Chapter Six

Summary and Implications

6.1 Introduction

Adolescence is very crucial stage in the development of human beings. Secondary school adolescents at this stage have to be guided at home, school and in the society. In the school they can be guided through the curriculum of different subjects. In secondary school much importance is given to the subject science, which has dual nature. It is a body of knowledge as well as it is seen as a process of thinking. The learning of the subject science should be developing critical thinking, problem solving, creative thinking and decision making in the students of secondary stage which are in the transitional stage of growth and soon will be entering the world of work. Through science education which is activity based it is possible develop core life skills like thinking skills and direct them towards better and happy life. Position paper on 'Teaching of science' by NCERT (2006) at various stages states the purpose of teaching science at secondary stage categorically. At the secondary stage the students should be engaged in learning science as a composite discipline, in working with hands and tools to design more advanced technological modules than at the upper primary stage, and in activities and analysis on issues surrounding environment and health. The position paper by National Focus Group on Science Teaching shows emphasis on systematic experimentation as a tool to discover/verify theoretical principles, and working on locally significant projects involving science and technology as important parts of the curriculum at this stage. Training in the scientific method, inculcation of scientific attitude is needed today especially to meet the challenges posed in daily life of the adolescent due to the characteristics of adolescence, fierce competition, market economy and rapidly changing world. "People today are faced with fast-changing world where the most important skills are flexibility in adapting to new demands of society and creativity in taking advantage of new opportunities. Teaching of science and technology can develop such skills" NCERT (2005). Siraj (2014) has reported about the development of life skills in schools at Bhubaneswar. Education programme in Bhubaneswar supported by United Nations Fund for Population Activities (UNFPA) aims at developing skills of students to tackle various problems in life. Training for teachers, principals and district education officers in

developing life skills is recommended by the observer of UNFPA. The Central Board of Secondary Education (CBSE) of India and the State Board of Secondary Education of Gujarat (GSEB) has introduced continuous and comprehensive evaluation system in secondary schools with the emphasis on life skills and value education. Gujarat Secondary and higher Secondary Board of Education (GSHSEB) have imparted training to the secondary school teachers across the state in the area of Life Skill Education with the help of Gujarat Council of Educational Research and Training (GCERT). The activities that are to be assigned or to be conducted with students for formative assessment by the subject teachers can be designed in such a way that gives scope to develop life skills. Rather well designed Life Skill Education Programme based on the concepts in the curriculum of the subject can help the subject teachers to evaluate the students for formative assessment too. Nature of science invokes abilities like proposing problems, defining the problem, thinking of many solutions, setting up hypotheses and their testing with controlled experiment, rethinking of new solution, discarding personal opinion in the light of new evidence and suspending judgment in case of conflicting evidence, challenging the principle of authority if needed thus distinguishing between scientific information and popular information in students while teaching the subject science. Comparing the skills to be developed through teaching of science with the indicators of skills of critical thinking, creative thinking, problem solving and decision making it can be concluded that development of life skills through teaching of science is possible and easy. Experiential Learning method and its principles can be used to design the activities Ramesh, (2014). Using integrated approach to develop life skills through teaching of science was found most appropriate by the researcher before conducting the present study. On referring literature related to life skills, teaching of science, nature of adolescents various questions arose in the mind of the investigator. They are framed in the form of Research Questions as stated below.

6.2 Title of the study

Development of Life Skills through teaching of science

6.3 Objectives of the study

5. To develop Life Skill Education Programme for the students of class IX of English Medium High School.
6. To implement the developed Life Skill Education programme.
7. To study the effectiveness of the Life Skill Education programme on students of class IX of English Medium High School in terms of the differences with respect to,
   A. Critical thinking skill. B. Creative thinking skill
   D. Decision making skill D. Problem solving skill.
8. To study the effectiveness of Life Skill Education Program in terms of Students' response at the end of each activity of Life Skill Education Programme.

6.4 Hypotheses

The present study involves five variables; four dependent and one independent variable. The score of the indicators of critical thinking skill, creative thinking skill, decision making skill, problem solving skill and students' response to the Life Skill Education Program are dependent variables while the treatment given through Life Skill Education Program is the independent variable. To achieve the above mentioned objectives following null hypotheses were framed to study the effectiveness of the Life Skill Education Program designed by the researcher.

H01: There will be no significant difference in the mean scores of indicators of Critical Thinking Skills of the students in pretest and post test with respect to the treatment given through LSEP to Experimental Group

H02: There will be no significant difference in the mean scores of indicators of Creative Thinking Skills of the students in pretest and post test with respect to the treatment given through LSEP to Experimental Group

H03: There will be no significant difference in the mean scores of indicators of Decision Making Skills of the students in pre test and post test with respect to the treatment given through LSEP to Experimental Group

H04: There will be no significant difference in the mean scores of Problem Solving Skills of the students in pretest and posttest with respect to the treatment given through LSEP to Experimental Group

H05: There will be no significant difference in the gain scores of the critical thinking skills of students of the experimental group to that of control group.

H06: There will be no significant difference in the gain scores of the creative thinking skills of the experimental group to that of control group.

H07: There will be no significant difference in the gain scores of the Decision making skill of the experimental group to that of control group.

H08: There will be no significant difference in the gain scores of the problem solving skill of the experimental group to that of control group.

H09: There will be no significant difference in the mean post test scores of Critical thinking skills of the students between experimental group and control group.

H10: There will be no significant difference in the mean post test scores of Creative thinking skills of the students between experimental group and control group.

H11: There will be no significant difference in the mean post test scores of Decision Making Skills of the students between experimental group and control group.

H12: There will be no significant difference in the mean post test scores of Problem Solving Skills of the students between experimental group and control group.

6.5 Operational Definition of the Terms

Effectiveness of the Life Skill Education Programme:

Effectiveness for the present study was seen comprehensively as indicated below.

This includes both quantitative and qualitative dimensions:

- The difference between the mean scores of indicators of Critical Thinking, Creative Thinking, Decision Making and Problem solving Skills of the students in pretest and post test with respect to the treatment given through LSEP to Experimental Group.
- The difference between the gain scores of the Critical Thinking, Creative Thinking, Decision Making and Problem solving Skills of students of the experimental group to that of control group.
- The difference between the mean post test scores of Critical thinking, Creative Thinking, Decision Making and Problem solving Skills of the students between experimental group and control group.
- Students' feedback and ranking of each of the activity and their opinion after the implementation of programme.

6.5.1 Delimitation of the study

- The study was delimited to the selected contents from the Gujarat State Board Textbook of class IX named 'Science and Technology' of the secondary school.
- It was delimited to the development of few life skills like critical thinking, creative thinking, decision making, problem solving.

6.5.2 Limitation of the study

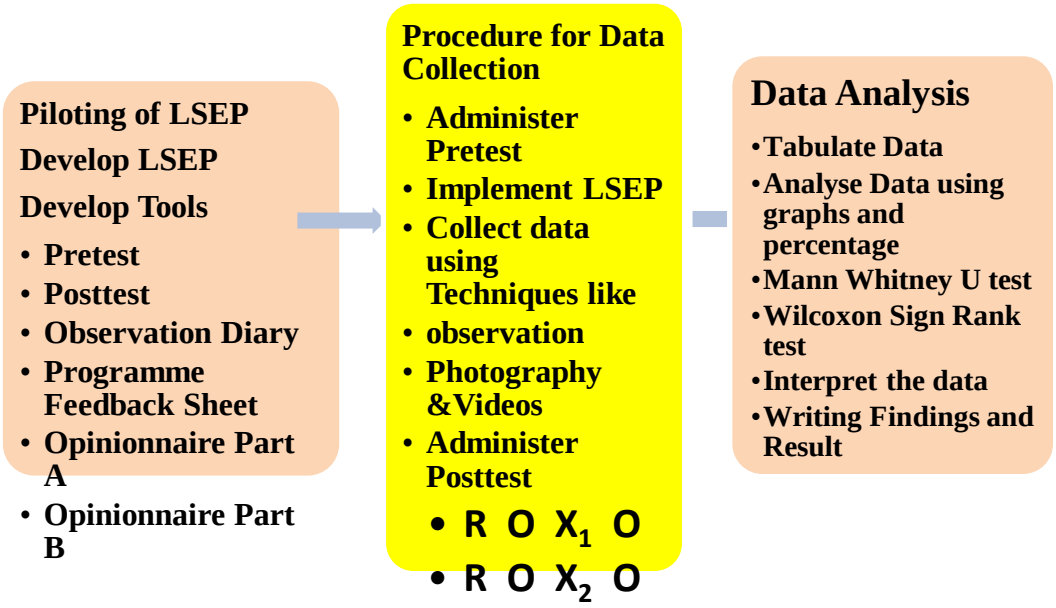
The study was limited to develop life skills like thinking skills mentioned earlier. However it was not intended to find its effectiveness related to science process skills or achievement scores of understanding of content, which should be science teacher's primary goal.

6.6 Methodology

6.6.1 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 (page_31). 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 (Gay, L. R. 1997)

Figure_6.1 Diagram of Research Design

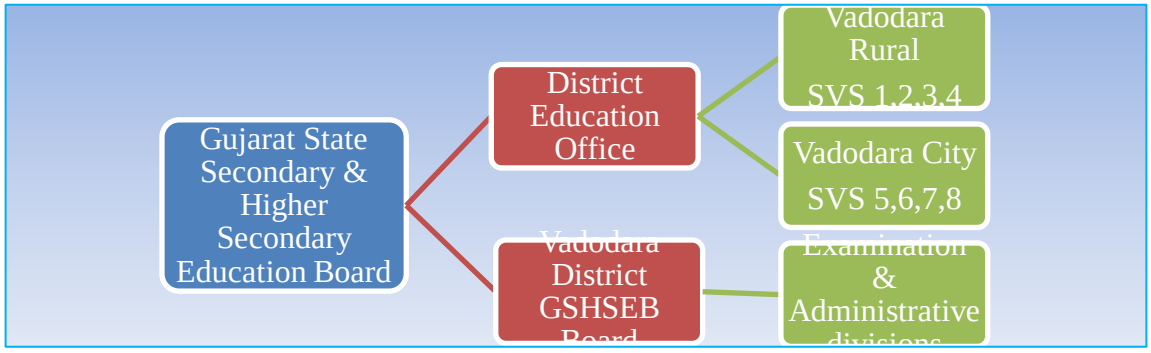


6.6.2 Population

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_6.2 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_6.1 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_ 6.2 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.

6.6.3 Sample

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 (2012-2013) were considered as Control group sample. The investigator adopted purposive sampling technique considering certain requirements and criteria to select the Experimental Group and the Control Group as mentioned on page 104.

6.6.4 Tools and Techniques of Data Collection

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

Tools used for data collection

7. Semi Structured Interview
8. Situation based pre test
9. Situation based post test
10. Observation Diary
11. Opinionnaire – Part A, Part B
12. Programme Feedback Sheet

Techniques for data collection

3. 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.
4. 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.

6.7 Data collection

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 data with pretest and posttest tools. While conducting the intervention programme known as Life Skill Education Programme, indicators of life skills were noted through participant observation. Total numbers of indicators (Table_4.7) of each type of thinking skill were calculated for each activity as shown in sample page of Observation Diary, (Appendix_3.16) at the beginning stage, developing stage and accomplished stage.

6.8 Data analysis

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 was used to find effectiveness

6.9 Major findings

- The first objective of the research being development of LSEP Programme, the researcher developed various group and individual activities, indoor as well as outdoor activities to teach science at secondary level. The designed activities provide testimony to the fact that it is possible to provide learning experiences based on needs of adolescents and science process skills for development of life skills like critical

thinking, creative thinking, decision making and problem solving skills through LSEP programme.

- The developed Life Skill Education programme was implemented on a group of sixty students as per the decided time duration and periods specified from 15-07-2012 to 20-03-2013. The total time required for the implementation was 2,100 minutes (thirty five hours) in the classroom transactions i.e. twenty eight working days over a span of nine months which does not include the field work and the preparation time taken by the students for activities such as Health Survey in Sayaji Baug, Verification of Gravity exerted on objects of different masses and internet surfing, data collection at home by students for investigation of Electrical energy consumed per family. It neither includes instruction time for LSEP activities and discussion time utilized by investigator for noting indicators of life skills in observation diary.
- The developed Life Skill Education Programme was found to be effective in terms of enhancement of four life skills, details of which are presented in the proceeding findings,
  - It was found that there was significant difference in the mean scores of indicators of creative thinking skill, decision making skill and problem solving skill of the students in pre test and post test with respect to the treatment given through LSEP to Experimental Group hence the treatment given enhanced the status of these life skills.
  - It was found that there was no significant difference in the mean scores of indicators of Critical Thinking Skills of the students in pre test and post test with respect to the treatment given through LSEP to Experimental Group hence the treatment given made no effect on the status of critical thinking skill.
  - It was found that there was significant difference between the gain scores of the Critical Thinking, Creative Thinking, Decision Making and Problem solving Skills of students of the experimental group to that of control group and hence effectiveness of LSEP was found more on the life skills of students of Experimental Group who were taught science with Life Skill Education programme than the students of Control Group who were not taught science with Life Skill education Programme, $U = 1.000$, $p = 0.043$

- It was found that there was significant difference between the mean post test scores of Critical thinking, Creative Thinking, Decision Making and Problem solving Skills of the students between experimental group and control group and hence effectiveness of LSEP is more on students' critical thinking skill, creative thinking skill, decision making skill and problem solving skill of Experimental Group who were taught science with Life Skill Education programme than the students of Control Group who were not taught science with Life Skill education Programme, U = 945, U = 1077.5, U = 430.5, U = 714.5 respectively and p = 0.01.
- Observed indicators of life skills in students, their feedback and ranking about each of the activity and their opinion after the implementation of programme.
  - Activity one: Drama: (Distance – Displacement) While watching drama investigator could observe indicators of life skills under study as C.T. – Ten, Cr. T. – Twenty Four, D.M. – Thirty three, P. S. – eighteen. This activity was ranked eighth by the students. Writing a paper pencil test does not give chance to students to mingle with each other in peer group, discuss scientific concepts with classmates and present it in the form of drama before the whole class that satisfies their need to seek appreciation from peer group.
  - Activity Two: Drama (Acceleration – Retardation): During the presentations investigator could observe indicators of life skills as, C.T. – twenty three, Cr. T. – thirty Four, D.M. – forty, P. S. – twenty three. Students ranked this activity too as eighth. As each team performed the drama, number of questions related to theory of motion increased increasing enthusiasm of the class to learn, unlearn and relearn.
  - Activity Three: Investigation: Health Museum in Sayaji Baug based on topic 'Why do we fall ill?' Indicators noted during this activity were C.T. – thirty five, Cr. T. – thirty nine, D.M. – thirty three, P. S. – twenty five. Students ranked this activity as fourth. . Students who didn't utter a single word in the first activity had many questions to ask and answers to give. This shows development in confidence and life skills in students.

- Activity Four: Health Survey on Common Cold among visitors of Sayaji Baug: Participant observation could come out with number of indicators of life skill as, C.T. – thirty six, Cr. T. – thirty, D.M. – forty five, P. S. – thirty two. Students ranked this activity too as fourth. Students made comprehensive report of data collected by each team and had conclusions showing relation between occupation, life style and the disease common cold.
- Activity Five: Make a toy: Catch the fly: Each team did this activity and exhibited critical thinking by asking questions like why, how, when and showed creativity in making the toy. The students used indicators of decision making skill in deciding the size of straw, angle between the straw, amount of force to be exerted and came up with different solutions to the problems occurred. Investigator counted the indicators of life skill during the LSEP as C.T. – thirty five, Cr. T. – forty one, D.M. – forty nine, P. S. – thirty three. Students ranked this activity as third.
- Activity Six: Make your own toy boat: This activity was ranked third by students. Indicators of life skills noted during this activity were C.T. – twenty eight, Cr. T. – fifty, D.M. – forty seven, P. S. – forty. Investigator could see the students using indicators of creative thinking, decision making and problem solving skills prominently. Presentations followed by probing helped the students to understand Newton's laws of motion and could relate that elsewhere in the real world and they could identify situations in real life where laws of motion are seen to be used.
- Activity Seven: Colloids around you PPT / enactment of Advertisement: As observed by the investigator indicators of life skills noted were C.T. – forty two, Cr. T. – forty eight, D.M. – forty two, P. S. – forty three. Students ranked this activity as tenth. Thinking critically on the advertisements they see on television and comparing the information shown on T. V. with information in science textbook they could relate chemistry with real life. Few students could recognise the falsity shown in advertisements. They could point out the difference in reality of chemicals used in cosmetic products and claim the

commercials make. Groups of girls who enacted showed the difference clearly indicating use of critical thinking.

- Activity Eight: Seminar with 3-D model of the fundamental unit of life, Cell: As noted during presentations, the indicators of life skills were C.T. – fifty one, Cr. T. – fifty nine, D.M. – fifty nine, P. S. – fifty four. This activity was ranked Twelfth by students. While making the model they got opportunity to think critically on the components of cell, think of many alternatives to make it, foresee the consequences of taking any decision, and think of innovative idea to show parts of living cell. Some teams preferred making PPT for showing difference between plant cell and animal cell. "Use of technology is easy for us and PPT can tell many points at a time" was their comment. "Earlier in primary class we were never given such tasks for formative assessment, we love this" they said. This shows that activities of LSEP are liked by students and their thinking was getting sharpened during implementation of LSEP, simultaneously taking their minds down the tour of scientific concepts.
- Activity Nine: Does gravity exert same force on stones of different masses? Indicators of life skill for this activity were noted as C.T. – forty five, Cr. T. – sixty one, D.M. – fifty eight, P. S. – fifty five. Students ranked it as thirteenth. Initially teams made mistakes in calculation of value of 'g' experimentally, when asked the reason for getting unequal values of g-theoretical, g-empirical; experimental errors were found, some had forgotten to convert units into standard units of length, time and acceleration. Thus discussions made them think critically on the experiment and could solve the problem after taking correct decisions. This indicates that the activity designed around science concepts gave enough scope to develop life skills.
- Activity Ten: Seminar with PPT on theme 'effect of pollution on plant tissues / animal tissues': Students placed this activity at fourteen. Concepts learnt in three lessons were woven well in the presentations. Presenting teams could answer all the questions asked by the audience on the topics chosen from lessons named Plant tissues, Animal tissues and Our Natural Resources.

- Activity Eleven: Skit to show Rutherford's Experiment: In depth discussions on scientific concepts, cross questioning on structure of atom led to the development of many indicators of life skill. Indicators of life skill for this activity were noted as C.T. – fifty seven, Cr. T. – fifty five, D.M. – fifty, P. S. – fifty. Students ranked this activity as third.
- Activity Twelve: Investigation: Electric Bill: PPT presentation: The score of indicators noted by the investigator were, C.T. – forty five, Cr. T. – fifty nine, D.M. – fifty eight, P. S. – fifty five. Students ranked this activity as sixth. Students used different skills of computer operation creatively as well as indicators of life skills like critical thinking, decision making and problem solving skills for making PPT.
- Activity Thirteen: Make Green Niche: Practical activity of growing plants belonging to different divisions gave clear understanding of characteristics of plants that helped students to classify them into different phyla. The indicators of life skill observed during presentations of the Green Niche by the investigator were C.T. – twenty four, Cr. T. – forty three, D.M. – forty nine, P. S. – forty five. This activity was placed at number seven by the students.
- Activity Fourteen: Make Crystal Garden: Ionic Compound: Students made colourful ionic compounds using metallic impurities. All the team members could answer the questions asked by audience during presentation on formation of ionic compound and covalent compounds. Students showed following indicators during this activity as C.T. – thirty four, Cr. T. – fifty five, D.M. – forty four, P. S. – forty three. This activity was ranked at eleven by the students.
- Activity Fifteen: 'Identify Me': Each team member enacted as an element belonging to their chosen 'GROUP' of the periodic table. Students showed immense pleasure in doing this activity and this lesson of Periodic Table which is not easy for the science teacher to teach in class IX was a joyful task with satisfaction looking to their achievement. Team members and the presenter answered their queries correctly. Indicators of thinking skill observed by the investigator during LSEP were, C.T. – forty nine, Cr. T. –

fifty five, D.M. – sixty, P. S. – sixty one. Students gave second rank to this activity. All students except one loved this activity.

- Activity Sixteen: Mime: Identify the Phyla/class of animal: Students of class IX of the experimental group school did this activity in excellent manner. Each team out of nine teams chose any one phylum of animal and any one class in it. The teams depicted prominent characters of the phylum of animal chosen and showed it through mime. Indicators of each kind of life skills observed during the activity were C.T. – fifty seven, Cr. T. – sixty five, D.M. – fifty eight, P. S. – sixty two. Students ranked Mime at first rank. They enjoyed the mime thoroughly and could identify the animals exhibited. They were able to describe its classification easily after the activity.
- Activity Seventeen: Project Grandma: To imbibe the idea of recycle, reuse and reduce use of Natural Resources given in the last lesson of semester two, textbook of Science and Technology the activity named Project Grandma was assigned to the students. The students prepared questionnaire before going for interview, noted the observations, prepared a report and presented it before the class. Indicators noted by the investigator were C.T. – fifty five, Cr. T. – fifty eight, D.M. – fifty five, P. S. – fifty six. Students ranked this as ninth.
- Project grandpa was assigned with the objective to make students aware about herbs and food used by grandparents in earlier joint families for welfare of the family. Students interviewed ten grand fathers and collected then analysed the data on home remedies through food grains and plant products used in Indian homes. Students ranked this activity as fifth. Indicators of life skills developed through this activity were C.T. – fifty seven, Cr. T. – sixty three, D.M. – fifty five, P. S – sixty three.
- Students were given a chance to use science process skills like measurement, observation, defining a scientific problem, experimentation, verification of results, arriving at a conclusion and writing scientific report. Though Life Skill Education Programme did not aim at developing science process skills, activities based on science content paved a way to development of science process skills too.

- Apart from thinking skills other life skills and values were seen getting developed in students. Other life skills like communication skill, coping with others, having empathy for others, coping with stress and other interpersonal skills were seen getting developed. Investigator could see value inculcation in them from change in their behaviour. Team spirit, respect for elders, value of time, value of money, value of unity were some prominently noted value in adolescents of class IX. In the beginning of the academic year 2012-2013 students' behaviour was unruly, without focus on work. Their primary teachers narrated stories of their misbehavior and motivation less life when they were in eighth. As implementation of LSEP continued investigator could see drastic change in their behaviour in second semester of that academic year.
- Principal of experimental group school opined that the students of class IX actively participated in activity based LSEP to acquire the knowledge and skills with happiness and desire to learn more. According to the principal the effect of LSEP lasted even during next academic year on the students under treatment. Other teachers of experimental group school opined that students of class IX participated enthusiastically in the activities given by the researcher during implementation of LSEP. According to them Students had great fun in doing activities like visit to Sayaji Garden and mime to show classification of animals.

6.10 Discussion

Science is a body of knowledge having dual nature: as a product and the process. It explains the phenomenon occurring in nature around us. It is known as a process as it makes one define a problem and seek its solution by scientific method. Science can emerge as something alive, doable and therefore exciting only if it is taught with that approach. If science is taught with student centric approach then science education will meet wider aims of education and at the same time it will encourage students to study it. If we study evolution of school science education in India, we see more and more content is added, overwhelmingly in the form of facts, in the syllabus.

as mentioned in chapter one, class IX adolescents should be exposed to activity based experiential learning. Life Skill Education Programme developed by the researcher has helped to develop life skills in adolescents of class IX through teaching of science. It was found to be effective in terms of

- The difference between the mean scores of indicators of Critical Thinking, Creative Thinking, Decision Making and Problem solving Skills of the students in pretest and post test with respect to the treatment given through LSEP to Experimental Group.
- The difference between the gain scores of the Critical Thinking, Creative Thinking, Decision Making and Problem solving Skills of students of the experimental group to that of control group.
- The difference between the mean post test scores of Critical thinking, Creative Thinking, Decision Making and Problem solving Skills of the students between experimental group and control group.
- Students' feedback and ranking of each of the activity and their opinion after the implementation of programme.
- Even though significant difference was not found in the scores of critical thinking skill of Experimental group and Control group when tested with Wilcoxon Signed Rank Test, the mean score of students of Experimental group for Critical Thinking was found to be higher in post test 70.65 as compared to the mean score value of post test 61.25 of Control group which indicated that there was enhancement in critical thinking skill i.e. the Life Skill Education programme was found to be effective. Result of Mann Whitney test used for testing significant difference between post test scores of both the groups have shown significant difference between them leading to conclude that LSEP was successful in enhancing life skills in Experimental Group.
- The mean post test score of students of Experimental group for Creative Thinking was found to be higher in 66.6 as compared to the mean score value of post test 56.1 of Control group which indicated that there was enhancement in creative thinking skill of Experimental Group i.e. the LSEP programme was found to be effective to develop creative thinking skill.
- The mean of post test score of Experimental Group was found to be 82.6 compared to 66.9 score of post test of Control Group. This indicates that LSEP could help to

develop Decision Making Skill in Experimental Group. In contrast to this mean post test score of Control group was 66.9 while pre test score of Decision Making Skill was 66.9 thus status of Decision Making skill of control group was found to be same during the academic year. LSEP left positive impact on the status of decision making skill of experimental group. There was no significant difference in pre test and post test scores of Control group.

- The mean of post test score of Experimental Group for Problem Solving was found to be 77.7 compared to score of 64 for post test of Control Group. This indicates that LSEP could help to develop Problem Solving Skill in Experimental Group. In contrast to this mean Pre test score of problem solving for Control group was 64.7 while post test score of Problem Solving Skill was 64.0 thus status of problem solving skill of control group was found to have reduced during the academic year. LSEP left positive impact on the status of problem solving skill of experimental group.
- In very first activity of science drama student exhibited only eighty five indicators of life skill. Later score of indicator of life skills show enhancement. 242 indicators of life skills were observed for Mime in which classification of animals was learnt. This shows that Science activities designed to develop life skill were found to be effective in developing life skills.
- Drama to show difference between distance and displacement i.e. very first activity of LSEP was found to be difficult for fifty five students out of sixty, while five students found it easy but no one found it very easy. Later same type of activity related to performing art was found easy by many. Number of students who categorised skit as easy were thirty four, forty students found role play easy, thirty six students called mime as easy.
- Activities like seminar where the students were asked to present theme through PPT; involving use of computer technology were liked by many as they liked surfing internet. These activities were easy for them.
- Principal of experimental group opined that students of class IX actively participated in activity based LSEP to acquire the knowledge and skills with happiness and desire to learn more. According to the principal the effect of LSEP lasted even during next academic year i.e. in class IX on the students under treatment. Other teachers of

experimental group school opined that students of class IX participated enthusiastically in the activities given by the researcher during implementation of LSEP.

On the basis of observations of this experimental study and its interpretations it can be concluded that Life Skills can be developed in class IX students of Grant-in-aid schools while teaching science by the subject teacher in the natural classroom setting through Life Skill Education Programme. Integration of life skill based education programme with any curricular subject for teaching the syllabus given by school's respective board can be used for developing life skills in the class IX students and make learning a happy endeavour. The ultimate aim of education as stated by scholars is to attain self realization that leads to guilt free, misery free, contended life. According to the investigator, teacher's role at any stage should be done in such a manner which will shape students' young minds with ability to take decision while thinking critically on the situation to be faced. It is essential to know creative abilities one has, time frame within which one has to work and address the problem with one's own limitations. The teacher can induce this in students only if enough experiences to sharpen life skills are provided to the students. With this notion, the investigator has attempted to develop life skills. Life skills are the skills that help us to deal with challenges in life effectively and attain happiness by developing objectivity. Life skills are those skills that are necessary for full participation in everyday living. They help us to live life with grace, positive mind and gratitude. There is no perfect decision, it is alright to fail but trying for the best in given situation needs to be imbibed by students in adolescence.

6.11 Implications of the study

'Development of life skills through teaching of Science' was a study conducted for class IX students in the city of Vadodara. The observations and findings of the study imply a few actions for school teachers, teacher educators, school trusts, school principals, parents, curriculum developers and policy makers.

Implications for School Teachers

School is a place where the tender minds gather with their heterogeneity in physical and mental capacities, their cultures at home, their socio-economic background, their mother tongues, their gender and the educational background at home. Yet a teacher in school

has to bring them together on a common platform of the school and educate them for better life. The present study implies that school teachers can design life skill education programme woven with curriculum of the subject for any class of the school and implement it in the school. If all subject teachers design it in consultation with each other when they do their academic planning, inter disciplinary approach can also be made effective. If language teachers, social science teachers, science teachers and mathematics teachers integrate activities for Life Skill Education with their subject and other subjects like physical education, drawing, computer technology burden on students of doing the activity will reduce as number of projects to be done are less. This will give them scope to look at any activity in a comprehensive manner. At the end of any academic year, teachers sit for academic planning for the next year, at the same time they can design activities that encompass development of generic life skills which evaluate understanding of concepts of few subjects together. They may have to ask students to make separate report sheets for each subject. Each subject teacher needs to frame questions for evaluation of the project in advance and link them with other written examinations they conduct in that year. This will save their time and energy too. Attempt can be made to design only six projects for the whole academic year that focuses on development of life skills integrating all curricular subjects. If this experiment is done continuously from first standard to tenth standard, students will exhibit life skills efficiently when they are out in the world of work or go to the universities for diploma courses or take up higher education through higher secondary. In the primary classes it is not needed to make them aware of the names of indicators of each life skill but it will be useful if names of thinking skills or social skills or inter personal skills or communication skills are introduced at secondary school level and at higher secondary level. If students entering the university are well equipped with life skills they will try to seek higher education in its true sense. Students' feedback on LSEP shows that more time is needed for preparation and presentation of LSEP. Presentations of activity report followed by plenary sessions need more time as probing and in depth discussions churn out the crux of the content particularly. "True learning takes place here", students' opined. School teachers should demand more time in school time table for the life skill integrated interdisciplinary teaching.

Implications for School Principals and School Trusts

It is a dire need of the society today to understand significance of development of life skills of school children and hence the school principals and school trusts should make teachers implement Life Skill Education Programme in their school. The school management should work as a facilitator and provide necessary space, audio-visual rooms, play ground, computer laboratory, and science laboratory and play things to play. Above all it is important to design timetable for each standard and each division in such a way that at least two teachers are available to conduct and evaluate activities of LSEP. Increase the school timings if needed accommodating more incentives for teachers. Time for outdoor activities need to be mentioned separately. Keeping safety factors in mind and involving parents in the outdoor activities LSEP activity can be implemented. When investigator of this study conducted LSEP in the school overall participation of students of experimental group in every school activity was seen on rise that lasted in class X too. Later those students who sought admission in higher secondary in the same school showed leadership qualities in them. As their thinking was improved they took quick and correct decisions than other newly admitted students who came from different schools.

Implications for Parents

- Parents of students of secondary section, especially class IX and X expect their wards to do wonders in the board examination and be achievers and money makers in future. They might not have taken efforts to their child's mental and physical development but they want their dreams to be fulfilled by their children, thereby putting emotional pressure on their child. One should never forget that secondary school students are in the stage of turbulence. Secretions of hormones, activation of sexual organs, flow of energy in their body, puberty and desire to shine out in their peer group keeps their thoughts on swing. Now if teachers are trying to direct their energies in positive direction, parents should co operate with their adolescent girls and boys by supporting them to do various projects under Life Skill Education Programme. Investigator of this study observed that when students are continuously exposed to presentations and group activities they start recognizing their capacities and limitations. They also start identifying their needs. Basically they start liking the school subject and want to know more about it. When the desire to gain more

knowledge is aroused they don't need lectures or preaching from anyone any more. They themselves start looking for books, information, knowledge and experiences in their surroundings. This leads to self motivated learners who can be data initiators not just data gatherers. Rao (2008), Gower et al (2013) and Martin et al (2013) insist on developing life skill education as sustainable practice, hence suggested to develop life skills through teaching of school subjects with involvement of their parents.

Implication for Teacher Educators

Teacher educators across the countries should rethink on designing of their curriculum for student teachers in the light of development of life skills with integrated approach. In the recent years though efforts have been made by teacher education colleges to develop life skills in student teachers and some of the well known institutions like CASE, Vadodara in India have conducted projects in this area yet integration of life skill education through teaching of curricular subjects need further exploration and demands interdisciplinary coagulation to carry this method forward in schools. Designing LSEP for unified curricula will be a tough task but it will certainly unite the subject teachers and bring benefits to the student teachers. This will percolate to schools through school teachers and reach society via well developed students.

Implications for Curriculum Developers

The investigator of present study felt the need to have a systematic approach towards life skill education in the school. To achieve this, curriculum developers for school education and for teacher education can frame the curriculum of various subjects in such way that it gives enough scope to develop life skills by integration of different subjects with life skills. Teacher education institutes can be asked to write textbooks on Life Skill Education, evaluation tools and techniques for evaluation of activities in LSEP, tools to test existing status of each kind of life skill on the basis of presentations made by student teachers, manuals for teachers in school and teachers in teacher education colleges for conducting LSEP while teaching subjects in the natural setting of the classroom.

Implications for Policy Makers

All the above things can be smoothly done only if the policy makers at the Ministry of Human Resource and Development at the centre support these ideas. Lot has been said in the new education policy in 2016 regarding Skill development that directs an individual

towards earning bread. However education should focus not only on developing money making machines but on developing true human beings and balanced individuals who will contribute for the steady progress of the Nation in democratic way. Compulsory school education either through educational institutes or through National Institute of Open Schooling (NIOS) is the first and foremost requirement of the nation as implied by various government policies in the recent years. NIOS has adopted the curricular approach of seamless integration in every subject to ensure effective internalization of life skills. The present study on development of life skills through teaching of science points to reframing of policies in the light of Life Skill Education at all levels of education.

6.12 Suggestions for further studies

The development of life skills through teaching of the curricular subject science is possible by activity based learning method or project based learning or inquiry approach or problem based learning method that is designed on the basis of curricular subject. After conducting the research on Development of Life Skills through Teaching of Science, investigator recommends few suggestions for further study as presented below,

- Main focus of this research was on development of thinking skills that would make the adolescent think critically, creatively to recognise and address the problem before her/him and take the right decision. In future research can be conducted for developing leadership qualities using Life Skill Education Programme along with development of thinking skills
- Very few researchers had attempted to develop thinking skills that are generic in nature earlier so many more number of researches can be conducted in this area.
- Investigator tried to develop life skills which actually are generic in nature but development of social skills, interpersonal skills, and communication skills can be done by the researchers.
- Development of Life skills through teaching of other subjects can be done for class IX in grant - in – aid schools as well as in private schools.
- The researcher conducted this study for secondary school adolescents that tried to develop life skills through Integrated Approach woven with curriculum of the subject

and formative evaluation pattern. Such study can be taken up for any standard and at any level; primary, secondary or higher secondary or at university level.

- A study to develop life skills through teaching of curricular subjects in the natural setting of the school in which the factors affecting the quality of teaching the subjects should be studied before designing the Life skill Education Program for the secondary school students.
- Status of teaching science with integrated approach should be studied separately in private schools, government schools, grant-in-aid schools and international schools. Further comparative study of status of science teaching with life skill integrated approach can be taken in various types of school in terms of science syllabus, laboratory facilities at secondary level, teacher's competency, fee structure, funding, student-teacher ratio, school policy, execution of government policies and accountability.
- Status of teaching of science in terms of life skills in private, government or aided schools that involves students individually can be studied to compare it with activity based approach for students as a member of team.
- Development of Life Skills and enhancement in achievement score can be studied simultaneously when the subject is taught with Life Skill Education Programme.
- Effect of a group of activities like power point presentations by students on the given content of subject, surveys, project presentation in teams, drama written and performed by students for given theme that relates subject with society can be observed and measured in terms of life skills.
- Further study can be taken up to reveal the relation between thinking skills and scientific attitude for adolescents of secondary or higher secondary school students.
- If possible researcher can take up this kind of research for randomly selected experimental groups across the districts and compare its effectiveness with respect to the life skills developed in male and female students.

6.13 Conclusion

"Education is manifestation of Perfection in human being that exists already in man. It is our own mental attitude which makes the world what it is for us. Our thought makes things ugly. The whole world is in our own mind. Learn to see things in the proper light."

(Swami Vivekananda) How aptly it applies to the teachers! Secondary school students are on the threshold of adulthood, which are neither counted in kids, nor among adults. Perceiving the naughty, bubbly adolescents as aimless creatures and not trying to bring out the best out of them is like closing your eyes in sunlight and screaming with fear of darkness. In this regard Vivekananda has asked teachers to look at things in proper light. Investigator also opines that we do not need to teach the students we only need to ignite their minds. While working as a science club coordinator, guide to students for conducting researches in National Children Science Congress (NCSC), conducting teacher training classes for the science teachers of secondary school for community science center investigator had always thought that 'something else' is getting developed in students who participate in science fairs, science drama, or through NCSC science projects. Students of earlier batches who learnt science from the investigator always came back to report about their progress after class X, recalling beautiful memories of real learning that had occurred in science class of standard IX. This inspired the investigator to take up this study and find that life skills were that 'something else' getting developed in them whenever they do activities other than homework, writing tests, giving oral tests during science class. Development of Life Skills through Teaching of Science in secondary school was an attempt to walk on an untrodden path for a secondary school science teacher that gave immense satisfaction of being a teacher of science of adolescents in class IX. The significant results of the study and fruitfulness of the Life Skill Education Programme is seen not only in terms of enhancement in life skills but development of desire for learning the subject was the gain of utmost importance. The teacher in investigator is happy for the student's life as they were well equipped after the study to meet everyday challenges their life poses before them without knowing that life skills got developed in them.