Chapter Four
Data Analysis and Interpretation

4.1 Introduction

In the previous chapter a complete account of the approach to study the main motive of the present investigation was explicated. Clear definition of objectives, research design, sample and tools employed, in the present study were discussed at length. The focus of the study is to develop Life Skill Education Programme designed for teaching science to adolescents of class IX and further studying its effectiveness in terms of development in terms of life skills. The present chapter provides details of development of Life Skill Education Programme for the students at class IX level. The process of implementation of LSEP and analysis of data is presented in this chapter too. Following is a detail of comprehensive examination of the data and the results, paving the way to interpretations and conclusions of the present study.

Nature of the present study is quasi experimental; sample is purposive; research design is pretest, posttest for control group and experimental group; tools are observation diary for participant observation and situation based validated pretest and posttest with close ended questionnaire. As mentioned in the earlier chapter, the study was aimed at developing LSEP to teach science for class IX students, implement it for a period of one academic year and study its effectiveness. The results are placed in the same order.

- Develop Life Skill Education Programme for teaching science.
- Implement the developed Life Skill Education programme.
- Study the effectiveness of the Life Skill Education programme.

4.2 Development of Life Skill Education Programme (LSEP)

The LSEP was developed stepwise during two academic years of 2010-2011, 2011-2012 detail of which is presented in this section.

- Analysis of the curriculum of Science for class IX offered at Grant-in-aid schools of Vadodara by Gujarat Secondary Education Board, Gujarat was carried out in 2010-2011 keeping in mind various criteria such as nature of content, scope of incorporating activities that have scope of integrating it with Life Skill Education. Position paper, named National Focus Group on Teaching of Science published by

NCERT in 2006 provided a comprehensive idea about the science curriculum structure.

- Analysis of the curriculum of the subject 'Science and Technology' at secondary school level was carried out to understand the subject matter thoroughly. It provided ideas about various learning outcomes, science process skills expected on teaching the content and life skills to be developed among class IX students to enable them to be happy human beings in future. Specific criteria considered while analyzing the curriculum was; concepts covered and possible activities which can be done by the students and scope of integrating life skills through 'Teaching of Science'.
- Various activities were identified from most of the units of text books of both semesters named 'Science and Technology' and planned keeping in mind the criteria; scope for development of life skills, understanding of important basic science concepts, possibility to design activity and objectives of teaching secondary science and technology curriculum.
- While designing the activities various modes of transactions were proposed along with the objectives of each of the activities. A rough outline of the possible activities was prepared for one academic year considering the above mentioned criteria and implemented on the student teachers during the academic year 2011-2012.
- Various activities implemented on the students were ;
  - ✓ Drama to show Rutherford's experiment
  - ✓ Field trip to Public Garden to identify plant species
  - ✓ Small group discussions on air pollution and its effect on environment
  - ✓ PPT presentations on Effect of soil pollution on plant tissues
  - ✓ Individual activities such as project file presentation on topic named 'Food resources / Natural Resources
  - ✓ Scientific Toys making from waste material
  - ✓ Know phylum and specie of animal through mime/ role play
  - ✓ Make Aquarium / Herbarium
- At the end of the academic year a group discussion was carried out to know their responses about each of the activities, its suitability for students.

- Suggestions for further improvement and alternative activities were collected from them in a written form with the help of Feedback Sheet, analysis of which is presented in frame 4.1.

Frame: 4.1 Feedback Provided by the students on various activities of LSEP carried out during the year 2011-2012 for Piloting of LSEP

- ✓ Visit to public botanical garden was the most preferred outdoor activity to develop problem solving, decision making, critical thinking skills and creative thinking skills. They unanimously opined that activities in public garden are suitable for learning classification of plants and animals as well as to know more about common diseases.
- ✓ Activity like Scientific Toys making should be performed for many more concepts.
- ✓ Making Aquarium or Herbarium may not be possible for all so creation of Green Niche can be done by the group of students.
- ✓ Students emphasized on group activities in place of Individual activity.
- ✓ Investigation for the scientific problems should be taken up. Calculation of consumption of electrical energy per family and verify that gravity acts equally on objects of different mass at the same place can be done individually and in group respectively.
- ✓ Students suggested that they would like to do individual activities at home with their grandparents. This may give them an opportunity to visit their native place and stay with their grandparents.

Based on feedback in the form of suggestions by students, possibilities of the execution of activities during one academic year with available resources and activities preferred by the majority of the students an outline of Life Skill Education Programme was prepared, final draft of which is presented in the table_4.1.

Table_4.1 Life Skill Education Programme (LSEP)

Sr no	**Topic, date & time**	**Main Objectives of LSEP**	**Activity**	**Requirements**
1 **a)**First **b)** **Second**	**Motion** 28-7-12, 70 minutes **30-7-12** Distinguish between distance and displacement 3-8-12, 70 minutes 4-8-12, 70 minutes Show acceleration and retardation and measure it.	**To develop critical thinking skill** Ability to analyze the information, categorise the components of information on "Distance and displacement" **To develop creative thinking skill** Ability to think differently than others Ability to incorporate all aspects to generate new ideas, Ability to present new idea with confidence	**Drama** Students will enact a situation in which linear / circular / zigzag motion will be exhibited that will be woven in a story when they will calculate the distance and displacement and show the difference between them. **Play with Toy** Students will play with a toy that moves on key or on battery and show the difference in acceleration and retardation enacting the characters they have designed in a story.	**For Drama** 9 Teams composed of 7 students each who have compatibility and live near each other are required. **Time** allotted for preparation of the drama 2 days **Time for presentation: 5** minutes per team **For play with toy** Toy train, Toy Car, Scale, chalk, stop watch, a rope. On Saturday one period of 45 minutes will be allotted to conduct this activity. Each team will get 5 minutes. **Time** allotted for preparation of the story **Time for presentation: 5** minutes per team
2 **a) Third**	**Why do we fall ill?**	**To develop critical thinking skill**	**On any convenient day excursion will be planned to a public**	**For visit to the health museum.** Notepad, pencil, pen, camera / mobile

b) Fourth	25-8-12, 120 minutes To understand personal health. 25-8-12, 120 minutes To find out the frequency of occurrence of Influenza amongst visitors of the Public garden.	Ability to analyze the information Ability to categorise the components of information Ability to challenge the assumptions behind the components of information Ability to judge or evaluate the authenticity and accuracy of information. **To develop problem solving** Ability to recognize that the problem exists. Ability to define the problem. Ability to think of many possible alternatives. **To develop decision making skill** Ability to list relevant choices, Ability to identify potential consequences of each choice Ability to assess the likelihood of each consequence actually	**garden in the city in the month of July.** **Visit to the health museum** Students will visit the health museum and work on any one of the topic, like: the reasons to fall ill, list the types of diseases, precautions to be taken, symptoms of some diseases and measures to cure the diseases. Topic for data collection will be chosen by lottery method by each team. **Survey in the Public garden** 9 teams of 7 students will go to 9 different places in the public garden, stand in team and interview the visitors to know the status of "Common Cold" in their family, record their interview with prior permission and make a table related to various	with camera, scale, pencil, A_4 size paper to write the report. **Time** allotted for preparation of the report 30 minutes **Time for presentation: 5** minutes per team **For Survey in the public Garden** Interviewer, Interviewee, Recording instrument/notepad, pen, A_4 size paper, scale, pencil. **Time** allotted for preparation of the report 30 minutes **Time for presentation: 10** minutes per team

		occurring Ability to determine the importance of these consequences Ability to combine all this information to decide which choice is the most appropriate.	components of data. The data collected during above activities will be presented by any team member of each team in the class.	
3 **a)** **Fifth** **b)** **Sixth**	**Force and Laws of Motion** 6-8-12, 70 minutes To understand how Newton's laws of motion work. 6-8-12, 70 minutes To understand and use Newton's laws of motion	**To develop problem solving skill** Ability to recognize that the problem exists. Ability to define the problem. Ability to think of many possible alternatives. Ability to verify the result of the solution. **To develop creative thinking skill** Ability to think differently than others Ability to incorporate all aspects to generate new ideas Ability to present new idea with	**Make your own game to play** **Catch the fly (food chain)** Instruction card : Take a stiff greeting card, draw or paste the picture of wall lizard on one side, paste pieces of plastic straws as shown in picture at given angle, pass the thread through the straws, hang the upper U part of thread on the nail, pull thread on any one side the lizard will move to catch the fly you pasted near the nail. Explain food chain using this toy that works	**For making your own game** Postcards/greeting cards, thread, cello tape, scissors/blade, plastic straws, hook on the wall, sketch pens or colourful stickers, Instruction card. 30 minutes time will be given to each student to make the toy. One instruction card will be provided between two students. **Time** allotted for preparation of the toy 30 minutes **Time for presentation:** 2 minutes per student **For making your own boat** Empty, small, shampoo-plastic bottle, two long rubber bands, a piece of hard plastic (3cm x 2cm) size, cutter, candle,

		confidence **To develop decision making skill.** Ability to list relevant choices, Ability to identify potential consequences of each choice Ability to assess the likelihood of each consequence actually occurring Ability to determine the importance of these consequences Ability to combine all this information to decide which choice is the most appropriate.	on Inertia and Newton's laws. **Make your own toy boat that will move on water.**Instruction card:Take an empty bottle of shampoo, tie two brand new unsharpened pencils to the bottle with a rubber band on both sides in such a way that equal portions of pencils protrude. Fix a rudder made of thick plastic behind the bottle at the protruding ends of pencils. When the rudder is unwound in water it should move ahead. Decorate your boat as you like.	match box, two new pencils, tub full of water, plasticine clay, plastic straw, coloured marble paper, a tub full of water to test the toy, Instruction Card. **Time** allotted for preparation of the toy 30 minutes **Time for presentation:** 2 minutes per student.
4 **Seven th**	**Properties of matter** To identify "colloids around you" 17-8-12, 70 minutes 23-8-12, 70 minutes	**To develop problem solving** Ability to recognize that the problem exists. Ability to define the problem. Ability to think of many possible alternatives.	**SEMINAR** **Theme Presentation**: Choose any one colloid around you and explain its type, properties, application, use, commercial advertisement for its sale, disadvantages	**For SEMINAR** Computer, CD, Computer Laboratory One week time will be given to prepare the CD. Those who cannot avail computer and Internet facility can present the project with real objects, charts and newspaper

		Ability to verify the result of the solution. **To develop decision making skill** Ability to list relevant choices, **To develop creative thinking skill** Ability to think differently than others Ability to incorporate all aspects to generate new ideas Ability to present new idea with confidence **To develop critical thinking skill** Ability to analyze the information Ability to categorise the components of information on types of colloids used in real life	if any, products similar to the one you have chosen. Present the theme in team with the help of PPT	cuttings etc, **Time** allotted for preparation of the project: one week **Time for presentation:** 10 minutes per team.
5 **Eight**	**The fundamental**	**To develop creative thinking skill**	**Project presentation in SEMINAR**	**For project presentation.** Any waste material like plastic wires,

h	**unit of life – "The Cell"** 30-8-12, 70 minutes To know and understand the function of each component of cell	Ability to think differently than others Ability to incorporate all aspects to generate new ideas Ability to present new idea with confidence **To develop problem solving skill** Ability to recognize that the problem exists. Ability to define the problem. Ability to think of many possible alternatives. Ability to verify the result of the solution. Ability to verify the process attempted to solve the problem.	Make a presentation on any one component of cell in the form of 3-D chart with your team. Any component of plant cell or animal cell like Golgi body, mitochondria, chloroplast, nucleus, endoplasmic reticulum etc will be drawn on the chart paper, with 3D effect by using different material like plasticine clay, wool, threads, bangles, sponge etc. Each member of every team will describe part of the cell organelle while presenting the project.	threads, pencil shavings, waste news paper, seeds which are thrown in kitchen, rubber bands, or any other material available, chart paper, colours, sketch pens, scale etc. **Time** allotted for preparation of the project: one week **Time for presentation:** 10 minutes per team.
6 **Ninet h**	**Gravitation** To understand the relation between gravity and	**To develop Critical thinking skill** Ability to analyze the information by identifying the components of information Ability to categorize or classify	**An Investigation** Project: Does gravity act more on the stone of more mass? **Format for written**	**For Investigation** 10 Stones from same place (same composition) but of different mass, Stop watch, 4 storied building, meter tape, notebook, pen, teammates, 2 foolscap papers

	mass of the object chosen. 28-9-12, 70 minutes 29-9-12, 70 minutes	the components of the information, Ability to challenge the assumptions behind the components of information, Ability to judge or evaluate the authenticity and accuracy of information Ability to systematically arrange the components to arrive at conclusion. **To develop problem solving skill** Ability to recognize that the problem exists. Ability to define the problem. Ability to think of many possible alternatives. Ability to verify the result of the solution. Ability to verify the process attempted to solve the problem.	**report:** Title / Aim Introduction Conceptual framework Material needed Time needed Procedure Observation Conclusion	**Time** needed: One week **Presentation: 5** minutes per team with written report.

7 **Tenth**	**Plant Tissues and animal tissues** To know the effect of pollution on different types of plant tissues and animal tissues and understand role of each tissue in the plant/ animal body 15-9-12, 70 minutes 17-9-12, 70 minutes 22-9-12, 70 minutes	**To develop critical thinking skill** Ability to analyze the information by identifying the components of information Ability to categorize or classify the components of the information, Ability to challenge the assumptions behind the components of information, Ability to judge or evaluate the authenticity and accuracy of information **To develop problem solving skill** Ability to recognize that the problem exists. Ability to define the problem. Ability to think of many possible alternatives. **To develop creative thinking skill**	**Presentation:** Each team of students will find out the effect of pollutants on the tissues of animal or plant through internet or by performing experiment. After one week each team will present it in the class with written report. Effect of Pollution on the tissues of plant/animal. Experiment/ PPT/ Oral presentation with a chart	**For Presentation of project:** Experimental apparatus, a plant, CD, Computer, Internet connection, Chart, pencils, colours and the team of students **Time** needed: One week **Presentation: 5** minutes per team with written report**.**

		Ability to think differently than others Ability to incorporate all aspects to generate new ideas Ability to present new idea with confidence		
8 **Eleve nth**	**Structure of Atom** Rutherford's Gold Foil Experiment 25-9-12, 45 minutes 26-9-12, 70 minutes	**To develop critical thinking** Ability to analyze the information by identifying the components of information Ability to categorize or classify the components of the information **To develop creative thinking skill** Ability to think differently than others Ability to incorporate all aspects to generate new ideas Ability to present new idea with confidence **To develop problem solving skill**	**Skit** Present Rutherford's Gold foil experiment in the form of a skit written by your team. Characters: Rutherford the great Scientist, Slow moving neutrons, atoms of gold foil, source of energy, electrons, protons, the team of scientists.	**Props** made of cardboard, paper and colours like positive electromagnetic field, negative electromagnetic field, vacuum pump; team of students, video camera, voice recording machine **Time** needed: One week **Presentation: 5** minutes per team with written report.

		Ability to recognize that the problem exists. Ability to define the problem. Ability to think of many possible alternatives. **To develop decision making skill** Ability to list relevant choices Ability to identify potential consequences of each choice		
9 **Twelth**	**Work, Energy and Power** Electrical Energy 7-11-12, 70 minutes 8-11-12, 70 minutes	**To develop critical thinking** Ability to analyze the information by identifying the components of information Ability to categorize or classify the components of the information Ability to challenge the assumptions behind the components of information, Ability to judge or evaluate the authenticity and accuracy of information	**An Investigation Project** **"Know your electricity bill."** 7 students of each team will collect Xerox copies of electric bill of past six months of their home. After attending an expert's talk on 'how to read electric bill' they will study the pattern of consuming units of electricity of each house and decide certain steps to reduce the consumption.	**For Investigation Project: "Know your electricity bill"** Electricity bills of 6 previous months, Record of the meter reading, Chart of consumption per week, Chart depicting reduction in consumption, Chart showing methods adopted to SAVE electricity and teammates. **Time** needed: One week **Presentation: 5** minutes per team with written report.

		Ability to systematically arrange the components to arrive at conclusion. **To develop problem solving skill** Ability to recognize that the problem exists. Ability to define the problem. Ability to think of many possible alternatives. **To develop Decision making skill** Ability to list relevant choicesAbility to identify potential consequences of each choice Ability to assess the likelihood of each consequence actually occurring, Ability to determine the importance of these consequences. Ability to combine all this information to decide which choice is the most appropriate.	Design a plan of action, follow the plan of action meticulously at home, try to reduce the consumption and get the graphs of consumption before the activity and after the activity. 9 such teams will present their data in the form of power point presentation in the computer lab.	

10 **Thirteenth**	**Diversity in Living Oraganisms-1** To study Algae Fungus Monocotyledons Dicotyledons around you. 3-12-12, 45 minutes 4-12-12, 45 minutes	**To develop critical thinking skill** Ability to analyze the information by identifying the components of information Ability to categorize or classify the components of the information **To develop creative thinking skill** Ability to think differently than others Ability to incorporate all aspects to generate new ideas Ability to present new idea with confidence **To develop problem solving skill.** Ability to recognize that the problem exists. Ability to define the problem. Ability to think of many possible alternatives.	**Make your own "Green Niche**" Locate the place around your school/home to collect samples of algae/fungus/monocotyledons or dicotyledons. Make a herbarium in suitable containers or transparent boxes.	**For making Herbarium** Samples of algae/fungus/monocotyledons/dicotyledons, Album of samples made by using recycled cardboard and paper. **Time** needed: One week **Presentation: 5** minutes per team with written report.

11 **Fourteenth**	**Chemical Bonding** Formation of Ionic compound. 4-3-13, 70 minutes 5-3-13, 70 minutes	**To develop critical thinking skill** Ability to analyze the information by identifying the components of information Ability to categorize or classify the components of the information **To develop problem solving skill** Ability to recognize that the problem exists. Ability to define the problem. Ability to think of many possible alternatives.	**"Make your crystal garden"** To make an Ionic Compound NaCl / $CuSO_4$. Students will take common salt in a container, make concentrated solution of salt in water, tie a very small crystal of salt to the thread, and allow it to remain immersed in water, place the glass container of salt solution in the window hang the thread in the window. Allow the glass container to remain in the window undisturbed till the crystal is formed. Form colourful crystals by adding colour and present it.	**'My Crystal Garden'** Common salt or Copper Sulphate powder, water, containers, stirrer, strainer, thread, hanger, empty glass jar **Time** needed: One week **Presentation: 5** minutes per team with written report.
12 **Fifteenth**	**Periodic Classification of Elements** 5-1-13, 70 minutes 7-1-13, 70 minutes	**To develop creative thinking skill** Ability to think differently than others Ability to incorporate all	**Role Play- WHO AM I?** 1) Represent each block elements through drama. 2) Depict the main characteristics of the	**For drama 'Who am I?'** A team of students, props like periodic table of elements, block to be presented, chart showing specific property of elements in that block etc. video camera,

	S – Block P – Block D – Block F - Block	aspects to generate new ideas, Ability to present new idea with confidence **To develop critical thinking skill** Ability to analyze the information by identifying the components of information, Ability to categorize or classify the components of the information **To develop problem solving** Ability to recognize that the problem exists. Ability to define the problem. **To develop decision making skill.** Ability to list relevant choices, Ability to identify potential consequences of each choice	elements in any one block. 3) Show why they belong to that block through dialogues. Sound and light can be used to add to the effect. Students will write a script on the elements belonging to the block they have chosen will enact like electrons, orbits and elements and show their properties. At the end the team will ask the audience to identify the block they belong to!	tape recorder if needed. **Time** needed: One week **Presentation: 5** minutes per team with written report.
13 **Sixteenth**	**Diversity in Living Organisms – 2** 30-1-13, 105 minutes 31-1-13, 105	**To develop critical thinking skill** Ability to analyze the information by identifying the	To present the characteristics of animal of chosen phylum through **Mime.** Mime is a role play without sound, without dialogues. Teams	**Material Requirements**: team of students, props displaying characteristics, chart showing specific property of species in that particular class and video camera if possible. **Time** to prepare one week. Each group **10**

	minutes Annelids Arthropods Pisces	components of information Ability to categorize or classify the components of the information **To develop creative thinking skill** Ability to think differently than others Ability to incorporate all aspects to generate new ideas Ability to present new idea with confidence **To develop problem solving skill** Ability to recognize that the problem exists. Ability to define the problem. **To develop decision making skill** Ability to list relevant choices, Ability to identify potential consequences of each choice	of students to display the characteristics of the animal chosen of chosen phylum. Other classmates were supposed to identify the animal, its phylum and its class.	minutes for **Presentation**, Presentation followed by question-answer session.
14	**Our Natural**	**To develop critical thinking**	**PROJECT:**	**For project "Grandma"**

Seventeenth	**Resources** **20-2-13, 45 minutes** Natural Resource around you.	**skill** Ability to analyze the information by identifying the components of information Ability to categorize or classify the components of the information **To develop creative thinking skill** Ability to think differently than others Ability to incorporate all aspects to generate new ideas Ability to present new idea with confidence **To develop problem solving skill** Ability to recognize that the problem exists. Ability to define the problem. **To develop decision making skill**	**"GRANDMA"** **Individual activity** Student of each team will meet at least 10 grandmothers or great grandmothers and find the methods used by them to recycle and reuse the resources. OR Prepare a report on the medicinal plants used by your family and relatives.	**Individual activity** Voice recorder / video recorder, notepad, pen interviewer and interviewee. 2 foolscaps to write a report. **Time** needed: One week **Presentation: 2** minutes per student with written report.

		Ability to list relevant choices Ability to identify potential consequences of each choice		
15 **Eight eenth**	**Food Resources** **23-3-13, 70 minutes** Food resources around you	**To develop critical thinking skill** Ability to analyze the information by identifying the components of information Ability to categorize or classify the components of the information **To develop creative thinking skill** Ability to think differently than others Ability to incorporate all aspects to generate new ideas Ability to present new idea with confidence **To develop problem solving skill** Ability to recognize that the problem exists. Ability to define the problem. **To develop decision making skill** Ability to list relevant choices Ability to identify potential consequences of each choice	**PROJECT:"GRANDPA" Individual activity** **Instructions:** Meet at least 10 grandfathers and find the food items consumed by people since last 100 years in your state and the role of farm fresh and homemade food products in the development of family with respect to economic and health status. Prepare a structured interview for collection of data.	**For project "GRANDPA" Individual activity** Voice recorder / video recorder if possible, notepad, pen interviewer and interviewee. 2 foolscaps to write a report. **Time** needed: One week **Presentation time: 5** minutes per team with written report.

4.3 Implementation of LSEP

The above described Life Skill Education Programme was implemented as per the schedule. Implementation of LSEP began after discussion of it with students of experimental group and ended after taking their opinion about it. During the period of implementation of Intervention Programme the investigator conducted all the duties of science teacher like paper setting, evaluation of notebooks, answer sheets, examination, supervision and teaching the syllabus using combination of various methods like lecture, demonstration, use of audio-visual aid, storey telling and discussion. To know the sampled students well; before implementing the programme the researcher discussed the academic achievement of the sampled students of experimental group in class VIII and their IQ with the science teacher of their previous class and other subject teachers. Based on the teacher's opinion the class of 63 students was divided into 9 groups of 7 in each. Each group was named according to the planets of the solar system of their choice. It was decided by the sampled students to form 9 groups each consisting of 7 students. Initially groups were formed according to serial order. Later criteria used for selecting the students in one group were closeness of residence of individuals and compatibility with each other. Each group was heterogeneous in nature wherein slow and gifted learners were chosen so that everyone can participate actively with motivation from each other. During the period of implementation of intervention programme the groups within the sampled students were framed twice and the group members were reshuffled to develop the socialization among the students. To conduct the activities mentioned in the LSEP the researcher has used regular science periods as well as proxy periods and 20 minutes extra time after the school hours. While observing the presentation of activities by the students the researcher encouraged other students to probe into the content presented by them, i.e. ask the questions to presenters like "how? Why? When? Explain with more examples", which led to the deep understanding of the concept of science that made them enjoy the process of learning. Intervention programme includes activities like drama, role play, make your toy, health survey in public park, visit to Health Museum, seminar for theme presentation using PPT or Three-D model/chart made by the students, investigation project on gravity and electricity, skit, making green niche, make crystal garden, mime, project Grandma and project Grandpa. The description of each activity that mentions the

scientific concepts involved, scientific process skills and thinking skills needed to perform these activities is specified in tabular form inAppendix_3.17**).**

Activity 1: A) Drama, to distinguish between distance and displacement

Dates of Presentation: 28-7-2012

Description of the activity: Lesson one Motion of the text book named 'Science and Technology' explains the concepts related to linear motion, distance, displacement, speed, velocity, acceleration and retardation, uniform and non-uniform motion. Students who have entered secondary section from primary section have just entered middle stage of adolescence. They like to show off themselves before their peer group but they have inhibitions. According to Hendrix et al (2011) 'Creative drama' was an effective strategy to increase science conceptual learning in the students when used as an active extension to teach science curriculum. Keeping this in mind investigator decided to design this activity of drama. Initially the students were awkward to come on the stage and show the difference between distance and displacement through enactment; however after dramatization by first group followed by probing by the investigator and audience, others learnt quickly. Each member of every group showed the difference between distance and displacement in one or other way. The concepts were woven in stories by them and dramatized it. Two days time was given to all the teams to prepare before performance. Each team was supposed to present the drama in five minutes. After performance each team member had to attempt to answer the questions asked by the audience.

Expected Learning Outcome

To conduct this drama student needed to understand the basic concepts like motion, distance, displacement, and scalar and vector quantity before performance. Students needed to think critically on the activity assigned.

Expected development of indicators of critical thinking skill is,

- identify components of information and classify the components of information
- arrange the components to conclude

They were required to take this as a problem to be addressed and take firm decisions with respect to what should be the plot for drama, how many characters will the play have, who will play role of whom, how should the concept be explained through dialogues,

which props should be used, any property (material) needed and any set arrangement should be done at the background.

Expected development of Indicators of Problem solving skill focused were,

- defines the activity well before its presentation (defining a problem)
- student accepts that performing drama is a worthwhile experience
- thinks of many alternative solutions to address this challenge

Thinking creatively can alone help to write script of the drama.

Expected development of creative thinking skill in this activity prominently is;

- incorporate all aspects of information to generate new idea
- change ways of performing task as per need and confidently present new idea

Expected development of Indicators of Decision Making focused is

- list relevant choices of scripts suggested by teammates
- combine all information to decide most appropriate choice

Indicators of **science process skills** required in this activity are defining the problem i.e. the activity assigned by the researcher, think of many solutions to do the activity and distinguish between scientific information and popular information related to distance and displacement. Students need to measure the distance travelled by the character in the play.

Plate_4.1 Students performing drama to show difference between distance & displacement

Activity 1: B) Play with your toy and show acceleration and retardation

Description of the activity: Students of each group performed a skit to show the difference between acceleration and retardation. The indicators of thinking skill focused in this activity were same as for Activity one A). The scientific process skills while performing this activity were to know and use number relations, measurement, space-time relations, communication, draw inference after the experiment, Sharma (2006). Two days time was allotted to each group for preparation before presentation. Observation of this activity required four periods 140 minutes distributed over four days.

Plate_4.2 Students performing skit to show difference between acceleration and retardation with their toys

Activity 2: A) Visit to Health Museum, B) Health Survey in the Public Garden

Description of the Activity: Lesson 9 "Why Do We Fall ill?" of 'Science and Technology' explains the concepts like types of diseases, causes and symptoms of diseases and remedial measures. Students of experimental group were taken to the Public Park in Vadodara. Sayaji Baug named after the generous and noble king of the city who ruled in early nineteenth century in Vadodara is a popular garden which is crowded by walkers every morning. This garden was selected for this activity of Health Survey. There is a Health Museum located in the fore part of the garden. It has exhibits that depict various kinds of diseases, their symptoms, remedial measures and significance of hygiene in human life. It also depicts complete life cycle of man and stages of growth. Students

were given a challenge to prepare a report on any one disease their group wants to study. Initially Nine group leaders were sent to the museum to choose the disease they wish to study. Only two groups were allowed to visit the museum at a time so that each group of seven students can collect data related to the disease they have opted to study. Each group got its turn to visit the health museum. This activity was done with the co-operation of other subject teachers. Following image shows students of one group moving out of museum after collection of data. Expected development of indicators of thinking skills, science process skills for [Activity 2: A] are shown after the description of [Activity 2:].

Plate_4.3 White building Health Museum seen at the back drop

Activity 2: B) Health Survey in the Public Garden

Description of the Activity: Amongst all infectious diseases common cold i.e. influenza is very common and prevalent in people. Students have tried to find out frequency of occurrence of influenza in the visitors of Sayaji Baug. Initially students were gathered at the place called Band Stand in the garden by the teachers of secondary section and they were assigned with the task they have to do by the investigator. They were instructed briefly about Health Survey. Their group had to frame questions to interview persons visiting the garden. They were required to take many decisions before survey. They were needed to analyze the resources they have for addressing the problem posed before them of making a survey report on status of Common Cold amongst the visitors with respect to

its frequency of occurrence, home remedies they use, preventive measures they take and its clinical treatment.

Expected development of indicators of critical thinking skill is,

- Ability to analyze the information
- Ability to categorize the components of information
- Ability to challenge the assumptions behind the components of information
- Ability to judge or evaluate the authenticity and accuracy of information
- Ability to arrange the components in order

Expected development of indicators of problem solving skill is,

- Ability to recognize that the problem exists
- Ability to define the problem
- Ability to think of many possible alternatives

Expected development of indicators of decision making skill is,

- Ability to list relevant choices
- Ability to identify potential consequences of each choice
- Ability to assess the likelihood of each consequence actually occurring
- Ability to determine the importance of these consequences
- Ability to combine all this information to decide which choice is the most appropriate

During activity 2-A and 2-B expected usage of **science process skills** is observation, formulating a hypothesis, verifying it through survey conducted in the garden, writing the report of the survey in the classified form and interpret it with graph.

Plate_4.4 Assigning LSEP activity - Groups ready for health survey

Activity 3: A: Make your own toy to play Catch the Fly!

Activity 3: B: Make your own boat to verify Newton's third law of Motion

Description of the Activity: Above mentioned activities are based on Lesson Three of Force and Newton's Laws of Motion. Students used waste material like pencils, rubber bands.

Expected Learning Outcome

- Understand how Newton's laws of motion work.
- Understand use of Newton's laws of motion

Students were expected to understand Newton's First law of Motion as every object continues to be in state of rest or of uniform motion unless and until acted by an unbalanced force. Students were supposed to know that force is that physical quantity which is proportional to the multiplication product of mass of the object and acceleration produced in it due to effect of force.

Expected development of Indicators of problem solving skill is

- Ability to recognize that the problem exists.
- Ability to define the problem.
- Ability to think of many possible alternatives.
- Ability to verify the result of the solution.

Expected development of indicators of creative thinking skill is

- Ability to think differently than others
- Ability to incorporate all aspects to generate new ideas
- Ability to present new idea with confidence

Expected development of indicators of decision making skill is

- Ability To List Relevant Choices
- Ability To Identify Potential Consequences Of Each Choice
- Ability To Assess The Likelihood Of Each Consequence Actually Occurring
- Ability To Determine The Importance Of These Consequences
- Ability To Combine All This Information To Decide Which Choice Is The Most Appropriate

Expected use of science process skills is measurement, experimentation, verification, identification and controlling variables and conclusion.

Plate_4.5 Students writing report of Health Survey

Plate_4.6 Student verifying Newton's first law along with concept of food chain with the toy

Plate_4.7 Students engrossed in making the toy to verify Newton's law

Activity 4: Presentation in Seminar on 'Colloids around you'

Description of the Activity: Lesson 4 "Properties of matter" describes states of matter, concepts of element, homogenous and heterogeneous mixture, compounds, colloids and solutions. Concept of colloids is abstract, but colloids are used in daily life by everyone in the form of hand wash or face wash or shaving creams. Television shows advertisement of these consumer goods so students are exposed to such products very often. This activity helped them to relate the concept of colloid with their real life.

Activity Format Theme Presentation: Choose any one colloid around you and explain its type (foam, emulsion, sols and gels), properties, application, use, commercial advertisement for its sale, disadvantages if any, products similar to the one you have chosen. Present the theme in team with the help of PPT

Requirements for seminar: Computer, CD, Computer Laboratory

Those who cannot avail computer and internet facility can present the project with real objects, charts and newspaper cuttings

Time allotted for preparation of the project: one week

Time for presentation: 10 minutes per team.

Expected Learning Outcome of this activity is

- To understand the concept of solution
- To know difference between kinds of solution
- To understand the composition of nano particles in colloids
- To observe its use in daily life

Expected development of indicators of problem solving skill is

- Ability to recognize that the problem exists
- Ability to define the problem
- Ability to think of many possible alternatives
- Ability to verify the result of the solution

Expected development of indicators of decision making skill is

- Ability to list relevant choices

Expected development of indicators of creative thinking skill

- Ability to think differently than others while presenting the advertisement
- Ability to incorporate all aspects to generate new ideas

- Ability to present new idea with confidence

To develop critical thinking skill

- Ability to analyze the information
- Ability to categorize the components of information on types of colloids used in real life.

Plate_4.8 useful colloids around us, slides from students' PPT

Table_4.2 showing colloids around us, from student's PPT

Dispersed Material	Dispersed in Gas	Dispersed in Liquid	Dispersed in Solid
Gas (bubbles)	Not possible	Foams: Soda pop: Whipped cream, beaten egg whites	Solid foams: Plaster: pumice
Liquid (droplets)	Fogs, mist, clouds, hairsprays	Emulsions: milk, blood, mayonnaise	Butter, cheese
Solid (grains)	Smokes: dust, industrial smoke	Sols and gels: gelatin, muddy water, jelly, starch solution	Solid sol: pearl, coloured glass, porcelain, paper

Activity 5: Project Presentation: Make 3 D model or chart to show cell organelles

Description of the Activity: Lesson 4 of semester 1 **'The fundamental unit of life – The Cell'** describes a living cell of plant and animal body. It explains the concepts related to various cell organelles their location in cell and function. This LSEP activity required students to make a presentation on any one component of cell in the form of 3-D chart with their team. Any component of plant cell or animal cell like Golgi body, mitochondria, chloroplast, nucleus and endoplasmic reticulum was drawn on the chart paper giving it a 3D effect by using different material like plasticine clay, wool, threads, bangles, sponge etc. Each member of every team described part of the cell organelle while presenting the project.

Material Requirements for the project presentation was any waste material like plastic wires, threads, pencil shavings, waste news paper, seeds which are thrown in kitchen, rubber bands, or any other material available, chart paper, colours, sketch pens, scale etc.

Time allotted for **preparation** of the project was one week.

Time allotted for **presentation** was 10 minutes per team.

Expected Learning Outcome

- Know the function of each component of cell
- Know structure, size, location of each component of living cell
- Note difference between plant cell and animal cell

To develop creative thinking skill

- Ability to think differently than others
- Ability to incorporate all aspects to generate new ideas
- Ability to present new idea with confidence

To develop problem solving skill

- Ability to recognize that the problem exists.
- Ability to define the problem.
- Ability to think of many possible alternatives.
- Ability to verify the result of the solution.
- Ability to verify the process attempted to solve the problem.

Plate_4.9 Image of 3D chart / model of cell

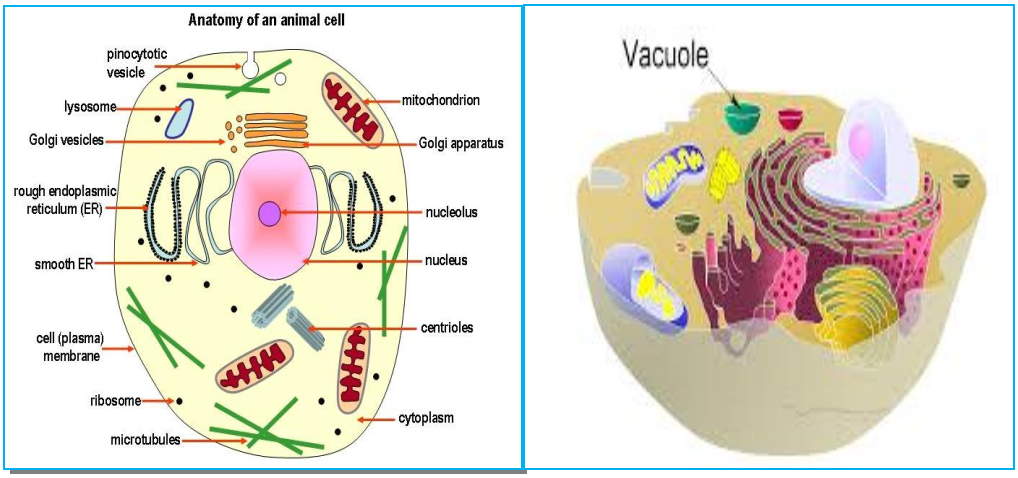
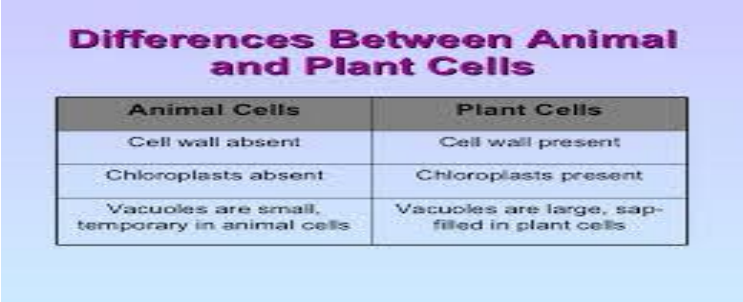


Plate_4.10 Slide depicting difference between plant cell and animal cell from a student's PPT



Expected use of Science process skills were analysis of data related to cell structure and organelles their functions and characteristics, identifying the difference, reporting the scientific data.

Activity 6: Verification Experiment: Does gravity act more on stone of more mass?

Lesson 2 of Semester two; Gravitation

An Investigation: Project: Does gravity act more on the stone of more mass?

Description of the Activity: This activity demands experimentation and proof of the fact that earth exerts same gravitational force on objects of different mass and value of gravitational acceleration is same for all objects at the same location on planet earth. Students were asked to observe free fall of five stones of different masses and materials from the terrace of their residential buildings. They were asked to choose three storeyed building for experimentation, where free ground space is available in the surrounding. Students were supposed to measure time of free fall for each stone using stop watch. They were asked to measure distance between balcony of each floor, terrace and ground. They were supposed to calculate velocity of falling stone at each interval and find acceleration experimentally. Further they were supposed to check equality of experimental value and theoretical value of **'g'** for each stone.

Expected Format for written report: Title / Aim, Introduction, Conceptual framework, Material needed, Time needed, Procedure, Observation, Conclusion

Expected Learning Outcomes:

- To understand the relation between gravitational force and mass of the object chosen.

- To understand the relation between gravitational acceleration of the object and it's mass. Considering values of G = Gravitational Constant = 6.674×10^{-11}, M = mass of earth = 5.97×10^{24} Kg, R = radius of earth = 6371×10^{3} m
- F = **G m M/ R^2** = mg, **g= G M/ R^2**
- Gravitational acceleration = **g** of an object is independent of mass of an object means the value of g does not depend on mass of the object when freely falling object is observed at the same place. Value of **g** for one place is same for all the freely falling (objects being pulled by gravity alone) objects.

Expected development of indicators of critical thinking skill

- Ability to analyze the information by identifying the components of information
- Ability to categorize or classify the components of the information,
- Ability to challenge the assumptions behind the components of information,
- Ability to judge or evaluate the authenticity and accuracy of information
- Ability to systematically arrange the components to arrive at conclusion.

Expected development of indicators of problem solving skill

- Ability to recognize that the problem exists.
- Ability to define the problem.
- Ability to think of many possible alternatives.
- Ability to verify the result of the solution.
- Ability to verify the process attempted to solve the problem.

Expected use of indicators of **science process skill** is in terms of use of apparatus like physical balance, use of stop watch, measurement of time of free fall of stones of different mass, skill of experimentation, verification of the experimental value of **'g'** with theoretical value of gravitational acceleration (g) and concluding after observation. Some more science process skill used by the students could be 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.

Activity 7: Seminar: Effect of pollution on plant tissues and animal tissues

Lesson 7: Plant tissues, Lesson 8: Animal Tissues

Description of the Activity: These lessons of the textbook discuss location and functions of tissues in various organs of the plant and animal body. The lesson on Our Natural resources of semester two discusses effect of pollution on our natural resources. Integrating both concepts this activity was designed.

Presentation of the activity was done in the following way. Each team of students found out the effect of pollutants on the tissues of animal or plant through internet or by performing experiment. After one week each team presented it in the class with written report, 'Effect of Pollution on the tissues of plant/animal'. This was to be done in the form of Experiment/ PPT/ Oral presentation with a chart.

Material and time required for Presentation of project was experimental apparatus, a plant, CD, Computer, Internet connection, Chart, pencils, colours and the team of students. One week **Time was** needed to observe this activity. Each team was given 5-7 minutes for presentation. Few teams performed the experiment at home, recorded its observation in the form of effect of pollutants on the plant, and then showed it through the power point presentation. Few slides of PPT showed role of tissues of plants and animals in brief and other slides depicted the effect of soil and water pollutants on the tissues.

Expected Learning Outcomes:

- Know the effect of pollution on different types of plant tissues and animal tissues
- Understand role of each tissue in the plant/ animal body

Expected development of indicators of critical thinking skill

- Ability to analyze the information by identifying the components of information
- Ability to categorize or classify the components of the information,
- Ability to challenge the assumptions behind the components of information,
- Ability to judge or evaluate the authenticity and accuracy of information
- Ability to systematically arrange the components to arrive at conclusion.

Expected development of indicators of problem solving skill

- Ability to recognize that the problem exists.
- Ability to define the problem.
- Ability to think of many possible alternatives.
- Ability to verify the result of the solution.

- Ability to verify the process attempted to solve the problem

Expected use of indicators of **science process skill** is in terms of observation of effects of pollution on plants, defining a hypothesis, verifying it through data available on internet, writing a scientific report on the basis of observations and data available, deriving a conclusion.

Plate_4.11Growth of same specie plant: arrested growth of plant in plastic jar exposed to air pollution, plant in earthen pot not exposed to air pollution

Activity 8: Skit: Rutherford's Gold Foil Experiment

Description of the Activity:

Lesson 5: Structure of Atom

This lesson discusses history of evolution of theory on structure of atom. Rutherford's gold foil experiment as given in the lesson gives an idea about the size of nucleus in the structure of atom. This activity was designed to bring clarity in the understanding of position of nucleus and sub atomic particles around it. Rutherford bombarded slow moving neutrons on the gold foil of 0.002 mm thickness and observed that the

Expected form of activity: Skit

Present Rutherford's Gold foil experiment in the form of a skit written by students' team. Characters of the play: Rutherford the great Scientist, Slow moving alpha particles, atoms of gold foil, source of energy, electrons, protons, the team of scientists.

Material and time required: Prop**s** made of cardboard, paper and colours like 'positive electromagnetic field, negative electromagnetic field, vacuum pump';

team of students, video camera, voice recording machine if possible. Time needed for preparation of skit is one week.

Presentation time: 5 minutes per team with written report.

Expected Learning Outcomes

- Know and understand Rutherford's Gold Foil Experiment
- Identify difference between proton, neutron and electron
- Understand the structure of atom
- Identify the forces of attraction and repulsion between subatomic particles

Expected development of indicators of critical thinking skill is

- Ability to analyze the information by identifying the components of information
- Ability to categorize or classify the components of the information

Expected development of indicators of problem solving skill is

- Ability to recognize that the problem exists.
- Ability to define the problem.
- Ability to think of many possible alternatives.

Expected development of indicators of decision making skill is

- Ability to list relevant choices
- Ability to identify potential consequences of each choice

Expected use of indicators of **science process skill** is in terms of experimentation in virtual form, relating space and time for enactment of motion of neutrons and electrons, arriving at conclusion about structure of atom after observation of motion of slow moving alpha rays (2 protons+ 2 Neutrons).

Activity 9: An Investigation Project: 'Know Your Electricity Bill'

Description of the Activity: Lesson 1, Semester 2: Work, Energy and Power, this lesson discusses relation between work done, energy and power. Work done is converted to energy and time rate of doing work is power. W = Power x Time. It briefly discusses electrical energy and mentions electrical energy consumed by an electrical appliance used at home. Very brief introduction of electrical units consumed in terms of Kilo Watt Hours is given. The LSEP activity is a project for **Investigation "Know your electricity bill"** of student's own home. **Time** needed for preparation was 1 month (9 days before Diwali vacation + 21 days of Diwali vacation = 30 days) and 1 week.

Expected method of performing the activity 7 students of each team will collect Xerox copies of electricity bill of past six months of their home. Material required for this project is a bunch of electricity bills of 6 previous months, one month record of their electric meter reading, chart of consumption per week, chart depicting reduction in consumption, chart showing methods adopted to SAVE electricity and list of teammates. After attending an expert's talk on 'how to read electric bill' they will study the pattern of consuming units of electricity of each house and decide certain steps to reduce the consumption. Design a plan of action, follow the plan of action meticulously at home, try to reduce the consumption and get the graphs of consumption before the activity and after the activity. 9 such teams will present their data in the form of power point presentation in the computer lab or present it in the form of project file.

Presentation time: 5 minutes per team with written report.

Expected Learning Outcome:

- Know how to take meter reading and measure units consumed
- Understand calculation of units consumed
- Calculate amount of bill

Expected development of indicators of critical thinking

- Ability to analyze the information by identifying the components of information
- Ability to categorize or classify the components of the information
- Ability to challenge the assumptions behind the components of information,
- Ability to judge or evaluate the authenticity and accuracy of information
- Ability to systematically arrange the components to arrive at conclusion.

Expected development of indicators of problem solving skill

- Ability to recognize that the problem exists.
- Ability to define the problem.
- Ability to think of many possible alternatives.

Expected development of indicators of decision making skill

- Ability to list relevant choices
- Ability to identify potential consequences of each choice
- Ability to assess the likelihood of each consequence actually occurring,
- Ability to determine the importance of these consequences.

- Ability to combine all this information to decide which choice is the most appropriate.

Expected utilization of **science process skills** is observation of units consumed, measurement of units, formulating a hypothesis related to consumption of electric energy and reaching to conclusion regarding consumption and bill, planning and implementing ways to reduce consumption, analysis of collected data, its interpretation in the form of graph and chart.

Activity 10: Make your own 'Green Niche'

Description of the Activity: Lesson 6: **Diversity in Living Oraganisms-1**explains classification of plants given by Robert Whittaker in 1969 as Five Kingdom Classification.

Expected method for group of students was to grow algae, fungus, and monocotyledonous plant, dicotyledonous plants (two from cryptogam, two from phanerogam) in pots or containers. If growing plants was not possible then the group could collect samples of plant, dry and paste in the album made by the group and present. Material needed for making a Green Niche is living green algae, fungus, monocotyledonous plant, dicotyledonous plant or album of samples of parts of plant made by using recycled cardboard and paper or transparent containers holding live plants. **Time needed** to grow or collect samples was one week. Each group was given **Presentation time** of **5** minutes with written report.

Expected learning outcomes as to identify Algae, Fungus, and Monocotyledonous and Dicotyledonous plants around

- To locate the place around your school/home to collect samples of algae/fungus/monocotyledonous or dicotyledonous plants
- To make and grow plants in a herbarium/ green niche in suitable containers or transparent boxes.

Expected development of indicators of critical thinking skill

- Ability to analyze the information by identifying the components of information
- Ability to categorize or classify the components of the information

Expected development of indicators of creative thinking skill

- Ability to think differently than others

- Ability to incorporate all aspects to generate new ideas
- Ability to present new idea with confidence

Expected development of indicators of problem solving skill

- Ability to recognize that the problem exists.
- Ability to define the problem.
- Ability to think of many possible alternatives.

Expected usage of science process skill is in terms of experimentation, observation, writing report, arriving at conclusion.

Plate_4.12 Activity 10: Green Niche: Algae, fungus, dicot plants grown by the students of Experimental group

Activity 11: Make your 'Crystal garden'

Description of the Activity:

Lesson 4 of Semester 2 named **Chemical Bonding** explains why and how of formation of compounds with ionic bond or covalent bond. Formation of a pure form of crystal of soluble ionic compound helps to understand formation of an ionic crystal. To make 'My Crystal Garden' material needed is common salt (NaCl) or Copper Sulphate ($CuSO_4$) powder, water, containers, stirrer, strainer, thread, hanger, empty glass jar. **Time** needed for preparation is one week. Each team was given 5 minutes for **Presentation** written report.

Expected method to make a pure crystal of Ionic Compound of NaCl / $CuSO_4$ is; students will take common salt in a container, make concentrated solution of salt in water, and filter it using filter paper to remove insoluble impurities. Tie a very small crystal of salt to the thread, and allow it to remain immersed in water, place the glass

container of salt solution in the window. Hang the thread in the window. Allow the glass container to remain in the window undisturbed till the crystal is formed. Form colorful crystals by adding colour and present it in the class.

Expected Learning Outcomes are

- To know process of getting pure form of crystal of ionic compound
- To know difference between dilute and concentrated solution

Expected development of indicators of critical thinking skill

- Ability to analyze the information by identifying the components of information
- Ability to categorize or classify the components of the information

Expected development of indicators of problem solving skill

- Ability to recognize that the problem exists.
- Ability to define the problem.
- Ability to think of many possible alternatives.

Expected utilization of **science process skills** in this activity of **My Crystal Garden** is observation, experimentation, setting up hypotheses and their testing with controlled experiment, rethinking of new solution.

Activity 12: 'Identify Me' Who am I? Role Play

Description of the Activity:

Lesson 3 of Semester 2 **Periodic Classification of Elements** explains classification of elements according to their characteristics. This is an activity to be performed individually. Each student is supposed to come forward and enact like an element of his/her choice from the selected block selected by his group. Students described themselves with the characteristics of that particular element and asked others to identify it. Other teammates kept quiet till he/she could answer all the questions asked by students of other teams. To observe this activity investigator used 9 extra periods in the week other than normal teaching periods.

Method needed to do this activity: Mono Acting - WHO AM I?

1) Each tram should represent chosen block of elements through role play.
2) Depict the main characteristics of the elements in any one block.
3) Show why they belong to that block through dialogues.

4) Sound and light can be used to add to the effect.

5) Students will write a script for the elements belonging to the block they have chosen will enact like electrons, orbits and elements and show their properties. At the end the team will ask the audience to identify the block they belong to!

For Role Play 'WHO AM I?' material required is team of students, props like periodic table of elements, block to be presented, chart showing specific property of elements in that block etc. video camera, tape recorder if needed. **Time** needed to do this activity is one week.

Presentation: 15 minutes per team with written report.

Expected development of indicators of creative thinking skill

- Ability to think differently than others
- Ability to incorporate all aspects to generate new ideas
- Ability to present new idea with confidence

Expected development of indicators of critical thinking skill

- Ability to analyze the information by identifying the components of information
- Ability to categorize or classify the components of the information
- **Expected development of indicators of problem solving**
- Ability to recognize that the problem exists.
- Ability to define the problem.
- **Expected development of indicators of decision making skill**
- Ability to list relevant choices
- Ability to identify potential consequences of each choice

Plate_4.13 Role play for an Element of Periodic Table & audience ready to identify!

Expected use of **science process skills** during this is analysis of data related to position of element in the periodic table, its uses and characteristics also skill to report the scientific data.

Activity 13: Mime: Identify phylum / class of animal, Identify the animal

Description of the Activity: Fourth lesson named Diversity in Living Organisms students chose phylum Echinodermata, Euarthropoda, Cnidaria and Annelida from the lesson of animal classification. During this LSEP activity students were asked to present the characteristics of animal of chosen phylum through Mime. Mime is a role play without sound, without dialogues. Each team of students was asked to display the characteristics of chosen animal in a group. This was a group performance. Other classmates were supposed to identify the animal, its phylum and its class.

Materials required in this activity are to be decided by the team mates. Requirements for this activity was a team of students, props displaying characteristics, chart showing specific property of species in that particular class and video camera if possible. **Time** needed to prepare this activity was one week. Each group was given **10** minutes for **Presentation**. Presentation was followed by question-answer session.

Expected Learning Outcomes

- Know the characteristics of each class, each phylum of that animal.
- Understand and depict the characteristics of that particular animal through **action.**
- Know the difference between the characteristics of animals of different phyla.

Expected development of indicators of critical thinking skill

- Ability to analyze the information by identifying the components of information
- Ability to categorize or classify the components of the information

Expected development of indicators of creative thinking skill

- Ability to think differently than others
- Ability to incorporate all aspects to generate new ideas
- Ability to present new idea with confidence

Expected development of indicators of problem solving skill

- Ability to recognize that the problem exists.
- Ability to define the problem.

Expected development of indicators of decision making skill

- Ability to list relevant choices
- Ability to identify potential consequences of each choice

Expected use of **science process skills** during this is observation, interpretation and analysis of data and reporting in the form of Mime.

Plate_4.14 Students with the model of specie: Sea Anemone, phylum Cnidaria presented at the end of Mime: Audience ready to probe


Plate_4.15 Girls showing characteristics of specie, spider of phylum Euarthropoda


Activity 14: Project GRANDMA: Use of medicinal plants in home remedy

Description of the Activity:

Our Natural Resources is Lesson eight of semester two of textbook named, **'Science and Technology'.** It describes the concepts like renewable and non-renewable resources, their role in climate control, their uses and impact on mankind and impact of human activity on the natural resources. It discusses of global problems like green-house effect and ozone layer depletion. Natural resources like local plants around us have many

medicinal properties. The ingredients like turmeric (Haldi powder), asophoetida powder (Hing), cumin seeds (jeera), carom (Ajwain) seeds, fenugreek (methi) seeds, coriander seeds (hara dhaniya), cardamom, cloves, chilly, mustard, garlic and onion which belong to Indian Kitchen and leaves of Indian basil plant (Tulsi), Azadirachta Indica (Neem), Night flowering Jasmine (Parijat), Hibiscus-Jasmine (Shoe flower have medicinal uses. Grandmothers in India know uses of such resources and use them as home remedy for acute diseases generally. Students of Experimental group were asked to interview at least 10 grandmothers, collect the data related to home remedies using local medicinal plants or cooking ingredients of her kitchen.

Method to do the **PROJECT: "GRANDMA":** Student of each team will meet at least TEN grandmothers or great grandmothers and prepare a report on the medicinal plants used by your family and relatives. OR find the methods used by them to recycle and reuse the resources provided they did not come across grandmothers who use medicinal plants for home remedy.

Material requirement for project "Grandma" is Voice recorder / video recorder if possible, notepad, pen, format of structured interview, interviewer and interviewee and foolscap papers to write a report.

Time needed for preparation: one week and time allotted for **Presentation: 5 min.**

Expected Learning Outcomes

- Know use of natural resources around
- Know existence of plant products in the kitchen that can work as home remedy for acute diseases
- Know importance of each ingredient in human life
- Know recycling and reuse of natural resources around

Expected development of indicators of critical thinking skill

- Ability to analyze the information by identifying the components of information
- Ability to categorize or classify the components of the information

To develop creative thinking skill

- Ability to think differently than others
- Ability to incorporate all aspects to generate new ideas
- Ability to present new idea with confidence

To develop problem solving skill

- Ability to recognize that the problem exists.
- Ability to define the problem.

To develop decision making skill

- Ability to list relevant choices
- Ability to identify potential consequences of each choice

Expected usage of **science process skills** is related to observation, analysis of data, formulating a hypothesis, testing it through survey, finding a conclusion and writing report. If data collected does not support the hypothesis then disprove it or derive a suspended judgment.

Activity 15: Project GRANDPA

Role of homemade food in development of Family's economic and home remedies for commonly occurring acute diseases

Description of the Activity: This LSEP activity is based on Lesson 9 named as **Food Resources.** This lesson discusses ways to improve crop yield by crop variety improvement, crop production management, and nutrient management, irrigation system, cropping pattern, crop protection management and animal husbandry. Most of the families of students of experimental group have agricultural land in rural area of Gujarat and their great grandfathers or grandfathers practice agriculture at their native place. However increasing trend is seen amongst the adolescents of class IX and their parents in consumption of fast food and processed food in the form of fried items available in packets. This is taking toll of their health. If students have technical knowledge about agriculture but do not realize importance of farm fresh homemade healthy food then there is a possibility that they might have information related to agriculture but stop practicing it in reality. After doing the project **Grand Pa** they should be motivated to use farm fresh and homemade food.

Method to do the **PROJECT: "GRANDPA"** Individual activity followed steps like

- meet at least 10 grandfathers
- find the food items consumed by people since last 50 years grown in your native place and in your state
- find the role of homemade food products in the development of family members

Material required to do project "GRANDPA" was voice recorder / video recorder if possible, notepad, pen, interviewer, interviewee and 2 foolscaps to write a report. Time allotted for preparation was one week. Students were asked to present their written report and share their experience of doing this activity orally.

Expected Learning Outcomes

- Know importance of farm fresh food in terms of economic welfare of family
- Know importance of homemade food in terms of health of family

Expected development in indicators of critical thinking skill

- Ability to analyze the information by identifying the components of information
- Ability to categorize or classify the components of the information

Expected development in indicators of creative thinking skill

- Ability to think differently than others
- Ability to incorporate all aspects to generate new ideas
- Ability to present new idea with confidence

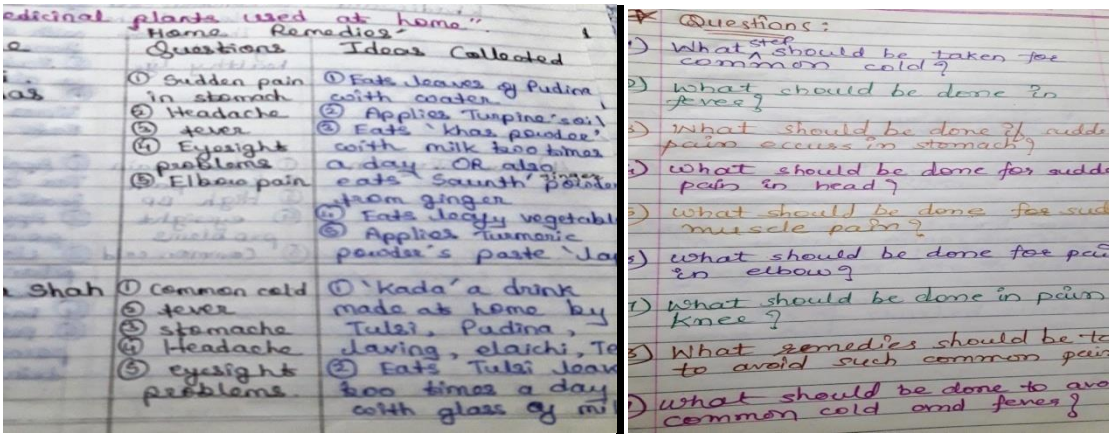
Expected development in indicators of problem solving skill

- Ability to recognize that the problem exists.
- Ability to define the problem.

Expected development in indicators of decision making skill

- Ability to list relevant choices
- Ability to identify potential consequences of each choice

Plate_4.16 Home remedies from Grandpa & questionnaire made by student



Expected use of **science process skills** during this activity is observation, data collection, defining a hypothesis related to family health in terms of usage of farm

fresh and homemade food and interpretation of the data to arrive at a conclusion after survey.

The investigator collected data before LSEP and after its implementation. Its effectiveness is measured through pre test and post test of experimental and control group on indicators of thinking skills. In the proceeding section it is discussed further.

4.4 Study of Effectiveness of Life Skill Education Programme (LSEP)

In the initial month of June, 2012 the number of students in the experimental group was Sixty three. Three students out of sixty three remained absent very often so they were removed from **'n'** reducing it to sixty. For Analysis of data n = 60 was used. First three activities have two sub activities each, so in all there were eighteen activities performed by the students. To achieve the objectives following null hypotheses were framed to study the effectiveness of the Life Skill Education Programme designed by the researcher. The difference in the mean scores of the dependent variables shows impact of the intervention programme.

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.

To test hypotheses H01 – H04 that states mean scores of post test and pre test of four life skills within the experimental group; Wilcoxon Signed Rank test of significance at 0.05 level of confidence was used. To test H05 –H08 i.e. to study significant difference between gain scores of experimental group to that 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 effectiveness. Proceeding sections provide details of the analysis of above mentioned hypotheses.

4.4.1 Analysis of the score of life skills studied before and after the treatment for the experimental group

To find Difference between scores of life skills of students of Experimental group before and after the treatment, Wilcoxon Signed Rank Test was used. The results are as shown in table 4.3. "A Wilcoxon Signed-rank test indicated that effect of LSEP was more on Creative Thinking, Decision Making, and Problem Solving Skills than Critical Thinking Skill for the students of Experimental group."

Table_4.3 Comparison of the score of life skills studied before and after the treatment for the experimental group

Tests	Mean	Standard Deviation	Z value	Asymptotic. Signed value (2-tailed)
Critical thinking pre test	68.12	7.78	-1.828[b]	0.07
Critical thinking post test	70.65	8.37		
Creative thinking pre test	34.92	12.99	-6.737[b]	0.01
Creative thinking post test	66.68	16.78		
Decision making pre test	67.08	7.16	-6.740[b]	0.01
Decision making post test	82.62	6.87		
Problem solving pre test	54.07	6.87	-6.663[b]	0.01
Problem solving post test	77.78	11.22		

- As per the Wilcoxon signed rank test employed on the scores of experimental group, it is observed that calculated asymptotic value 0.01 < 0.05, so it is significant at 0.05 level of confidence for creative thinking, decision making and problem solving Skills. Hence Hypotheses H02, H03, H04 are not accepted. However, asymptotic value for critical thinking skill is 0.07 > 0.05 so difference between mean scores of pre test and post test is not significant at 0.05 level of confidence. Hence, Hypothesis H01 is accepted.
- From the above table values, it is indicated 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.
- From the above table values, it is indicated 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.

4.4.2 Analysis of gain scores of life skills under study of experimental group to that of control group

To find difference between gain scores of thinking skills for experimental group and control group i.e. to test H05 – H08, mean (average) of each set of raw data is calculated. Gain score is equal to the difference between Post test mean and Pre test mean score of

each thinking skill, calculated for each group. These eight values are tested for significance using Mann Whitney test of significance, by software SPSS 20.

Table_4.4 Analysis of gain scores of life skills of experimental to control group

Tests under comparison	N	Mean	Std. Deviation	Mann Whitney U	Z	Sig. (2 tailed)
Posttest – Pretest	8	9.6800	12.54624	1.00000	2.02	0.04

Table_4.5 Result of Mann-Whitney U test

Test Statistics[a]	**VAR00001**
Mann-Whitney U	1.000
Wilcoxon W	11.000
Z	-2.021
Asymp. Sig. (2-tailed)	.043
Exact Sig. [2*(1-tailed Sig.)]	.057[b]

"A Mann-Whitney test indicated that effectiveness of LSEP is 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.

4.4.3 Analysis of post test scores of experimental group and control group

To test difference between post test scores of experimental group and control group i.e. to test hypotheses H09 – H012 Mann Whitney test was used and the result is as shown in table_4.6.

Table_4.6 Analysis of post test scores of experimental group and control group

Factors	**N**	**Mann-Whitney U value**	**Z Value**	**Asymptotic Sig. (2-tailed)**
Critical thinking skills	120	945.00	-4.49	0.01
Creative thinking skills	120	1077.50	-3.80	0.01
Decision making	120	430.50	-7.19	0.01
Problem solving skills	120	714.50	-5.70	0.01

*** Significant at 0.05 level of significance P value is < 0.00001**

"A Mann-Whitney test indicated that 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.

Detail Description of Result of Mann Whitney test for test Hypotheses H09 – H012

- From table 4.5 it was observed that Mann Whitney U value was 945 and Referring Table value for normal probability (Table A of Siegel, 1956) under null hypothesis (H09) of z, for $z < 4.49$ the two tailed probability was found to be smaller than our decided significance level i.e. 0.05, hence the null hypothesis i.e. " There will be no significant difference in the enhanced scores of the critical thinking skills of the experimental group to that of control group. " is not accepted and it can be said that experimental group and control group differ stochastically in terms of enhancement of critical thinking skill.
- From table 4.5 it was observed that Mann Whitney U value was 1077.5, Referring Table for normal probability value (Table A of Siegel, 1956) under null hypothesis (H010) of z, for $z < 3.8$ the two tailed probability was found to be smaller than our decided significance level i.e. 0.05, hence the null hypothesis i.e. " There will be no significant difference in the enhanced scores of the creative thinking skills of the experimental group to that of control group " is not accepted and it can be said that experimental group and control group differ stochastically in terms of enhancement of critical thinking skill.
- From table 4.5 it was observed that Mann Whitney U value was 430, Referring Table for values of normal probability (Table A of Siegel, 1956) under null hypothesis (H011) of z, for $z < 7.19$ the two tailed probability was found to be smaller than our decided significance level i.e. 0.05. Hence the null hypothesis i.e. "There will be no significant difference in the enhanced scores of the Decision making skill of the experimental group to that of control group." is not accepted and it can be said that experimental group and control group differ stochastically in terms of enhancement of decision making skill.
- From table 4.5 it was observed that Mann Whitney U value was 945, Referring Table for values of normal probability (Table A of Siegel, 1956) under null hypothesis (H012) of z, for $z < 5.7$ the two tailed probability was found to be smaller than our decided

significance level i.e. 0.05, hence the null hypothesis i.e. " There will be no significant difference in the gain scores of the problem solving skill of the experimental group to that of control group. " is not accepted and it can be said that experimental group and control group differ stochastically in terms of enhancement of problem solving skill.

It can be said from the above analysis that life skill education programme could enhance the thinking skills of the experimental group as the scores show significant difference at decided level of significance.

4.4.4 Effectiveness of LSEP in terms of students' response in development of life skills as observed by the researcher during implementation of LSEP

The researcher decided to use activities designed for LSEP to be used for formative assessment while piloting LSEP then while implementing LSEP which helped to keep fear of examination far from students. Hence students experienced joy of learning and being with their friends at a time. How did investigator evaluate performances / presentation of activities? This question is answered in detail for each activity in the following paragraphs.

Activity 1: Drama (Distance-displacement)

Initially students were given idea about the concept of distance and displacement through diagrams on the blackboard. They were asked to explain difference between distance and displacement through drama. Students were confused and "it is difficult, very difficult, I can't do it" were their reactions. Girls of Neptune group were first to show courage to present drama. They asked the investigator to repeat the instructions, tried to understand and wrote a script with dialogues around a plot, shared their ideas with each other, decided who will enact as whom, who will start, who will end the drama, which props to be used, how will they end the drama explaining the scientific concept. The group had to sharpen their Critical thinking and Problem Solving and Decision Making Skills and use creativity to design a drama and perform it. After watching their performance other students got excited and their inhibition to perform before the class vanished. Later each group discussed different stories to make a plot for drama and showed difference between distance and displacement. Probing by audience after each presentation made the concepts of distance – displacement, scalar – vector clear. Investigator noted the indicators for each student of each group in observation diary. As mentioned in LSEP

(Appendix_3.17) to perform this activity student needed ability to identify that writing a drama is a problem and one needs to use components of all thinking skills to address this and then attempt to take up the task. Students needed ability to analyze the information on distance, displacement given in science textbook, categorise components of information, think differently to design the plot for drama, incorporate all aspects to generate new idea, think of all possible alternatives, and identify potential consequences of the decision and present new idea with confidence. Explaining difference between distance and displacement only on paper does not give scope to develop life skills mentioned above. 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. 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.

Activity 2: Drama (Acceleration-Retardation)

For the same lesson of 'Motion' two more concepts carried importance, show difference between the two vector quantities indicating motion in opposite direction, where force of friction plays role. Before this activity investigator discussed about the procedure to carry it out but less instructions were needed, the groups which were hesitant to ask the teacher showed boldness to ask questions related to the content in science, method to write dialogues out of a story and discussed rigorously among their teammates about way to address the challenge given by their teacher. They got another chance to show their talent to the classmates and show that they have understood the difference between acceleration and retardation. 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. Adolescents of class IX bubbled with energy and happiness. 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.

Activity 3: Investigation: Health Museum in Sayaji Baug based on topic 'Why do we fall ill?'

Science teacher had discussed the causes, symptoms, treatment and preventive measures for acute and chronic diseases quickly with the class before the visit to Sayaji Baug. On a convenient day excursion was planned to a public garden in the city in the month of July. Visit to the health museum was scheduled. Parents were asked to drop their wards at Band Stand located at the centre of the public garden. Here students were given instructions regarding conduction of health survey. Each team was asked to select the disease it wished to study. Some chose contagious diseases and others non contagious chronic diseases. When asked the reason to choose particular disease they said "my relative is suffering from it" or "this is very painful disease'" or "many suffer due to this disease and it is fatal so we would like to study it". Health Museum in Sayaji Baug located near Amphi Theatre has exhibits showing human body systems, balanced diet, happy and healthy family, diseased organs, and description of many acute as well as chronic diseases, their symptoms and preventive measures or remedial measures. Only team leaders were sent inside the museum to see the exhibits and decide which disease they will choose to make report. Once the disease was chosen by the team; three teams were sent at a time in the museum to collect data related to particular disease. Other groups enjoyed playing around the place in their teams till then. Some groups started preparing a format to make report on the chosen disease. It was pleasure to watch them discussing about science in the lap of nature around the museum. When students were reporting about how they have decided to prepare the report of the disease chosen, investigator could identify the indicators like ability to categorise the components of information, analyse the information, ability to challenge the assumptions behind making of exhibit, ability to define the problem, ability to think of many solutions to the problem and indicators of decision making skill used by each student of the team. 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. 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.

Activity Four: Health Survey on Common Cold among visitors of Sayaji Baug

This activity was conducted on the same day and in the same garden as mentioned for activity three with time difference of two hours. Students were instructed to take a notepad and pen and discuss in group and make a structure of questions for interviewing the visitors of Sayaji Baug for Common Cold. Twenty minutes time was given for preparation and 45 minutes for data collection. Once all teams were together at the Amphi theatre, presentations were conducted. As the name suggests Influenza: Cough and Cold is a very commonly occurring disease. People are seen suffering with cold very often. The teams made questionnaire to be used for interview. Teams were asked to know about the age, occupation and residential area of the interviewee, frequency of cold, medicines he / she takes, reasons for its frequent occurrence, any preventive measures taken, food consumed during occurrence of common cold. Students made tabulated reports after the interview. Sayaji Garden is spread over a large area so teams were sent to different spots so that no team simply copies the data from other. Students made comprehensive report of data collected by each team and had wonderful conclusions, some are stated here verbatim,

- Persons who do more physical work in their occupation suffer very less number of times from cold
- Old people take good care of them, avoid eating readymade street food and do regular exercise, yog and pranayam
- People doing white collar job, sitting in office for long hours and do not care for their health suffer due to cold many times in a year but they prefer taking decoction made of Tulsi, bel (Billi) leaves, ginger and turmeric in water instead of allopathic medicine
- Visit to garden regularly for walk helps them maintain health

Reports made by students and discussions followed after their presentations showed rise in indicators of critical thinking, creative thinking, decision making and problem solving skills. 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.

Activity Five: Make a toy: Catch the fly

To understand Newton's laws of Motion in a better way by Play Way method investigator asked the students to get old greeting cards, invitation cards, string (manja), cello tape, scissors, Fevi quick glue, plastic straw which students like to collect after drinking cold drink, wax colour chalks, sketch pens etc. They were supposed to see the procedure followed by the investigator and make a toy for own on their own. Once the toy was ready they were asked to test Newton's first law of motion, check presence of inertia and apply unbalanced force to see the motion. An insect was drawn on card coloured the picture, pasted it on the cardboard and was asked to show the motion of lizard moving on strings towards the insect depicting the food chain. 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

Using the old, empty and flat shampoo bottle, two unshaved pencils, rubber bands, steel flaps of old floppy disks students made their toy boat after watching demonstration given by the teacher. Tested its motion in a water bath tub and tried to make it at home. They presented use of Newton's third law of motion during demonstration of working of a toy boat in water bath tub. They used variety of material to decorate the boat and some converted it to yacht. Audience asked questions to the presenters related to laws of motion. Preparation and presentation time is given in the schedule given in Table_ 4.1 gives details of LSEP with dates and time taken. 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. 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.

Activity Seven: Colloids around you- PPT / enactment of Advertisement

One week time was given to prepare prior to presentation in the month of August. Teams of students were supposed to make power point presentation (PPT) or present it in the form of advertisement of that colloid in daily use. All groups of boys and two groups of girls preferred making a PPT of ten slides with animation applied to slides and showed use of cold creams, body wash, face wash and eatables in the form of colloids. They could define the colloids well and describe properties of this kind of matter. While two groups of girls chose enactment as mode of presentation. They showed advertisement of face wash and face packs as colloids used in our daily life. When probed by audience after presentation they could describe the composition of suspended particles in the medium and answer the questions related to properties of colloids. Students used indicators of problem solving, creative thinking and decision making skills in doing this activity which were apparently seen in the performers. 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. 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.

Activity Eight: Seminar with 3-D model of the fundamental Unit of Life Cell

Students performed this activity with ease as they were assigned with such activity in primary classes too. They used threads, cardboard, thermocol, cotton balls,

sponge, plastic beads, straw, grain, colored chalks and variety of material to make three dimensional models of plant cell / animal cell and the teams presented it in the seminar. 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. 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.

Activity Nine: Investigation: Does gravity exert same force on stones of different masses?

Many students found this activity difficult. They were supposed to calculate value of **'g'** by doing experiment and compare it with theoretical value. For this they took stones of same material but different masses. Then measured change in velocity per unit time to calculate acceleration of stones under free fall. Most of the teams couldn't reach conclusion easily. The empirical and theoretical values did not match, so they were upset. When asked the reason for getting unequal values, 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. Students ranked this activity as Thirteenth. Investigator could note the indicators of Life Skill as C.T. – fifty two, Cr. T. – fifty two, D.M. – fifty, P. S. – fifty five.

Activity Ten: Seminar with PPT on theme 'effect of pollution on plant tissues / animal tissues'

This activity was designed in LSEP to strengthen the concepts of pollution of natural resources and effect of pollution on tissues of plants and animals. All nine teams of experimental group did this activity in more systematic manner than previously assigned seminar. Investigator had taught the lessons named Plant tissues, Animal tissues and Our Natural Resources by traditional chalk and talk method. To evaluate what have they learnt through activity for formative assessment investigator designed this activity in LSEP. Students needed least guidance for this activity as previous activity of Seminar showed 223 indicators of life skills, which shows considerable rise in indicators of life skills. Some teams made PPT showing effect of pollution on plant tissues and some on animal tissues. Concepts learnt in three lessons were woven well in the presentations. Presenting teams could answer all the questions asked by the audience. Total 219 indicators of life skills were observed by the investigator by then. 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 placed this activity at fourteen.

Activity Eleven: Skit: to show Rutherford's experiment

Students enacted the experiment performed by Rutherford. Each team member had a role to play of neutrons, gold foil, electrons, nucleus, protons and electromagnetic field. As many students were needed for skit they took help of other team members. Physics which otherwise is a boring subject for many became interesting. At this developing stage of students audience had gained expertise in asking questions and directing the discussion in the manner they want. Investigator had to take extra efforts to manage their enthusiasm. In depth discussions on scientific concepts, cross questioning led to 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:

Students studied their domestic electric bills of previous six months which they got from MGVCL, learnt how to calculate units of electrical energy consumption, how to measure consumption in watt-hour for each electrical instrument, and calculate the bill. Expert

from MGVCL was invited to teach them how to read an electric bill, how to take meter reading, how to tally the units calculated theoretically and the number printed in the electric bill. All the groups made graphs out of collected data from each member of the team and presented it through PPT. Computer teacher was asked to consider this activity for computer subject's formative assessment so that students remained free from tension of doing more assignments for the subject computer. Students used different skills of computer operation creatively to make PPTs. Their presentations showed use of indicators of all thinking skills. 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.

Activity Thirteen: Make Green Niche: Growing plants of different divisions: Classification of Plants: It is not easy to make classification interesting and enjoyable to teach and learn unless the teacher focuses on what is the basis for classification and how to classify living beings. In class IX science syllabus there are five lessons related to classification. Classification of plant tissues, animal tissues, living world, animals, plants, and elements in nature are included in science textbook. It is difficult for students to remember the order of classification and identify the plant or animal. 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: On learning how compounds around us are formed by elements in theory class, it was necessary to see the ionic or covalent compound in reality. Making a crystal garden allowed students to watch variety of ionic compounds formed around them and study the crystalline nature of the compounds like Sodium Chloride, Potassium Chloride, Potassium Bromide, Potassium Iodide and Sodium Fluoride. Students of each team decided to make crystals in the same glass bowl. Material to make ionic crystals alone was available in school and it was made available to all the teams. 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: Role Play (Elements in Periodic Table)

Classification of elements seen around us is done on the basis of atomic number of elements. Students of experimental group had learnt arrangement of electrons in orbits with Bohr's Electron Configuration technique in theory class and understood the periodic table with the help of chart. As this activity of 'Identify Me' began, students were little hesitant about presenting themselves as an element, the students of first team were not sure about which characteristics of elements they are talking about and why. Writing it on paper is easy compared to present orally before the classmates they thought. But one of the team members who took investigator's help to know the method to do the role play, presented it well, followed by plenary session and everyone got the technique to do it. Then 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. Students who had absolutely uneducated parents and zero educational culture at home also could present themselves as the element and answer the questions asked by the audience. Students who never read science text book earlier started reading through the printed lines and between the lines as they were allowed to keep the textbook lesson open for asking questions to the presenter. The audience asked questions like "why is this element placed in third group or how can you decide whether this element will make oxide or trioxide?" Or "Do you have a strong metallic character?" or "why is your atomic radius smaller than the previous element?" 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: Classification of Living World is taught with Five Kingdom Classification as suggested by Robert Whittaker in the textbook named, 'Science and Technology'. This activity was done to learn classification of animals rather to make students interested in so called 'boring chapter'. Most of the science teachers with whom the researcher discussed about this chapter said "why is this chapter included in class IX syllabus". "It is so difficult to teach or show them readymade PPT on it and finish the lesson". 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 (acting without dialogues). They enacted using props like saree, flash cards, models made of thermocol, charts and showed characteristics of sea anemone, jelly fish, corals, spider and python. It was not so easy to depict all characters and ask audience to identify the species as mentioned above. It was easy for the teams who chose the class Aves or Pisces or mammals to depict the characteristics through mime. By now students had gained many indicators of life skills which helped them to perform the activity in an efficient manner. Sum total of skills of all students observed during this activity was 242. 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. This activity was done very well by the students**.** The teams visited grandmothers living around their homes. Some visited in pairs and some went individually to interview their grandma's friends. The task to be done was to collect data from grand moms regarding their methods to reduce, recycle and reuse of materials around them. 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.

Activity Eighteen: Project Grandpa:

The lesson Food Resources was taught last in the academic year which gives a hidden message about having healthy diet and use food resources for good health. Food grains and plant products used in Indian homes, work as medicine too for acute diseases. 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 conducted interview of 10 grandpas each and collected data related to use of fenugreek, coriander, cumin, mustard, sunflower and flax seeds as medicine for stomach ache, heat stroke and gastric trouble. Ginger, Tulsi (basil), mint, Amla (Indian gooseberry), ajwain (carom-bishop's weed) are used for cold, indigestion, viral fever, good hair and skin and many more health problems. Students were extremely happy to do this project as their grandfathers were very happy to go with the grandchild to interview his friends. My Grandfather and his friends pampered our team, treated us with affection and told his friends about our important study we had conducted with pride. Later they shared many ideas which will be useful in our future life" they thought. 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. Analysis of life skills noted in observation diary by the investigator is given below.

4.4.5 Analysis of life skills recorded using Observation Diary

Investigator of this study observed presentation of each activity as a participant observer and noted indicators of each life skill in observation diary as shown in Table_4.7. Data in Table_4.7 shows the classification of indicators of life skills under study. Investigator discussed about the preparation of activity after its presentation by each team. Observation of videos and photographs helped the investigator classify the score of each thinking skill.

Table_4.7 Indicators of Life Skills noted in Observation Diary

LSA Number	Type of activity	Indicators of Life skills			
		Critical Thinking	Creative Thinking	Decision Making	Problem Solving
(1-a)	Drama	10	24	33	18
(1-b)	Play with Toy- drama	23	34	40	23
(2-a)	Investigation-Health Museum	35	39	33	25
(2-b)	Health Survey	36	30	45	32
(3-a)	Make a toy – Catch the fly	35	41	49	33
(3-b)	Make a toy- Boat	28	50	47	40
4	Seminar (PPT / Chart)	42	48	42	43
5	Seminar with Model	51	59	59	54
6	Investigation- Gravity	52	52	50	55
7	Seminar- PPT	45	61	58	55
8	Skit	57	55	50	50
9	Investigation - Electric bill	45	59	58	55
10	Make Green Niche	24	43	49	45
11	Make Crystal Garden	34	55	44	43
12	Identify Me – Role Play	49	55	60	61
13	Mime Identify the Class	57	65	58	62
14	Project Grandma	55	58	55	56
15	Project Grandpa	57	63	55	63

The data collected was categorized in three stages beginning, developing and accomplished and analyzed as follows. Later sum of indicators of thinking skills for six activities each were calculated for 1-6, 7-12, 13-18 activities respectively. This gave an idea about the status of thinking skills in the beginning of LSEP, in the middle of LSEP and in last stage of LSEP.

Table_4.8 Total Score per activity of Life skills noted during LSEP

LSEP Number	Type of activity	Score
(1-a)	Drama (Distance-displacement)	85
(1-b)	Drama (Acceleration – retardation)	120
(2-a)	Investigation-Health Museum	132
(2-b)	Health Survey in Sayaji Baug	143
(3-a)	Make a toy – Catch the fly First law of Motion	158
(3-b)	Make a toy- Boat	165
4	Seminar (PPT / Chart) Colloids	175
5	Seminar with Model Cell	223
6	Investigation- Gravity	209
7	Seminar- PPT Pollution	219
8	Skit	217
9	Investigation - Electric bill	229
10	Make Green Niche	231
11	Make Crystal Garden	176
12	Identify Me – Role Play	234
13	Mime Identify the Class / Phyla	242
14	Project Grandma	224
15	Project Grandpa	238

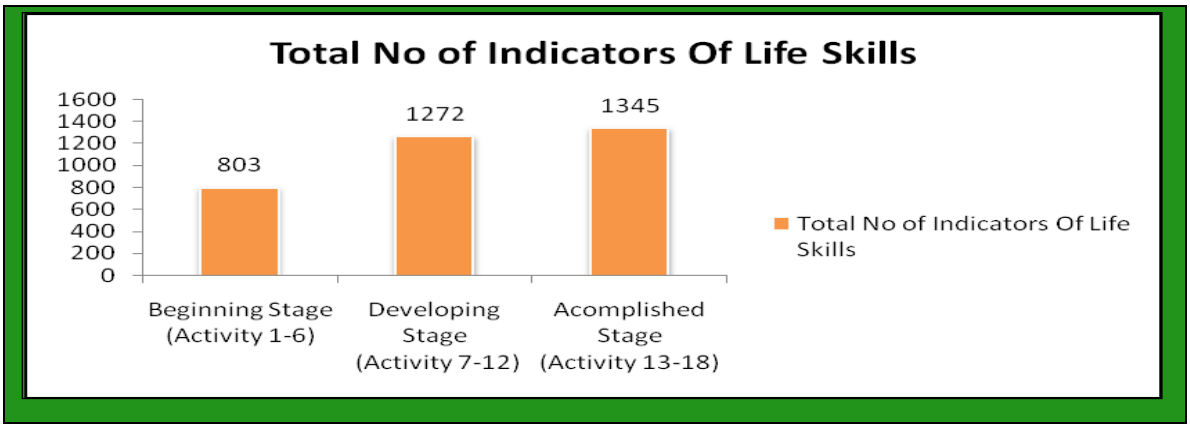
Above Table 4.8 shows the total number of indicators of life skills observed during implementation of each activity of intervention programme by the investigator using observation diary (Appendix_3.16). It was noticed that number of life skills observed for each activity increased gradually indicating that implementation of LSEP was effective in developing life skills under study. 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. Table_4.9 and

Graph_4.1 shows analysis of the indicators of life skills noted as a participant observer by the investigator. Table_4.9 shows enhancement in life skills in three stages of LSEP.

Table_4.9 Total number of indicators of life skill during stages of LSEP

Sr No	Stages of LSEP	Total No of Indicators Of Life Skills
1	Beginning Stage (Activity 1-6)	803
2	Developing Stage (Activity 7-12)	1272
3	Accomplished Stage (Activity 13-18)	1345

Graph_4.1 Total number of indicators of life skills



4.4.6 Analysis of opinions of students related to their choice of preference

Data related to liking of each student towards activity in LSEP was collected by using tool Opinionnaire-Part A, (Appendix_3.18). Each student of experimental group was given separate sheet to opine about their preference of choice. Students of Experimental Group were asked "Dear Students this data sheet asks your true and frank opinion about the activities that were conducted during the academic year 2012-2013 under Life Skill Education Program. The second column of the table shows name of the activity and you are supposed to tick mark your choice of preference in the column shown in the right." This data is presented in table_4.11.

Table_4.10 Choice of preference of activities

LSEP Number	Type of activity	Number of students who prefer the LSEP activity mentioned in column 2	Ranks given by students to the activity of LSEP
1	Drama	51/60	Eighth
2	Health Survey	57/60	Fourth
3	Make a toy	58/60	Third
4	Seminar (PPT / Chart) colloids	49/60	Tenth
5	Seminar with Model	45/60	Twelfth
6	Investigation- Gravity	42/60	Thirteenth
7	Seminar- PPT	41/60	Fourteenth
8	Skit	58/60	Third
9	Investigation - Electric bill	53/60	Sixth
10	Make Green Niche	52/60	Seventh
11	Make Crystal Garden	48/60	Eleventh
12	Identify Me – Role Play	59/60	Second
13	Mime Identify the Class	60/60	First
14	Project Grandma	50/60	Ninth
15	Project Grandpa	54/60	Fifth

Students show lesser liking for the activities like seminar or presenting seminar on investigation project of gravity. But students show more liking for indoor activities like role play, drama, skit, make a toy and outdoor activity like health survey in public garden, visit to health museum. Arranging the activities according to their ranks the order is;1) Mime, 2) Identify Me (Role Play), 3) Skit, 3) Make a toy 4) Health Survey, 5) Project Grandpa, 6) Investigation-Electric Bill, 7) Make Green Niche, 8) Drama, 9) Project Grandma, 10) Seminar (PPT), 11) Make Crystal garden, 12) Seminar with Model, 13) Investigation Gravity, 14) Seminar PPT on pollution.

4.4.7 Analysis of students' response to the activities of LSEP with respect to the difficulty they experienced during performance

Data related to students' opinion about the Life Skill Education Programme was collected through Opinionnaire-Part B, (Appendix_3.19). It stated "Give free and frank opinion for improvement in the instructional processes of '**Teaching of Science'** through following activities. Please underline your choice to select any one level of difficulty in performing

LSEP activity from the given choice. Put a tick mark before any suggestion that you agree with from the list given at the end of the paper." Students' liking towards the activities is analysed in table_4.11 while suggestions chosen by them are presented after the table.

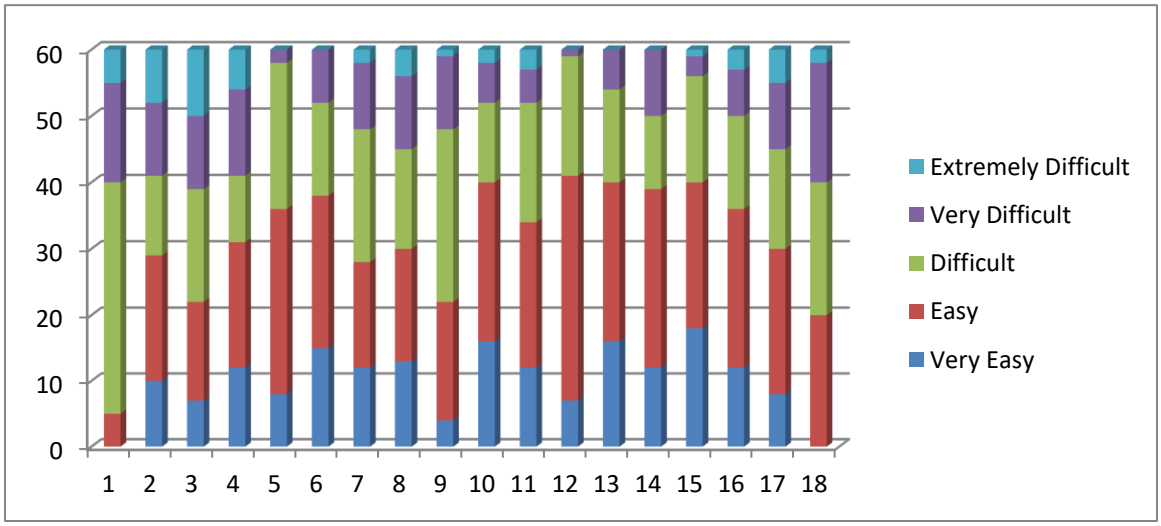
Table_4.11 Number of students as per difficulty level they experienced while performing activities in LSEP

Sr. No.	LSEP Number	Type of activity	Very Easy	Easy	Difficult	Very Difficult	Extremely Difficult
1	(1-a)	Drama	0	5	35	15	5
2	(1-b)	Play with Toy- drama	10	19	12	11	8
3	(2-a)	Investigation- Health Museum	7	15	17	11	10
4	(2-b)	Health Survey	12	19	10	13	6
5	(3-a)	Make a toy, Catch the fly	8	28	22	2	0
6	(3-b)	Make a toy- Boat	15	23	14	8	0
7	4	Seminar (PPT / Chart)	12	16	20	10	2
8	5	Seminar with Model	13	17	15	11	4
9	6	Investigation- Gravity	4	18	26	11	1
10	7	Seminar- PPT	16	24	12	6	2
11	8	Skit	12	22	18	5	3
12	9	Investigation - Electric bill	7	34	18	1	0
13	10	Make Green Niche	16	24	14	6	0
14	11	Make Crystal Garden	12	27	11	10	0
15	12	Identify Me – Role Play	18	22	16	3	1
16	13	Mime Identify the Class	12	24	14	7	3
17	14	Project Grandma	8	22	15	10	5
18	15	Project Grandpa	0	20	20	18	2

In the table_4.11 numbers shown in last five columns represent frequency of number of students. From the above observations it is indicated that number of students tagging the activity as "difficult, very difficult, extremely difficult" is seen reducing as implementation of LSEP progressed. The percentage of students opining the activity as 'easy' or very easy has increased over the period of implementation of LSEP. This indicates development in life skills which were essential to perform the activities. Activities of LSEP gave them scope to develop critical thinking, creative thinking, decision making and problem solving 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 categorized 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.

Graph_4.2 Showing level of difficulty experienced by students while performing each activity of LSEP



Analysis of suggestions given by students in group discussion collected by same tool:
Following Suggestions were given by students in oral discussion, which were to be chosen from a printed page three of Opinionnaire – part B

1. More time should be given to prepare and perform the activities.
2. Evaluation through activities is the best, no written exam should be held
3. More outdoor activities should be included
4. Evaluation through LSEP should be followed by SSC board in tenth standard
5. Activities like drama, seminar presentations, mime, role play should be there for each topic in each subject in place of written exam
6. More of 3-D model making, working model making should be included

7. If school time is less, then holidays can be used
8. More group activities should be included
9. Laboratory based activities should be included in LSEP
10. Test papers of school exams should be like pretest and posttest, situation based
11. Students should be allowed to form groups with students of their choice

Table_4.12 Table showing suggestions given by the sample

Sr. No.	Suggestion from students of Experimental Group	No. of students who agree
1	More time should be given to prepare and perform the activities	60
2	Evaluation through activities is the best, no written exam	50
3	More outdoor activities should be included	45
4	Evaluation through LSEP should be followed by SSC board in tenth standard	55
5	Activities like drama, seminar presentations, mime, role play should be there for each topic in each subject in place of written exam	45
6	More of 3-D model making, working model making should be included	23
7	If school time is less, then holidays can be used	48
8	More group activities should be included	60
9	Laboratory based activities should be included in LSEP	16
10	Test papers of school exams should be like pretest and posttest, situation based	58
11	Students should be allowed to form groups with students of their choice	53

- All students want more time for preparation, more group activities and they suggested achievement test papers of term exams should be like pre test- post test situation based questionnaire. Investigator probed the class to know the reason for less number of students suggesting activities like model making or laboratory based activity. According to those few students model making and laboratory activities are done every year in the school, so they would now suggest new kind of activities.
- At the end of the implementation of the LSEP one feedback session was conducted with the students. They shared their experiences of doing various activities and participating in the programme. Students responded that they could understand that science not only experiments in the laboratory but through various creative and practical activities. Investigation on Know your electric bill, project grandpa and project grandma were

directly related to their social life. They learnt how to reduce their unnecessary wants, reuse material and recycle resources from their grandmothers and learnt about medicinal plants and home remedy, around us through grandfathers they met during Project Grandma and Grandpa respectively. They responded that various activities such as Science drama, preparing toys out of waste materials, visit to health museum and botanical garden can contribute to achieve the higher level of objectives of science learning at secondary level. Principle of experiential learning and learning by doing could realize to greater extent in the process of implementation.

Frame_4.2 Qualitative responses given by the students as verbatim

- "This way of learning science is fun; I learnt hard concepts like periodicity in properties of elements well with Role Play in the activity named Identify Me!"
- "During the visit to Sayaji Garden for Health Survey I learnt how to frame questions for interview, how to interview people, how to make report"
- "Each activity made us think hard. I had to think of all components of information, rethink and make plan".
- "Showing characteristics of particular phylum through mime was such a wonderful experience. My team could depict the characteristics well and in second attempt audience could identify the specie. Learning classification of living beings in this way has left no doubts about why and how of classification."
- "Madam, Science should be evaluated this way only! Not by writing paper!"
- "I learnt writing script for drama and learnt how to direct it!"
- "I got confidence to speak and write. I think I can use the skills developed in me in my life."
- "My grandpa was very happy that I interviewed his friends and collected data related to homemade food and family's welfare; I feel satisfied and happy."
- "I loved activities related to PPT and seminar as I love computers and surfing on internet!"
- "Model making and laboratory experiments are done in school from class five, so I will prefer new activities along with those old ones!"
- "I liked doing Project Grandpa and Grandma as I got to know many things from them about recycle & reuse of waste at home and save our planet earth from environmental

Imbalance." "I liked this activity very much for one more reason that I got so many things to eat when I interviewed Grandmothers living around my home that I couldn't take lunch on that day.

- "My experience of Project Grandma was very good. I learnt new ideas to apply them in our daily life and help in recycling, reusing and reducing things which will help to protect environment."
- "By doing Project Grandpa I came to know about many home remedies for common acute diseases which we face in daily life."
- "I have experienced a lot of emotions, feelings during the survey. It was a pleasant sight visiting grandparents. They have explained to me how to recycle and reuse materials and how to reduce use of unnecessary things. Though some grandparents were not comfortable while answering my questions, they gave me new creative ideas to recycle and reuse. Grandpas told me home remedies for cold, cough & indigestion."

4.4.8 Feedback on LSEP given by Principal and colleagues through Programme Feedback Sheet after the implementation

Opinions of Experimental group's school Principal and other subject teachers were taken through Programme Feedback Sheet (Appendix_3.20). In all three colleagues responded. Their opinions are given below,

- 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. According to them Students had great fun in doing activities like visit to Sayaji Garden and mime.