thinking skills like critical thinking, creative thinking, decision making and problem solving skill was used (Appendix_3.7 to 3.10). To make each tool of post test five situations were designed that occur in adolescent's life and demands the use of thinking skills to face the situations. These situations were parallel to the situations framed for pretest Helaiya (2010).

3.5.2.3.1 Post test to study existing status of critical thinking skill

There are thirty eight questions in this tool (Appendix_3.11). The post test consists of the questions that are based on the situation which would need to use various indicators of critical thinking skill existing in the student. The indicators of critical thinking skill are to analyze the information by identifying the components of information, to be able to categorize or classify the components of the information, to be able to challenge the assumptions behind the components of information, to be able to judge or evaluate the authenticity and accuracy of information and to be able to systematically arrange the components to arrive at conclusion. The researcher has identified five real life situations which occur around the adolescents or they have read/ seen in the form of short stories. Multiple choice questions were framed on each situation. Each question has five choices. No choice is right or wrong, the number shown in front of each choice shows the number of indicators needed to select that particular choice. First four choices are answers pertaining to the question which are close to each other. Fifth choice is open ended statement that gives freedom to write whatever they think. While writing the multiple choice statements, it is ensured that one would need none or some indicators of the thinking skill to think of the answer in that particular way. If the choice selected does not show any connection with thinking then it is assumed that no indicator of thinking skill is shown means zero indicators are used. Here it is assumed that critical thinking skill should ultimately lead the individual to classify between **Dos** and **Don'ts**, hence the last question posed to the student in this tool is about classification of given statements into dos and don'ts. After learning concepts of health and diseases it is assumed that students can classify between healthy, healthier and economical food habits. Discussions with the researchers who have worked in the field of life skills or science education guided to modify the test to final form. Experts' (Appendix_3.6) valuable suggestions were considered and the Post test was redesigned. The suggestions were regarding identification of the indicators of critical thinking skill from sample's answers, the thinking pattern of adolescents, evaluation of close ended and open ended multiple choice questions for each situation.

3.5.2.3.2 Post Test to study existing status of Creative Thinking Skill

This tool has five activities to be performed by the students using their own creativity. At the end of five activities five questions are posed to study the existence of indicators of creative thinking skill (Appendix_3.12). The activities of post test are based on the scientific concepts like balanced diet for good health, green house effect, energy pyramids in biosphere, sustainable development and food chain. The indicators of Creative thinking skill are to be able to think differently than others, to incorporate all aspects to generate new ideas, to generate more innovative ideas, to be confident while presenting own ideas, to change ways of performing task as per the requirement and to get bored with the monotony of work. Discussions with the researchers who have worked in the field of life skills or science education guided to modify the test to final form. Experts' (Appendix_3.6) valuable suggestions were considered and the Post test was redesigned. The suggestions were regarding identification of the indicators of creative thinking skill from sample's creative work, the thinking pattern of adolescents, evaluation of close ended and open ended multiple choice questions for each situation.

3.5.2.3.3 Post Test to study existing status of Decision Making Skill

This tool has twenty five items (Appendix_3.13). To study the existing status of Decision Making Skill five situations from adolescent's life were identified and five questions were framed for each situation. The researcher has identified such situations in their life where they have to take decision based on scientific knowledge they have gained. While framing questions and statements of multiple choices, care has been taken to see that the process of attempting the test itself will make the students think about their own thinking process. Discussions with the researchers who have worked in the field of life skills or science education guided to modify the test to final form. Experts' (Appendix_3.6) valuable suggestions were considered and the Posttest was redesigned. The suggestions were regarding identification of the indicators of decision making skill from sample's answers, the thinking pattern of adolescents, evaluation of close ended and open ended multiple choice questions for each situation.

3.5.2.3.4 Post test to study existing status of Problem Solving Skill

There are twenty five items in this tool (Appendix_3.14). The researcher has put five situations before the sampled students which appear as problems in their school life. Discussions with the researchers who have worked in the field of life skills or science education guided to modify the test to final form. Experts' (Appendix_3.6) valuable suggestions were considered and the Post test was redesigned. The suggestions were regarding identification of the indicators of problem solving skill from sample's answers, the thinking pattern of adolescents, evaluation of multiple choice questions for each situation.

3.5.2.4 Construction of Observation Diary

In this study of development of life skills was tried through implementation of LSEP. The Life Skill Education programme was implemented as per the observation schedule shown in (Appendix_3.15). It is a timetable that guided to follow the time schedule to conduct and observe the process of development of life skills during the implementation of Life Skill Education Programme. The investigator observed the use and exhibition of the indicators of thinking skills during the presentation of activities by the sampled students as a participant observer and noted them in observation diary (Appendix_3.16) is a book of tables that was used to note the skills exhibited by the students/team of students during the implementation of LSE programme in first semester that was conducted before Diwali and in second semester that was conducted after Diwali vacation. Sample of the page in observation diary is shown below. Each team of seven students performed activities assigned to them. In all nine teams of experimental group performed activities. The researcher has carried the process of evaluation and noted indicators of life skill exhibited by each student with colored dots while observing the presentation of activities as a participant observer. The sample of observation diary is shown here. The colour code was decided for each thinking skill. The coloured dots used to recognise existence of thinking skill in each student of experimental group during participant observation method are shown below.

Table_3.4 Sample page of Observation Diary

Critical Thinking (RED)  Creative Thinking (BLUE) 

Decision Making (YELLOW)  Problem Solving (BLACK) 

Roll.No.	**Date 28-07-12**	**Name of Team**	**Name of the Students**	**Indicators of Life Skill Observed**
55	**Activity** Drama: Distance & Displacement	**Pluto**	Shahne Janhavi	CT_1  CR T_1 
56			Shaikh Ayesha	CRT_2  PB_1 
57			Shaikh Iqraa	 
58			Shaikh Kareena	DM_1  CR_3 
60			Solanki Hemangi	CRT_1  PB_1 
61			Surtani Avi	DM_2  CR_1 
63			Shah Janvi	CR_2 

3.5.2.5 Construction of Opinionnaire

Opinionnaire Part A Appendix_ (3.18) and Opinionnaire Part B Appendix_ (3.19) are documents showing opinion of experimental group students. The tool Opinionnaire for students shows their liking towards the activity of LSEP. This data sheet asked students liking about the activities that were conducted during academic year 2012-2013 under the Life Skill Education Programme. Each student of the experimental group was given a separate sheet to opine about fifteen activities.

Opinionnaire Part B Appendix_ (3.19) is a tool to collect the data related to sample's free and frank opinion for improvement in the instructional processes of '**Science teaching'** through assigned activities. Keeping characters of adolescents in mind close ended questions were framed to know their feedback. They were supposed to choose any one level of difficulty; very easy, easy, difficult, very difficult, extremely difficult before the space given for opinion. The students of experimental group were also asked to choose suggestion related to the activity to improve it further that was given at the end of the sheet.

3.5.2.6 Construction of Programme Feedback Sheet

Programme Feedback Sheet (Appendix_3.20) for school Principal and teachers was designed to know their opinion about the scope of activities of LSEP to develop critical thinking, creative thinking, problem solving and decision making skills in the students during implementation of Life Skill Education Programme. They were also asked whether students had fun during presentation of activities of LSEP.

Each of the above mentioned tools will check for the indicators of thinking skills as shown in the summary of tools shown below.

Table_3.5 Tools for the study

Sr. No	Tools for Data	Data collected / Indicators of life skills to be checked
1	Semi Structured Interview for principals Part A	School Profile, validation of pretest, posttest
2	Semi Structured Interview for principals Part B	Opinion about conduction of tests and implementation of LSEP
3	Pretest / Posttest for Critical Thinking	➢ **CT_1** = Identify component of information ➢ **CT_2** = Classify components ➢ **CT_3** = Challenge assumptions ➢ **CT_4** = Evaluate accuracy of information ➢ **CT_5** = Arrange components to arrive at conclusion
4	Pretest / Posttest for Creative Thinking	➢ CRT 1 = Think differently than others ➢ CRT 2 = Include all aspects to generate new idea ➢ CRT 3 = Generate innovative idea ➢ CRT 4 = Confident while presenting ➢ CRT 5 = Change ways of performing task ➢ CRT 6 = Get bored with monotony
5	Pretest / Posttest for Decision Making	➢ DM 1 = List relevant choices ➢ DM 2 = Identify their consequences ➢ DM 3 = Assess likelihood of occurrence of consequence ➢ DM 4 = Determine importance of these consequences ➢ DM 5 = Decide most appropriate choice
6	Pretest / Posttest for Problem Solving	➢ PBS 1 = Recognise that problem exists ➢ PBS 2 = Define the problem ➢ PBS 3 = Think of possible alternatives ➢ PBS 4 = Verify the result of the solution ➢ PBS 5 = Verify the process attempted to solve the problem

7	Observation Diary	All the above indicators exhibited during implementation by each student of the team
8	Opinionnaire Part A	Students' opinion about Liking towards activities of LSEP
9	Opinionnaire Part B	Students' opinion about ease of doing activities of LSEP
10	Programme Feedback Sheet	Teachers' opinion about development of Life Skills through LSEP

All the above mentioned tools were validated by experts in the field of education and psychology. Reliability of pretests and posttests were checked using Cronbach's Alpha (SPSS) that valued as 0.65 for 25 items in each tool. This value has proved that these tools for data collection, designed by the researcher are reliable and sample selected is representative of the population.

3.6 Principles followed while constructing tests

3.6.1 Principles followed while constructing Pretest

- Prior to construction of the situation based pre-test researcher carefully reviewed the existing research literature, as well as all the related instruments that have already been used by other researchers on development of life skills like Pujar et al. (2012), Helaiya (2010) and Subasree (2010).
- The situations framed in the test are generally experienced by the adolescent of class IX or he/she has seen it happening around with his/her elder or younger sibling/friend.
- While framing the statements of multiple choice questions and answers the intellectual, physical, social and emotional characteristics and needs of adolescents are considered Edlin (2011).
- Questions with ambiguity were avoided.
- Care is taken to see that the language of the situations and questions is lucid for students and unnecessary jargon or technical terms were avoided Subasree, (2010).
- Investigator followed ordering of items in the tool. Easy items are kept first so that students get motivated to answer.
- Principles such as relevance, clarity of test items, were strictly adhered to in order to establish congruence with the background of adolescents studying in grant-in-aid schools as judged by the researchers during review of related literature.

- Though some of the skills are inter-linked, care was exercised to include the test items closely related to each of the dimensions being measured and also to avoid duplication of test items in the other dimensions Subasree (2010).

3.6.2 Principles followed while constructing post test

To design and develop post tests principles similar to pre test were used with little difference,

- The situations in post test were based on the scientific concepts involved in the activities of Life Skill Education Program (LSEP) with the assumption that students have understood the scientific concepts focused during implementation of LSEP and they have imbibed certain indicators of thinking skill while doing LSEP activities. Those indicators would be exhibited through answers they choose to address the real life problems posed before them.
- The situations framed in the test are generally experienced by the adolescent of class IX or he/she has seen it happening around with his/her elder or younger sibling/friend.
- The language of situations, questions and multiple choice options is easily understandable to the class IX Student. Care was taken to see that the language of it is lucid for students and unnecessary jargon or technical terms were avoided.
- While framing the statements of multiple choice questions and answers the intellectual, physical, social and emotional characteristics and needs of adolescents are considered.
- Questions with ambiguity were avoided.
- Investigator followed ordering of items in the tool. Easy items are kept first so that students get motivated to answer.
- While framing questions it is kept in mind that no choice selected by the students should be judged as right/wrong, only number of indicators needed to select that choice should be observed. Indicators needed for thinking of each statement is pre decided by the investigator.
- Any kind of prejudice or bias towards any gender or community is avoided.

Following table shows changes made in the posttest after validation by experts. Experts suggested that maximum number of Indicators should be used by the students while answering close ended questions based on the situations.

Table_3.6 Depicting changes in Pre test tool after Validation by experts

Sr. No.	Life Skills	No. of situations before validation	No. of situations deleted after validation	No. of situations added after validation	Total number of situations for actual study
1	Critical Thinking	3	1	3	5
2	Creative Thinking	2	2	5	5
3	Decision Making	6	1	0	5
4	Problem Solving	4	3	4	5

3.7 Data Collection

The process of data collection began from beginning of July 2012 and it continued till end of March 2013, for experimental and control group.

- Data related to school profile and opinion about pretest, post test tools, LSEP programme were collected from principals of both schools
- The researcher used pretest initially to gather data related to existing status of Life Skills before intervention
- Collected data related to status of life skills being developed during implementation of LSEP by using participant observation technique and Observation Diary
- Data of existing status of life skills were again collected after the implementation of LSEP using posttest
- Opinions of Students about liking or disliking were collected from students through Opinionnaire -- Part A that helped to know their choice of preference of activity.
- Opinions of students of experimental group related to level of difficulty of the activities in LSEP were collected through Opinionnaire -- Part B
- Feedback related to the LSEP programme was collected from teachers of experimental group, Principals of Experimental School and Control group School through Programme Feedback Sheet.

3.7.1 Procedure followed for Data Collection

The investigator personally collected data in phases as mentioned in the procedure of data collection.

Table_3.7 Phases of Procedure of Data Collection

Phase I	**Study of existing status of life skills before Implementation of Intervention Programme**
Phase II	**Development and Implementation of Intervention Programme**
Phase III	**Study of existing status of life skills after the Implementation of Intervention Programme**

3.7.1.1 Phase I: Study of existing status of life skills before LSEP

In this phase, to know the Existing Status of Life Skills before Implementation of Life Skill Education Programme was conducted by administering Pre tests to the students of control group and experimental group.

3.7.1.2 Administration of Situation based Pre Test for Students

Situation based pre test was administered to the students of class IX of control group and experimental group. Suitable days and periods/classes were chosen in the month of July to conduct four pre tests for experimental group in Jeevan Sadhana English Medium High School. After discussion with Vidyut Board Vidhyalaya School principal two days were assigned to the researcher to conduct four pre tests. Administration of each test required two periods of 35 minutes each. Pre test score was collected for control group and experimental group. The table shows its time schedule. The investigator allotted one hour and ten minutes (2 periods=70 min) for each part of the pretest. The status of existence of two life skills was tested in one day. Thus within two days of month of July the Pre test was conducted for experimental group and within two days for control group. Totally it took 4 days to collect data for both the groups. To study existing status of control group and experimental group before intervention programme T_1 and T_2 of 70 minutes per test for one group was conducted. This process was repeated in the next week for test T_3 and T_4. (T_1 = Test for Critical Thinking, T_2= Test for Creative Thinking, T_3= Test for Decision Making, T_4= Test for Problem Solving Skill)

Table_3.8 Schedule for administration of Pre-test

Sr. No.	Sampled Group	Name of Pretest	Date	Time
1	Experimental	$Pr.T._1$&$Pr.T._2$	13-07-12	70 minutes
2	Experimental	$Pr.T._3$ &$Pr.T._4$	14-07-12	70 minutes
3	Control	$Pr.T._1$&$Pr.T._2$	20-07-12	70 minutes
4	Control	$Pr.T._3$&$Pr.T._4$	21-07-12	70 minutes

3.7.2 Phase II: Development and Implementation of LSEP

In this phase intervention programme termed as **Life Skill Education Programme** (LSEP) was developed on the basis of feedback obtained after piloting of LSEP on the batch of Class IX in the academic year of 2011-2012. It was developed for teaching topics of Science included in the Class IX textbook named as 'Science and Technology' recommended by Gujarat State Board of Secondary and Higher Secondary Education, Gandhinagar. This was implemented after making final draft and validation by experts.

3.7.2.1 Development of Intervention Programme

According to Subasree (2010) activity Based Life Skill Education Programme should be developed by the researcher by considering the nature of science, characteristics and needs of adolescents and the principles of experiential learning related to it (Appendix_3.17). Following points are kept in mind while designing the Life Skill Education programme.

- Adolescence is a stage of life when anxiety, curiosity and energy are at its peak. The adolescents need continuous physical, mental activity and acceptance by peer group. Team activities give them an opportunity to be together, think together and present together. The activities based on the concepts of science prescribed in their textbook should give them a chance to explore more about the concept to be learnt.
- Nature of Science is such that it is the product of enquiry for knowledge as well as the process of constructing knowledge. Scientific way of thinking when adopted to address real life problem develops scientific attitude.
- Principles of Experiential Learning are Intention, Preparedness, Planning, Authenticity, Reflection, Orientation and Training, Monitoring and Continuous Improvement, Assessment-Evaluation and Acknowledgment (www.nsee.org)

- Characteristics of Experiential Learning described by Burnard (1989) are action, reflection, phenomenological understanding, subjective human experience, firsthand experience as a source of learning.
- According to Ramesh, (2014), experiential learning programmes should have attributes like student based rather than teacher based, the process of learning should be important not the product (definitions, laws etc.).
- LSEP should be based on principles of experiential learning like holistic understanding, organized around experiences. Activity should be perception based, not theory based. There should be individual learning within the group (Joplin, 1981).
- The contents which have maximum scope for development of Life Skills were selected from the Gujarat state board text book named 'Science and Technology' of class IX in consultation with the subject experts. The Life Skill Education Programme was designed for each topic of the chosen content.
- The order of topics for LSE activities is in accordance with the topics prescribed by the state board in Semester One and Semester Two textbooks of the subject named 'Science and Technology'.
- Care has been taken to design the activity that gives scope to the student to think and use indicators of thinking skills considered for present study.
- While preparing and presenting the activity student would need to use science process skills like observation, classification, number relations, measurement, space-time relations, communication, prediction, inference, making operational definitions, formulating a hypothesis, interpreting data, identifying and controlling variables, experimenting and concluding Sharma (2006).
- While designing the activities wastage of material resources and time are avoided.
- Monotony in performance of the activity is avoided.
- Ease of conduction and evaluation of these activities in terms of thinking skill are considered. Table_3.6 shows changes suggested by experts in LSEP during validation.
- Piloting of Life Skill Education Programme was done before finalising it. Initial draft of Life Skill Education Programme (Table_4.1) was made and tried on students of class IX of 2011-2012; details of which are mentioned in chapter IV.

All the activities were discussed with the students of experimental group before implementation and some activities were changed or canceled as per their wish. Initially seventeen activities were designed by the researcher, later activity on Wave Motion and Chemical Reactions was canceled due to lack of time in the second semester. Activity thirteen of 'Make my zoo / Aquarium' was modified to **Mime** due to lack of feasibility as suggested by the students of experimental group. Final form of **Life Skill Education Programme** (see Appendix_3.17), that has in all fifteen topics of science. First, second and third activities have two sub activities which are related to the same concept focused. Most of the activities are to be done in group, except a few. In all there are Eighteen Activities. Details of each activity are mentioned under the column of 'Activity' with Instructions that were provided to each group. Requirements for each activity are mentioned in its column with time needed. Most of the activities were presented in the group while few were presented individually (Appendix_3.17).

Table_ 3.9 Total No. of items in each Life Skills before and after the validation

Sr. No.	Type of Life Skill based Activities for	No. of activities before validation	No. of activities deleted after validation	No. of activities added after validation	Total number of activities for actual study
1	Critical Thinking	7	1	7	13
2	Creative Thinking	5	2	6	9
3	Decision Making	6	1	5	10
4	Problem Solving	17	4	1	14

3.7.2.2 Implementation of Intervention Programme LSEP

The pre-designed final draft of Life Skill Education Programme (Appendix_3.17) was implemented to the experimental group from 15-07-2012 to 20-03-2013. Following table shows schedule for implementation of LSEP. LSEP was conducted totally for 2100 minutes of 28 working days spread over the span of 9 months of academic year of 2012-2013. Table_3.7 describes dates and time of conduction of activities.

Table_3.10 Schedule for Implementation of LSEP

Sr. No.	Name of Activity	Date	Time in Minutes
1	Drama	28-7-12, 30-7-12	70 minutes each class
2	Play with Toy- drama	3-8-12, 4-8-12	70 minutes each class
3	Investigation Health Museum	25-8-12,	120 minutes
4	Health Survey	25-8-12	120 minutes
5	Make a toy – Catch the fly	6-8-12	70 minutes each class
6	Make a toy- Boat	6-8-12	70 minutes
7	Seminar (PPT / Chart)	17-8-12, 23-8-12	70 minutes each class
8	Seminar with Model	30-8-12	70 minutes
9	Investigation- Gravity	28-9-12, 29-9-12	70 minutes each class
10	Seminar- PPT Effect of pollution on plant/animal tissues	15-9-12,17-9-12 22-9-12	70 minutes each class
11	Skit on Rutherford's Gold Foil Experiment	25-9-12 26-9-12	45 minute 70 minutes
12	Investigation - Electric bill	7-11-12, 8-11-12	70 minutes each class
13	Make Green Niche	3-12-12, 4-12-12	45 minutes each class
14	Make Crystal Garden	4-3-13, 5-3-13	70 minutes each class
15	Identify Me – Role Play	5-1-13, 7-1-13	70 minutes each class
16	Mime Identify the Class	30-1-13, 31-1-13	105 minutes each class
17	Project Grandma	20-2-13	45 minutes
18	Project Grandpa	23-3-13	70 minutes

3.7.3 Phase III: Study of existing status of life skills after the Implementation of Intervention Programme

To know the status of life skills of the sample after implementation of LSEP, posttest that was designed earlier was then administered in the class of experimental group as well as control group.

3.7.3.1 Administration of Post tests

Post test that was designed parallel to pretest was administered to sample with prior permission of both school principals.

Table_3.11: Schedule for administration of Posttest

Sr. No.	Sampled Group	Name of Post test	Date	Time
1	Experimental	$Post.T._1$&$Pr.T._2$	16-03-13	70 minutes
2	Experimental	$Post.T._3$ &$Pr.T._4$	18-03-13	70 minutes
3	Control	$Post.T._1$&$Pr.T._2$	20-03-13	70 minutes
4	Control	$Post.T._3$&$Pr.T._4$	21-03-13	70 minutes

Table 3.8 shows the schedule for posttest. Data collection Schedule for posttest was prepared that was conducted after implementation of LSEP in the month of March 2013.

3.8 Data Analysis

In present study, data were collected quantitatively by situation based pretest and posttest for experimental group as well as control group. Tools for data collection were designed according to the objectives of the study; data were collected phase wise as described in the procedure for data collection. Data related to indicators of critical thinking skill, creative thinking skill, problem solving and decision making skill were analysed using quantitative methods. Researcher has shown detailed procedure followed for evaluation of pretest and posttest tools. While conducting the intervention programme known as Life Skill Education Programme, indicators of life skills were noted through participant observation. Initially total numbers of indicators (Table_4.2) of each type of thinking skill were calculated for each activity as shown in sample page of Observation Diary, (Appendix_3.17). Later indicators for each thinking skill that were observed during presentation of activities were tabulated in (Table_4.3, 4.4, 4.5 and 4.6). This tabular data were further used to calculate percentage wise Performance of Students in Critical thinking Skill, Creative Thinking Skill, Decision Making Skill and Problem Solving Skill at the beginning stage, developing stage and accomplished stage.

To analyze the data collected through pretest and posttest, evaluation of test was done thoroughly and indicators of each of thinking skill for each student of the control group and experimental group were calculated. Data were collected for the purposive sample. The data were found to be approximately normal but not perfectly normal hence non parametric tests like Mann Whitney U test and Wilcoxon Signed Rank tests were used. To study significant difference between the pretest and posttest of the same sample **Wilcoxon Signed Rank test** of significance was used. To study significant difference between the pre-test of experimental group and pretest of control group or posttest of experimental versus posttest of control group, Mann Whitney U test is used. Data is interpreted according to the implications of the theory related to '**Mann Whitney U test'** and '**Wilcoxon Signed Rank test**'. Software tool of SPSS 20 was used to find the effective.