Chapter: 4

Data Analysis and Interpretation

4.0 Introduction

In the previous chapter a complete account of the approach to study the main theme of the present investigation was elucidated. 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 an activity based science teaching programme at B.Ed. level and further studying its' effectiveness. The present chapter provides details of development of the Activity Based Science Teaching Programme for pre-service student teachers at B.Ed. level. The process of implementation ABSTP and analysis of which is also presented in this chapter. Following is a detail of comprehensive contemplation and the results, paving the way to interpretations and conclusions on the present study.

4.1 Data Analysis and Interpretation

As presented in the previous chapter, the study intended to develop an Activity Based Science Teaching Programme (ABSTP) at Department of Education, The M S University of Baroda, Vadodara, implementation of an ABSTP on student teachers for a period of one academic year and studying its' effectiveness. The results are presented in the following sequence.

- ❑ Development of an Activity Based Science Teaching Programme.
- ❑ Implementation of an Activity Based Science Teaching Programme on sample.
- ❑ Studying effectiveness of the developed Activity Based Science Teaching Programme.

4.2 Development of an Activity Based Science Teaching Programme (ABSTP)

The ABSTP was developed stepwise during two academic years 2007-2008, 2008-2009 detail of which is presented in this section.

- ❑ Analysis of the syllabus of the course "Teaching of science" offered at Department of Education, The Maharaja Sayajirao University of Baroda, Vadodara was carried out keeping in mind various criteria such as nature of content, scope of incorporating activity/activities and scope of integrating it with secondary curriculum. This provided a comprehensive idea about the course structure.

- Analysis of the curriculum of the subject 'science and technology' at secondary school level carried out to understand the subject matter thoroughly. It provided ideas about various content competencies to be developed among student teachers to enable them to be effective teacher at secondary level and design activities for them. Specific criteria considered while analyzing the curriculum were; concepts covered and possible activities which can be done by science teachers, scope of integrating the possible activities in the course 'Teaching of Science'.
- Various activities were identified from each of the units of Teaching of Science and planned keeping in mind the criteria; Objectives of the course teaching of science, Adequate content coverage from each of the unit, posilibility to design activity for student teachers', and Objectives 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 2007-2008.
- Various activities implemented on the student teachers were ;
  - Demonstrations on science concepts from secondary science and technology Syllabus.
  - Field trips to District Science Centre Dharampur of Valsad district, Community Science Centre, Vadodara, and Nature Park at Sindhrot near Vadodara.
  - Small group discussions on science laboratory; framing of objectives of science teaching.
  - Individual activities such as presentation on science and society, analysis of science textbook.
  - Workshop Activities on preparation of various teaching aids discussion and developing a science skit and executing to create awareness in the society about environmental problems and its protection.
  - Brainstorming on Inquiry Training Model and scientific method of inquiry.
  - Establishment of online forum and maintained by the student teachers.

- At the end of the academic year a group discussion was carried out to know their responses on each of the activities, its suitability for student teachers.
- Suggestions for further improvement and alternative activities were collected from them in a written form with the help of Feed Back Sheet, analysis of which is presented in frame 4.1.

Frame: 4.1 Feedback provided by Student teachers on various activities carried out during the year 2007-2008

- ✓ Field trips were the most important activities to develop content clarity in prospective teachers. They unanimously opined that every prospective science teacher should be taken to the field trips of the same places visited by them.
- ✓ Sessions on performance of science demonstrations should be more in number as it increased their understanding of science concepts as well as enhance their experimental skills.
- ✓ Reading material/instructional material should be provided for various methods of teaching before actual practice in the classroom.
- ✓ Suggested to visit the functional general science and technology laboratory before the execution of activity.
- ✓ In the unit technology in teaching they have suggested to form online group to enable them to submit the assignment, sharing of ideas/resources and to be in touch with each other.

- Activities suggested by the student-teachers in addition to the executed activities are conducting science quiz, formation of science club in department, visit to botanical garden, visit to planetarium for star gazing, preparation of aquarium, preparation of vivarium in small group, visit to science park Ahmadabad, project work on social issues by student teachers, practical exposure to the methods of teaching in classroom, making the unit science curriculum more interesting, showing some movies related to science fictions, organizing experts talks, workshop on teaching aids, writing science skit and enacting in group etc.
- Based on feedback, suggestions by student teachers; possibilities of the execution of activities during one academic year with available recourses; activities preferred by the majority of the students an outline of the Activity Based Science Teaching Programme was prepared, draft of which is presented in table no 4.1.

Table 4.1 : An initial draft of the proposed Activity Based Science Teaching Programme					
Sr. No.	**Topic**	**Objectives**	**Learning experiences**	**Time**	**Requirements for execution**
Introductory Sessions					
1	Introductory session	To acquaint the group members with department of education and to brief them about the ABSTP program	Warm up exercise	40 minutes	Circular Seating arrangement Video recordings
2	Objectives of teaching science	To make them aware about the importance of teaching science in school.	Focused group discussion	30 minutes	Circular Seating arrangement Video recordings
		To enable them to frame the objectives of teaching science at secondary level	Group activity followed by discussion	30 minutes	
Methods of Teaching					
3	Lecture-Demonstration	To make them aware about the lecture-demonstration method	Planning the lesson individually.	80 minutes	Topics and small group formation Video recordings
		To enable the student teachers to perform the demonstration effectively	Presentation by the group members.		
4	Assignment	To make the student teachers aware about the use of assignment method	Planning the lesson.	80 minutes	Topics and small group formation Video recordings
		To Prepare the lesson plans to execute the demonstration method for teaching given topic.	Small group discussion Presentation by the group members.		
5	Play way method	To make the student teachers aware about play way method in science teaching	Planning the lesson	80 minutes	Topics and small group formation

		To Prepare the lesson plans to execute the method with given topic of science.	Small group discussion Presentation by the group members		Video recordings
6	Project	To make the student teachers aware about project method in science teaching	Planning the lesson Individually.	80 minutes	Topics and small group formation Video recordings
		To Prepare the lesson plans to execute the method to teach science	Small group discussion Presentation by the group members		
7	Selection of the method	To make the student teachers aware of the alternatives in organizing the science instruction and selecting the best suitable.	Focused group discussion	40 minutes	Video recordings
Resources For Teaching Science					
8	Teaching Aids	To make them aware about the teaching aids and their uses in science teaching	Orientation about teaching aids + discussion	40 minutes	
		To enable them to prepare the teaching aid for any of the teaching point	Preparing teaching aids in groups in the classroom	60 minutes	Materials for preparing teaching aids. Seating arrangement
9	Science laboratory	To provide ideas about an ideal science laboratory	Group work on Preparation of science laboratory model	90 minutes	Worksheets Marker pens
Technology in science teaching					
9	Internet	To prepare student teachers to create their own email account.	Orientation Practical class	80 minutes	Computer lad with facility of 40 pc. Permission from respective authority
		To prepare them to use the internet service to share information with peer group.	Discussion on collected information	Varied	

		To enable them to collect the required information from internet to teach science.	Activity to submit online assignments	Varied	
Science Activities					
10	Science script writing	To enable them to develop the ability to write a script on science related topics. To develop instructional and other material for science	Orientation on script writing Discussion on issues related to science Preparing script on them	80 minutes	Paired activity Experts from language Recording
11	Brain-Storming	To enable them to develop critical thinking in their students	To conduct brainstorming in class on societal issues pertaining to science	45 minutes	PowerPoint Presentatation And discussion
		To prepare students to conduct brainstorming sessions.		45 minutes	
12	Bird watching	To provide them opportunity to visit the field. Importance of bird watching To enable them to plan about the bird watching for teaching science	Taking them into field Nal sarovar, Sidhrot University botanical garden	120 minutes	Subject experts to guide the student teachers
13	Field-trip	To provide them firsthand experience about the field trip To involve them in planning Organizing Executing the field trip	Taking them into field District Science centre, Dharampur Community science centre Vadodara.	Varied	Group of teachers in the science teaching Permission from place of visit Permission from department
14	Aquarium / vivarium for school	To involve them into preparation of viverium Planning Procuring the material and execution of the same		Varied	

- Thus prepared Activity Based Science Teaching Programme was referred to the experts for the validation. (List of the experts appended in annexure X). Suggestions provided by the experts were incorporated and modifications were made accordingly.
- Modified ABSTP programme was implemented on the student teachers during the subsequent academic year 2008-2009 to study the possibilities of implementation of each of the activities and time required.
- At the end of the year student teachers' feedback was collected for each of the activities and its effect on them through group discussion.
- Based on the student-teachers feedback and researcher's observation during the tryout of ABSTP Addition/modification/omission of activities was made to prepare the final draft. The Activities added were; inquiry training model, film show on global warming, preparing best toys from waste material, innovative ways of evaluating science learning, role play on science club and formation of online group. The activities modified were; brain storming on scientific method of inquiry, science laboratory, field trip, teaching aids, methods of teaching. The activities omitted were; science script writing, bird watching, preparation of aquarium, vivarium.
- The Activity Based Science Teaching Programme was finalized keeping in mind the feasibility of its implementation in one academic year 2009-2010 with available resources during the academic year.

4.3 Implementation of an Activity Based Science Teaching Programme (ABSTP)

The ABSTP was implemented keeping in mind the periods allotted for the course teaching of science, timetable and the academic calendar of the B.Ed. programme for the year 2009-2010. It was implemented in a natural environment without any control over variables so that it be implemented further with modifications. At the time of implementation the outline was fixed but it has flexibility in terms of slight change in timings and modifications in the mode of transactions as per the need of the particular group. The programme was implemented personally by the investigator during the academic year 2009-2010 on the group of student teachers opting for the course teaching of science. In two activities preparing best toys from waste material and brainstorming experts were invited, during the visit to community science centre, District Science Officer, CSC and subject area instructors were involved in the activity. Implementation

of the programme started on 29.06.2009 which lasted up to 12.03.2010. Total of twenty activities were conducted as per the decided time schedule.

Table 4.2 provides an outline of the developed Activity Based Science Teaching Programme with the time schedule, objectives, time duration in minutes and periods specified mode of transactions and expected outcome of the activities. Time required for the implementation was 2,605 minutes (43.40 hours) in the transactions i.e. fifty seven periods of forty five minutes each which does not include the field work and the preparation by the student teachers for activities such as internet surfing for group formation, laboratory visits and visit to District Science Centre, Dharampur.

Table 4.2 Outline of the implementation of an Activity Based Science Teaching Programme (ABSTP)

Sr.	Name of the Activity	Date	Time (Minutes)	Objectives of the activity	Method/Methods Learning Experiences	Expected Outcome of the activity
1	Introductory session	29.06.2009 30.06.2009	45 minutes 45 minutes	► To make the student teachers interact with the peer group in pair and then introduction Student teachers by each other. ► To help the student teachers to know each other. ► To increase the interaction of the student teachers. ► To make Student teachers understand about the peer member ► To help student teachers acquire the ability to know others through interaction and eliciting the information from the peer members. ► To provide the student teachers opportunity to present the relevant information about his/her partner in front of the group.	► Orientation to students, pair – share, discussion and introducing the partner to the group.	► Awareness about the programme and Development of fellow feeling in the group members.
2	Demonstration of activities based on selected concepts from Science textbook	03.07.2009 21.07.2009	35 minutes (60 min × 4) = 240 minutes	► To help Student teachers select, decide, invent content related demonstration which is feasible to perform in classroom situation. ► To procure /prepare/develop the required/method/equipment and materials. ► To encourage student teachers to perform in front of the peer group and teachers. ► To provide exposure to observe various demonstrations performed by their peers. ► To enhance their demonstration ability ► To assist Student teachers sharpen their observation ability, critical thinking, creative thinking, analytical and synthetic ability.	► Assignment of task, Organizing the activity on a select date, Demonstration performance by student teachers in front of group on select concept from school science secondary level followed by discussion and	► Improvement in experimental skills and clarity of concepts ► Increased confidence level for demonstration in front of students.

				► To create an environment where in discussion is encouraged to clarify their content/demonstration related doubts	question answer on the performed demonstration. ► Focused group discussion and feedback for improvement.	
3	Enlisting Qualities of an efficient Science Teacher	16.07.2009 18.07.2009 20.07.2009	45minutes 45 minutes 45 minutes (Total 135 minutes)	► To enable student teachers to identify the essential qualities every science teachers should have ► To enlist the essential qualities to be possess by every science teacher. ► To make the student teachers aware about expectations of society from science teachers by sharing the listed qualities. ► To develop a science teacher quality scale by refining the listed qualities. ► To make the student teachers rate oneself on the essential qualities Science Teachers Qualities Scale) STQS. ► To help student teachers identify one's strength and weaknesses as a teacher on the basis of own rating.	►Small group discussion on qualities of good science teachers, Preparation of comprehensive list of qualities of science teacher. ►Referring it to the expert and finalizing the checklist. ►Test of science teachers qualities	► Awareness, motivation and sensitization for qualities to be acquire during the training programme. ► Increase in Self evaluation ability ► Role clarity is achieved
4	Formation of Online group	06.07.2009 20.07.2009 Onwards	No time bound activity	► To prepare student teachers to create their own email account. ► To prepare Student teachers to use the internet service to share information with peer group. ► To enable Student teachers to collect the required information from internet to teach science. ► To disseminate the science related information to the group for improvement of teaching. ► To create a network of science teachers to share their	►Orientation and ►Practical class ►Discussion on collected information ►Submission of assignments online ►Sharing of information about	► Increase in their info-savvy and techno-savvy skills. ► Networking of all the student teachers for

				expertise and learn from others. ► To enable Student teachers to use the online group for submission and dissemination of science knowledge.	educational websites, latest news about science.	disseminating the knowledge and promoting science. promoting paper less culture
5	Critical analysis of objectives of teaching of science as decided by various institutions / commissions / committees	22.07.2009 28.07.2009	(35+60) 95 minutes	► To make student teachers aware about the importance of teaching science at secondary level. ► To make the student teachers aware about the various skills, ability and qualities to be developed by student teachers ► To give student teachers historical perspective of change in emphasis on different aspects of objectives of teaching science ► To study the objectives of teaching science as suggested by various commission and committees at different point of time in India ► To enable the student teachers decide the objectives of teaching science at secondary level in the contemporary society. ► To enable student teachers to judge the relevance/ comprehensiveness of objectives of teaching science at contemporary society.	►Focused group discussion, ►Group activity. ►Discussion followed by individual writings	► Increase in the understanding about objectives of science teaching and progressively learning experiences to be provided in the class rooms ► Task clarity is achieved
6	Brainstorming session on Scientific Method	28.09.2009	(45×2) 90 minutes	► To make Student teachers aware about the scientific method of inquiry. ► To provide Student teachers opportunity to brain storm about various topics which can be addressed through brainstorming	►Puzzling situation and brainstorming on a given situation, discussion on process of inquiry	► Awareness about the usage of brainstorming and

						sensitization for using it in classrooms
7	Orientation about various methods of teaching of science	24.07.2009	60 minutes	▶ To make Student teachers aware about the various methods of teaching science and provide criteria of selecting a suitable method for particular content.	▶Orientation to various methods of teaching through power point presentation	▶ Awareness, clarity about various methods of teaching
8	Preparing Lesson Plan by following suitable method(s) of Teaching Science and Implementing the same in the real classroom situation	30.11.2009 04.12.2009 21.12.2009	45minutes 35 minutes 45 minutes	▶ To enable Student teachers to select the suitable method for their content ▶ To understand the criteria for selecting any method of teaching. ▶ To enable Student teachers to develop lesson plans using appropriate method. ▶ To practice the developed method in practicing schools on a given content. ▶ To critically evaluate the implementation and discuss the problems faced by student teachers in executions.	▶Providing an instructional material ▶Discussion about the methods of teaching context of executing it in practicing class. ▶Group Discussion on methods with specific content in small group ▶ Developing lesson plans for teaching through various Focused group discussion ▶ Presentation of ideas ▶ Refinement of ideas ▶ Practicing in schools	▶ Implementation of methods in classrooms and reflection on it

9	Exploring possibilities of inculcating values through teaching of science	17.08.2009 27.11.2009 28.11.2009 04.12.2009 21.12.2009	45 minutes 60 minutes 35 minutes 45 minutes	▶ To make the student teachers aware about the specified value which can be inculcated while teaching science at secondary level ▶ To enable student teachers to explore the possibilities of integrating the different values in the given content at secondary science. ▶ To decide the appropriate learning experiences to inculcate the specified value. ▶ To make Student teachers realize that these values can be integrated while teaching science at secondary level. ▶ To decide the plugging points in the content where in specified values can be integrated. ▶ To actually practice the integrated values during the practice teaching sessions in the practicing schools. ▶ To help the student teachers critically judge the extent and effectiveness of values practiced in schools.	▶ Focused group discussion ▶ Presentation of ideas ▶ Refinement of ideas ▶ Practicing in schools ▶ Reporting in written form ▶ Discussion on its implementation	▶ Interest and attitude for teaching science is increased
10	Science Excursion to Dharampur Science Centre	01.12.2009 02.12.2009 04.12.2009	One day (six hours in the field)	▶ To provide Student teachers experience of the science excursion ▶ To involve Student teachers in planning, Organizing and executing the science excursion ▶ To enhance student teachers understanding about the concept of science knowledge. ▶ To expose Student teachers to interact with the exhibits and plots present in field and enhancing their understanding about application of learnt concepts. ▶ To provide Student teachers experiential learning through science excursion.	▶Planning, Organizing and execution of a visit to the center. Clarifying doubt of the students in the field. ▶Motivating them for observation	▶ Clarity regarding the science concept increased
11	Awareness, sharing and integrating (wherever	23.12.2009	45 minutes	▶ To orient the student teachers for various electronic media and print media through which science can be taught ▶ To discuss about scope of using Student teachers in secondary science classes.	▶Discussion followed by library and reference work ▶Preparing list of	▶ Increased computer-literacy and using it for

	possible) technology in teaching of science			▶ To list out educational journals, websites to teach science at secondary level.	websites, movies, and aids.	information gathering & disseminating ▶ Online submission of assignment
12	Awareness regarding Science Process Skills	07.10.2009 20.01.2010	(45 + 60) 105 minutes	▶ To make the student teachers aware about the science process skills; both basic and integrated process skills. ▶ To enable student teachers to identify different process skills used by Student teachers in various science activities. ▶ To discuss various ways to develop science process skills among secondary school students. ▶ To provide exposure about the evaluation of science process skills.	▶Orientation about science process skills identifying basic and integrated science process skills by Situation based questions. ▶Discussion on how to evaluate these skills	▶ Increased understanding about processes of science
13	Planning for an ideal multipurpose science laboratory	11.11.2009 25.01.2010 25.01.2010	(45×3) 135 minutes	▶ To make student teachers aware about the importance of science laboratory for secondary science classes ▶ To provide exposure by visit to science laboratories of secondary schools. ▶ To enable student teachers to discuss and prepare a plan for multipurpose science laboratory. ▶ To present a plan for secondary science laboratory before the group. ▶ To prepare Student teachers to evaluate the laboratory plans presented by the peer groups. ▶ To enable Student teachers to learn the criteria of an ideal science laboratory.	▶Written guideline for observing the laboratory. ▶Visit to science laboratory. ▶Small Group work for designing their own prepare their science laboratory ▶Presentation by group with Power point presentation, charts , displays ▶peer evaluation ▶	▶ Clarity about planning for new science laboratory ▶ Designing , developing plan of science laboratory

14	Discussion on how to make science learning joyful	21.01.2010	60 minutes	► To make the student teachers aware about various mode to make science learning joyful. ► To identify various activities to make science joyful. ► To orient Student teachers for play way and experiential learning to make science interesting.	►Discussion on scope of non formal way to teach science. ►Science club, waste materials, movie, games, science museums etc	► Innovative ideas are generated for making science interesting
15	Visit to Community Science Centre Vadodara	23.01.2010 18.02.2010	120 minutes 240 minutes	► To provide Student teachers exposure to the community science centre. ► To provide student teachers exposure to the resources of science learning. ► To provide Student teachers understanding of various science concepts and teaching learning materials. ► To enable Student teachers to realize the importance of community science centre as a tool to popularize science among school students & member of the community at large. ► To create a network of learned community to popularize science among society.	►Planning organizing and coordinating with students and authority CSC Vadodara. Taking them to the CSC Vadodara, providing them first hand experiences of science display.	► Interest for science teaching is increased, awareness about CSC is generated
16	Viewing prerecorded video of demonstrations of activities / experiments based on concepts from science curriculum and discussion on it	10.02.2010	Four hours	► To provide student teachers exposure for effective demonstration. ► To identify the errors/mistakes committed by student teachers ► To find out alternative solutions, activities to make the concepts more clear. ► To enable Student teachers to generate newer ideas for activities in science classes.	► Video recordings of previous year students , few recordings of workshop on science were shown to them	► Clarity about their mistakes resulted in better performance in Demonstration performance

17	Film show on global warming	19.02.2010	60 minutes	► To provide Student teachers exposure to the issues related to environment ► To make Student teachers realize the impact of film as a powerful media to teach science related issues	► Film show on inconvenient truth Followed by discussion ► Listing causes of global warming and role of teacher in reducing it	► Awareness, sensitization about environmental problems and global warming
18	Demonstration of activities based on selected concepts from Science textbook	16.02.2010	35 minutes + (60×4) 240 minutes (Total 275 minutes)	► To check student teachers' experimental skills. ► To provide Student teachers exposure to demonstration based on various science concepts. ► To study the level of enhancement in selecting the activity and performing the demonstrations.	► Assigning the task date finalization ► Individual student's presentation on select concept followed by discussion on the performed demonstration ► Feed back for further improvement. ► Assigning marks to the students	► Realization of increased confidence in performing the demonstration
19	Preparation of TLM from waste materials (Best out of Waste)	17.02.2010	90 minute	► To provide exposure for preparing science TLM from west materials ► To enable Student teachers to prepare various science material from the waste materials	► Collection of west material from home. Learning to prepare the toys to explain the science concepts	► Sensitization about using waste materials to make science classed live, interesting and joyful

20	Identifying and enlisting possible activities / TLMs from textbook of Science	01.02.2010 03.02.2010	45 minutes 45 minutes	▶ To enable Student teachers to list out equipments, materials, which can be used in science teaching and learning at secondary level ▶ To make Student teachers aware about the teaching learning needed for science classes ▶ To prepare chapter wise listing of equipments to tech science ▶ To prepare a comprehensive listing of the equipments in science. ▶ Preparing a comprehensive improvised kit for science classes	▶ Group work ▶ Formation of the group ▶ Listing chapter wise equipments ▶ Models preparing in group ▶ Charts	▶ A comprehensive list of TLM and activity for VII and IX grade is prepared
21	Conceptualization Science Club through Role playing	22.02.2010	Five to six hours for field work 40 minutes for performance	▶ To enable Student teachers to learn about science club for teaching science. ▶ To make Student teachers aware about the status of science club in schools. ▶ To disseminate the knowledge to the peer group	▶ Reference work, visit to the science club of CSC and Zenith School ▶ Dramatization to provide information to the group	▶ Sensitization about status of SC in schools and role of teacher in same. An oath and commitment for improving quality of science teaching in school is taken
22	Developing innovative items /techniques for evaluation of students in	11.01.2010 18.01.2010	45 minutes 60 minutes	▶ Student teachers will be able to ▶ Identify various type of evaluation techniques for measuring learning of students ▶ Students will be able to expose for some innovative methods of evaluation of science learning ▶ Develop innovative tool to measure learning of science.	▶ Discussion based on their past experiences ▶ Showing them some tools of evaluation of	▶ Development of various science puzzles, stories and games to

	Science				psychomotor skills ► Showing innovative tool to evaluate their understanding of science concepts ► Group work on preparing tools	evaluate science learning.
23	Understanding the importance of Inquiry Training Model in teaching of science	12.03.2010	60 minutes	► To provide student teachers the experience of process of inquiry and enable to understand the importance of inquiry in science. ► To prepare Student teachers for using ITM in secondary science classes. ► To enable Student teachers to prepare lesson plans using these model.	► Putting student teacher a puzzling situation and carry out the process to get the process of inquiry ► Discussion on practicing this model in class room	► Clarity and awareness for using this model in classroom

This programme was developed for would be science student teachers to train them through Activity based teaching for science and technology subject at secondary level. Implementation of the programme began with the onset of the academic year 2009-2010. In the initial an ice breaking session was conducted for student teachers to develop the group feeling in them. The group was then exposed to various activities listed in the table 4.2 with exact date and time schedule of its implementation. Details about the procedural aspects of the activities are mentioned below one by one.

Activity one: Qualities expected in science teachers

This activity was indoor activity and implemented for realization of qualities expected from science teachers so as to enable them to develop the same.

- Student teachers were divided in the small groups.
- Recalling the good teacher whom they respected and liked and vice versa.
- Identifying the qualities of the teachers whom they respected and liked and vice versa.
- Listing of the qualities of teachers in general and science teachers in specific.
- Modifications in the list based on experts comments.
- A final Rating scale (STQ scale) was prepared.

Activity Two: Demonstrations of selected concepts from Science textbook

This was an indoor activity to enhance student teachers content knowledge, experimental ability and presentation skills.

- Student teachers are given instructions six days prior to execution of the activity.
- They selected a concept from secondary science curriculum to perform the demonstrations/activity to explain the concept for secondary school students in front of the peer group.
- They ensured the procurements required.
- On the decided date student teachers have performed in front of the group members and teachers one by one. Each of the students took about 5 to 10 minutes for the performance.
- Teachers have observed directed and provided clarification in the case of any confusion related to concept.
- While one student teacher was performing other student teachers observed and ask questions if any doubt was there.
- The whole session was video recorded for the purpose of feedback.

- Focused group discussion held at the end to provide them feedback about their performance, process skills execution and enhancement, refinement needed, alternative activity/activities possible, safety measures to be ensured while performing.

Plates 4.1 and 4.2: Student Teacher performing the science demonstration

Activity Three: Critical analysis of objectives of science teaching at secondary level

This was an indoor group activity to make student teachers realize the shift in the objectives of science teaching and expectations of various commissions from a science teacher.

- Student teachers were divided in the group of five.
- Discussion on why science is taught at secondary level as a compulsory subject.
- Preparation a brief note on why science is taught at secondary level by each
- Sharing the same with other groups
- Discussion and development of a general perception about why science is taught at secondary level.
- A scenario of science teaching at secondary school level was built up thought discussion.
- Indentifying gaps between objectives intended and classroom practices to achieve them for secondary school level.
- Orienting them about the changes in the objectives of teaching as reflected by various commissions and committees on education in India through power-point presentation.
- A critical evaluation of the aspirations of educationist, practices in schools and expectations of the society and shifting emphasis of objectives.

- They could realize that there has been shift in the emphasis from providing disciplinary knowledge to preparing students for knowledge construction.

Activity Four: Field trip to District science centre at Dharampur

Field trip was planned to Dharampur, District Science centre which is considered to be one of the most popular Science Centers in Gujarat for popularizing science in local community.

- Student teachers were motivated to plan and organize a visit to the District Science Centre, Dharampur.
- Instructions were given to them for various activities namely; interacting with exhibits, recording the observation, collection of specimen at the centre.
- It was a seven hours journey around 300 kms from Vadodara city one way. Student teachers spent around six hours time in the centre.

Plates 4.3 and 4.4: Learning with fun about physics concept at DSC, Dharampur

Plates 4.5 **and 4.6:** Student teachers engaged in observation at DSC, Dharampur

- The DSC, Dharampur consisted of various science displays (plates 4.3 to 4.8) both in open garden and inside the museums. Student teachers interacted with various indoor and outdoor exhibits understand the underlying science concepts, discuss the difficult topics with peers, teachers and experts.
- Group discussion on importance of field visits and community science centers in developing interest in students as well in science teachers after the visit.
- They understood and experienced the learning science with fun at CSC, Dharampur.

Plate 4.7: Student teachers at auditorium listening to the DSO, Dharampur

Plate 4.8: Teacher educator explaining a science concept at Technology room, DSC

Activity Five: Science laboratory

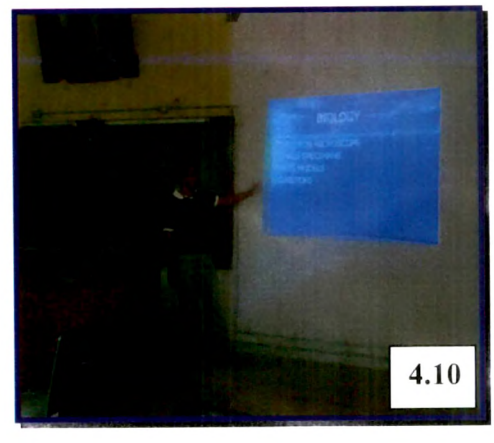
This activity was a blend of library work, field work, in house discussion and presentation by groups to enable them to understand the about ideal science laboratory and prepare the lay out plan of the same.

- Student teachers were given library work to develop the criteria for observing the science laboratory.
- Student teachers visited the general science laboratory in secondary schools while practice teachings phase I.
- They observed the science lab for secondary schools in terms of the developed criteria.
- A discussion on sharing of their observation about the secondary laboratory they have seen was conducted. They concluded that in many of the schools laboratory is not there and even if it is there it was not functional or up to the required level.
- Student teachers were divided themselves in six groups and study the written guidelines for a multipurpose science laboratory provided to them.

- They were asked to prepare a hypothetical plan of general science laboratory for secondary school with all possible details; layout, location, required materials, charts, models, technological gadgets.
- A lay out plan for their science and technology laboratory with budget and location along with the required infrastructure and materials and apparatus was prepared by each group and there were six groups of such. In the process of developing they consulted civil engineer and had estimation of layout and finance from them.
- Sharing of thus prepared plan with other groups (plates 4.9 & 4.10).
- The entire group had new ideas for their laboratory and way of presenting to the group. Sample of Layout plans are appended in annexure XXIII.
- Student teachers could evaluate the presented General Science Laboratory Plan.

Plates 4.9 and 4.10: Presentations of the layout of general science laboratory

4.9



4.10

Activity Six: Value Inculcation

This activity was carried out four days prior to the student teachers' second phase of practice teaching. During this phase they were to plan for the unit involving various activities and also evaluate the learning achievement of the students of the schools. Here student teachers were expected to assume a role of full fledged regular teacher of a school and involve themselves in various activities of a school.

- Student teachers were made aware about various values of science namely; utilitarian, vocational, aesthetic, intellectual, economic, scientific attitude, spiritual, moral.
- They were told to think about development and integration of values in secondary science students with the content given to them for practice teaching.
- Small groups were formed based on the similar content they got for teaching.

- They discussed in groups for integrating values in the students at secondary level while dealing with the given content. Focus was on two aspects; what are the values which can be integrated and how these value can be integrated?
- Members in every group could discuss and plan about learning experiences needed to integrate the values in their classrooms.
- Sharing of thus prepared plan with other group.
- Additions, alterations, modifications as per the requirement after each of the presentation. Researcher has provided inputs as per the requirements.
- Student teachers made an attempt to integrate the discussed values in their students during their practice lessons.
- They kept the record of the same and submit the same after practice teaching. In the report they provided their experience while implementing the same, problems faced by them and students responses for the same.
- They have shared their experiences in class and students responses about the same. Student teachers prepared lesson plans on various topics ;
  - While teaching about classification plants utilitarian, vocational, social value and aesthetic values were integrated in students in school.
  - Biosphere was taught and various learning experiences were provided to integrate intellectual, utilitarian, moral values as well as provide students training for developing scientific attitude in students.
  - Food nutrition and health was taught and various values such as utilitarian, aesthetic, vocational, social were integrated and attempt was made to develop scientific attitude in them.

Plates 4.11 & 4.12: Student teachers engaged in group discussion on value inculcation

4.11

4.12

Activity Seven: Visit to Community Science Centre, Vadodara

Community Science Centre, Vadodara is one of the best science centers in Gujarat and rose to the status of Regional Science Centre, Gujarat funded by Gujarat Council of Science and Technology (GUJCOST). The centre is working for the popularizing science among school students in particular and community in general.

Plates 4.13 & 4.16: Group of Student Teachers engaged in learning science concepts at CSC, Vadodara

Plates 4.17 & 4.18: Student Teachers involved in listening the expert at the science club at CSC, Vadodara

- Student teachers visited the centre two times along with team of teachers.
- Student teachers interacted with the exhibits at their pace and understood the concepts of science. In case of any difficulties Subject experts were present in each of the Rooms to explain the concepts.
- Every corner of the hall was full of scientific exhibits. Student Teachers divided themselves in three different groups and visited three different halls namely; physics, life sciences and ICT rooms. They also had an opportunity to witness participation of students of various schools in the activity of science club organized as one of the major activities by CSC for school students.
- It took six hours (Two visits of three hours each) for students to cover all exhibits. They took notes, photographs as well as video graphs of the exhibits.
- It was the experiential and collaborative learning where they discussed and clarify their doubts with their friends and experts.
- They were asked to submit a detailed report of the visit to Community Science Centre, Vadodara.

Activity Eight: Film show on global warming

From the movies of scientific importance researcher has identified the movie "The Inconvenient Truth" to sensitize the future teachers about the global warming and provide a chain to be continued for school children. The film shown to them is modified by German Technology Cooperation, climate change Unit, Indo-German Energy programme, Bureau of Energy Efficiency, Ministry of Power , Government of India and shorter than the original movie and provide purely educational concerns.

- The film was screened at audiovisual room on large screen at Community Science Centre, Vadodara and discussion was held by the expert present there.
- A film was shown to them; student teachers have noted down the questions and queries on global warming rose in their mind while viewing the movie.
- A full length discussion was carried out and the director of CSC provided additional information about global warming and clarified student teachers doubts on it.
- Student teachers were sensitized for environmental issues and also discussed role of science teacher in creating awareness in secondary students.

Plate 4.19: Student teachers watching movie on global warming at CSC Vadodara

Plate 4.20: A discussion on the global warming by Mr. Jitendra Gowdi, Director, CSC Vadodara

Activity Nine: Best out of waste

This activity was in the form of a workshop by Ms. Neela Dongre, a secondary school teacher with eighteen years of teaching experience and actively involved in the science club activities of community science centre at Vadodara.

- Student teachers were instructed in advance to bring certain waste materials from home such as used ballpoint pens, waste CDs, floppy disk, empty shampoo bottles, thread, plastic wastes, balloon, cello tapes, straws, water bottles etc.
- On the decided date the activity was executed
- General discussion about the importance of using toys to teach science by the invited guest was carried out.
- A simple toy was prepared by the expert. She prepared boat from shampoo battle to explain the concept of Newton's third law of motion, conversation of physical energy into kinetic energy, Archimedes principle and floating of object.
- While preparing another toy she involved student teachers in the preparation of the toys as instructed by her.
- Student teachers tried to prepare the discussed toys with the waste materials.
- A discussion and explanation of underlying science concept as well as use of the prepared toys and possible alternative toys for the said concept was held.
- All the student teachers interestingly participated in the activity and at the end of the session seven different toys were ready for science class.
- Many student teachers came forward with their own ideas to prepare toys or models for explaining science concept.

Plate 4.21: Workshop on preparation of toys from waste material

Plate 4.22: Demonstration of the prepared toy from waste materials

Activity Ten: Viewing video recording and discussion

This activity was carried out after the demonstration one and before demonstration two. Student teachers performance during the demo I was video recorded for the self viewing and reflecting on the mistakes and improving further. It was screened on large screen.

- Video recording of the performances of the student teachers in the demonstrations was shown to the group.
- Student teachers observed the video of their own performance along with the group.
- A discussion on their performances and executing the demonstration carried out at the end of each video clip.
- Suggestions about the science process skills exhibited and refinement required were given.
- Student teachers were shown the three best video clips of the ideal demonstration terms of their executions, arrangements and precision. This video clips were identified from performances of student teachers of 2008-2009.
- They were given guidelines to be kept in mind while performing demonstrations.
- The group enjoyed the activity very much as they have seen themselves for the first time in the video and get chance to observe their own performance.
- All the student teachers got an opportunity for self evaluation of one's own performance by viewing the pre recorded video clipping.

Activity Eleven: Science Process Skills and their evaluation

This activity was carried out to develop basic understating about the science process skills and its enhancement in students. The six basic science process skills namely: Classification, observation, communication, measurement, inference and prediction.

- A brief theoretical input about the science process skills was given.
- Several illustration including video clipping of the performances during demonstration o were provided through power point presentation.
- Few situations were presented to them for identify the particular science process skill used in the given conditions.
- Various science process skills exhibited by them while demonstration I were identified through group discussion.
- Student teachers discussed about various ways through science process skills can be developed and evaluated.
- They could realize that the science demonstrations, brainstorming session and field visits were the activities essentially enhanced science process skills in them.
- The Group also concluded that various learning environments and hands on experiences are needed to develop science process skills in students.

Activity Twelve: Identifying and enlisting possible TLMs from textbook of Science

This was an indoor group activity for making student teachers aware about the various teaching learning material required for teaching science at secondary school level.

- Student teachers were divided in the group of five members in each.
- All the chapters from the GSEB textbook of standard VIII and IX were distributed evenly to eight group.
- They were assign task to identify the demonstration, activities, experiments for each chapters in addition to the activities describe in the textbooks.
- They have identified the required demonstration, activities, experiments and a list was prepared by the student teachers chapter wise.
- A list of possible charts, models, materials, apparatus required for the using listed experiments, demonstrations and activities in the classroom was prepared by each of the group.
- Thus prepared list was shared with other group members and at the end a consolidated list was prepared.

- Thus prepared consolidated list was uploaded on online group for the access of group member. (List appended in annexure XIX)

Activity Thirteen: Brainstorming on scientific Method

This was a classroom activity to provide student teachers experience of scientific method of inquiry by brainstorming. Student teachers were provided the live demonstration by the expert.

- A candle was lightened and put it in the glass bowl half filled with water. Then it was covered by a glass inverted on it.
- Student teachers were asked to predict the result and observe the process.
- The candle extinguished after some times and the water level rose in the glass.
- Student teachers observed and hypothesized about various causes of the single phenomenon.
- They provided various possible causes about the phenomenon.
- Student teachers discuss about the possibilities for the result.
- A hypothetical situation was paused to them by which they were required to predict the possible outcomes in the same activity, what would happen if size of the candle is altered, number of candle is increased, size of glass to be kept inverted on a candle is altered and also the amount of water in vessel is altered in all the possible combinations.
- They were assigned task to perform, observe and record the results of this activity at home.
- They learnt to hypothesis, experiment, observe, classify, analyze, synthesize, generalize and predict about the given situation.
- Discussion on results obtained and reasons for various results held.
- They could find out the relation between the amount of water rose in the glass, time taken by the candle to extinguish and size of the candle.
- This activity cleared the steps of scientific inquiry along with the excitement of brainstorming.

Activity Fourteen: Methods of teaching and instructional material of it

This activity was carried out a week before the student teachers were to go to different schools for the second phase of practice teaching. During this phase they were to plan for the unit involving various methods, activities and also evaluate the learning achievement of the students of the schools. Here student teachers were expected to

assume a role of full fledged regular teacher of a school and involve themselves in various activities of a school.

- A hard copy of Instructional material prepared by the researcher in the form of a brief lecture notes was provided to student teachers and the same was also uploaded on the online group. (Copy attached in Annexure XV).
- Student teachers studied at their own pace.
- The same was illustrated with examples through power point presentation in a classroom situation.
- In consultation of science teacher of practicing school, student teachers had decided the content to be taught.
- They were divided into groups based on similarity of the content/units which they were expected to teach in the practicing school.
- Discussion about the possible methods based on the content selected and the resources available for teaching was held.
- Refinements were made in the individual ideas and Final lesson plans were prepared and executed in the classrooms by the student teachers during practice teaching.
- When they came back to department after completing of the practice teaching in schools; a discussion was held on their experience about using the various methods, problems faced by them, students' participation, classroom climate while implementations and their supervisors comment on those particular classes and their peer groups responses on the same.
- Majority of the student teachers reported that in case of use of heuristics method and role play students were very energetic but classroom management was a problem. Two of them could use them successfully in the classrooms.
- Majority of them said demonstration and discussion were the methods most suitable for contents of science.
- One student also conducted brainstorming session for teaching them about sources of energy.

Activity Fifteen: Inquiry Training Model

Inquiry Training Model (ITM) is a model from information process family to train the learners for processing the available information to arrive at a workable solution. Learners are confronted with some puzzling situation with direction in the form of

- Student teachers visited ten different schools to study the functions of science clubs in school. Visit to CSC provided by them clarity on objectives and expected functions of Science club.
- From CSC vadodara, they collected information about the functioning of the SCs at secondary level. Based on this they visited the SCs in different schools.

Plates 4.23 & 4.24: Student teachers performing in the role play on science club

4.23

4.24

- The scenario was presented in the form of a role play through dramatizing the experiences they had from schools.
- Student teachers enacted as the role of principal trying to hide the no functioning and opposite to it role of one of the school teachers very enthusiastically providing all the details about science club activities.
- At the end of the role play the actors made the student teachers take an oath to start science club activities in the schools they would be joining as teachers.
- Classroom was converted in the theatre and every student teacher showed enthusiasm to carry on the flame of popularizing science among students.
- A discussion on their experience on enacting and learning through role play was carried out. They understood role play as a powerful method to create awareness and sensitization about certain social issues while teaching science with long lasting impact on them.

Activity Seventeen: Evaluation techniques and tools for science learning

The activity carried out to provide them exposure to various evaluation items and innovative tools to evaluate students learning. Student teachers already had a basic understanding about various evaluation techniques used in the secondary schools based on their school experiences and course educational evaluation at B.Ed. level. Student teachers were exposed to various modes of learning science by this time.

- The question was asked, how should evaluation be? If various learning experiences were provided and science process skills were executed by the learners during field visits, demonstrations, role play, brainstorming, group works, individual work and library work.
- Student teachers came up with the responses such that oral testing, quiz, group discussion, observation, Multiple Choice Questions of application level. They were made to discuss advantages and limitations of each one.
- They discussed that evaluating science process skills are important but time consuming and difficult.
- The class ended with the question that what are the other techniques and tools which interest the student and evaluate their understanding and skills.
- A test having story containing science concepts with it and series of questions was conducted on them in the next class.
- When asked to reflect on the test they responded that it was interesting and checking understanding and application of learnt concepts of science.
- A rubric was prepared to evaluate experimental skills of student teachers were shown to them.
- Various innovative tools have been suggested by the student teachers such as cross words on science concepts, a poem based on science concepts, stories to evaluate students understanding.
- The class was divided in groups of five students randomly.
- The task assigned to them for preparing a new tool to measure learning outcomes of the learners at secondary level for any topic of their choice.
- Student teachers could suggest many different tools however they found difficult to construct.
- Out of the eight groups four groups could construct and submit the evaluation tools develop rest of the groups could not submit it. A sample of the submitted tool is attached as annexure XX.

Activity Eighteen: Demonstration II

This was an indoor activity to study the level of enhancement in student teachers' content knowledge, experimental ability and presentation skills. This was the similar activity to the demonstration I repeated by the student teachers at the end of the academic session.

- ❑ Student teachers are given instructions six days prior to execution of the activity.
- ❑ They selected a concept without repeating the concepts covered during demonstration one from secondary science curriculum to perform the **demonstrations**/activity to explain the concept for secondary school students in front of the peer group.
- ❑ They ensured the procurement of required apparatus.
- ❑ On the decided date student teachers have performed in front of the group members and teachers one by one. Each of the students' took about 5 to 10 minutes for the performance.
- ❑ Teachers have observed directed and provided clarification in the case of any confusion related to concept.
- ❑ While one student teacher was performing other student teachers observed and ask questions if any doubt was there.
- ❑ This has made them realize the difference in their earlier and the later performances.

Plates 4.25 & 4.26: Student Teacher performing demonstration on science concept


4.25


4.26

Activity Nineteen: Formation of online group and its execution

This activity was initiated in the beginning of the year and lasted up to the end of the year. It intended to enable the student teachers to interact with the World Wide Web and share the available knowledge with the peers. A facility is available on yahoo to create an online group to connect the users for sharing the ideas. The same was used and group was created and maintained.

- ❑ Student teachers were given the Information Sheet in the initial of the year and their email addresses were collected.

- An online group on yahoo was created and student teachers were informed to join the group by accepting the invitation sent to them. Researcher was the moderator of the group. Notification of the same is appended as Annexure XI.
- Student teachers were motivated to create their email ids if not having and made members of the group.
- The major attraction for joining the group was the Instructional Material on methods of teaching and science concepts kept on it in the initial stage.
- Gradually they were motivated to share the ideas, knowledge and link about science information whenever they got.
- During their practice teaching phase they had shared the resources they used for teaching similar topics by uploading it on group. The science Demonstration they performed as one the activities were also uploaded either directly by them or by the researcher in the cases of failure in unloading the files. The reports of CSC vadodara and Dharampur Visits were also submitted by them online group.
- There were many members who actively uploaded information on the group
- Regular access to internet facilities were limited in the department hence, many of them could not be active.
- The whole science group was connected through a common network and academic networking and sharing could continue and still it exists.
- Following is the link to access the group and send request to join the group. http://tech.groups.yahoo.com/group/science_2009_10.

At the end of the implementation of the ABSTP one feedback session was conducted with them. They shared their experiences of doing various activities and participating in the programme. Student teachers were responded that they could understand that teaching science is not only experiments in the laboratory. They responded that various activities such as Science club, preparing best toys out of west materials, educational movie, games, visit to science museums and community science centres can contribute to achieve the higher level of objectives of science teaching at secondary level. Principle of learning by doing could realize to greater extent in the process of implementation.

The responses of the student teachers are provided in the frame 4.2

Frame: 4.2 Responses provided by Student teachers on various activities carried out during the year 2009-2010

- ✓ "Even though I have done my masters in science, first time I experienced demonstration of an activity in front of a large group although with little fear in the beginning, I could do it. This has helped me in practice teaching".
- ✓ "During the visit to DSC, Dhrampur, I got firsthand experience and gained a lot of knowledge and I saw instruments of science that I had never seen before".
- ✓ "Mam, I realized for the first time that learning science could be so effective outside the classrooms also".
- ✓ "Wow!! I did not know about it. I shared that experience with my whole family frankly speaking mam' I would like my kids to definitely visit such places as a science teacher". (After the visit of Community science centre vadodara)
- ✓ "Very nice "I LOVED IT". I took the whole movie and showed to my practice teaching students and I promise to you, I will show it to my students in my future also." (About the film show on global warming).
- ✓ "Madam, I have never analyzed the burning candle experiment from multiple angles. Doing this activity and recording the observation was a thrill to me." (After the brainstorming session).
- ✓ "Mam, u really made us to use our E-mail addresses!"
- ✓ "Excellent idea of having science group as we can directly send and receive the soft copies of assignment at our convenience".
- ✓ "Madam! It was great satisfaction when I submitted the assignment online. I told all my friends about it".
- ✓ "Though I am staying near CSC, Vadodara, I had never visited it before. Madam i really learnt a lot from the centre and visited again after our visit before practice teaching which helped me a lot".

4.4 Effectiveness of an Activity Based Science Teaching Programme (ABSTP)

In order to study the effectiveness of the developed ABSTP following null hypotheses were formulated.

H01: There will be no significant difference between the mean achievement of the student teachers' in pre test and post test with respect to the treatment given through developed Activity Based Science Teaching Programme.

H02: There will be no significant difference between the mean score of experimental skills of the student teachers' in pre test and post test with respect to the treatment given through developed Activity Based Science Teaching Programme.

H03: There will be no significant difference between the mean score of nature of science scale of the student teachers' in pre test and post test with respect to the treatment given through developed Activity Based Science Teaching Programme.

H04: There will be no significant difference between the mean score on a quality of science scale of the student teachers' in pre test and post test with respect to the treatment given through developed Activity Based Science Teaching Programme.

To test above stated hypotheses, paired sample't' test was employed and't' values were computed for each of the hypotheses, details of which have been presented in the subsequent tables.

4.4.1 Difference between achievement score of student teachers' before and after the treatment

Table 4.3: Significance of Difference between the Mean Score obtained by Student teachers' on Achievement test before and after the treatment

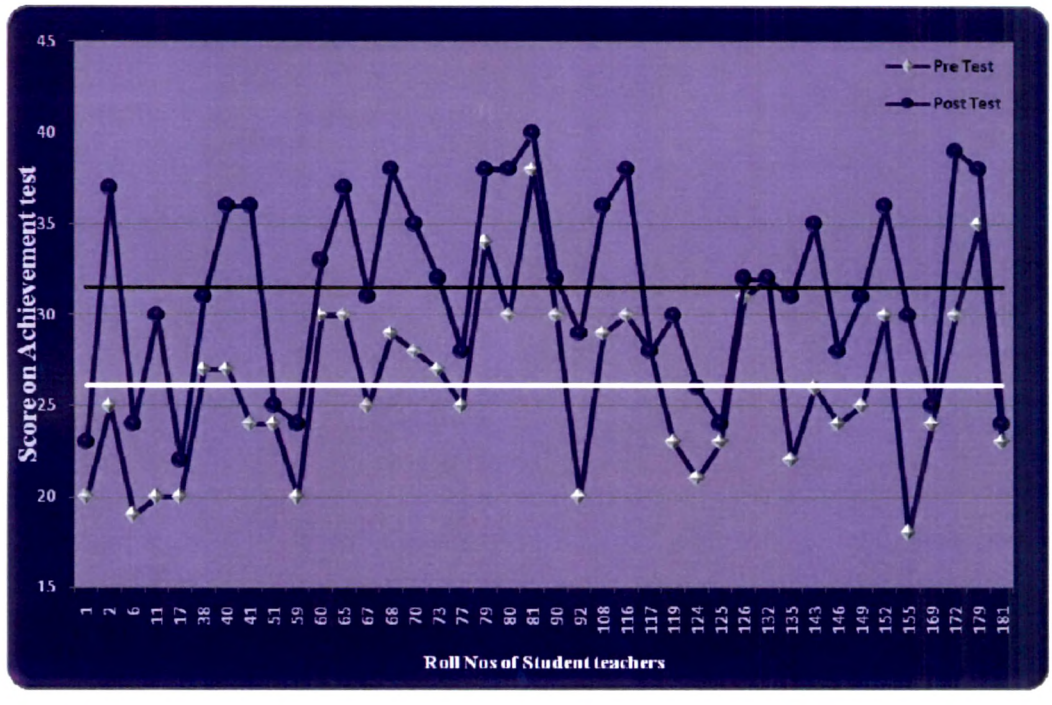
Achievement test Total Marks: 50	Mean	S.D.	S.E.M	Degree of Freedom	't' value
Pre test	26.15	4.7260	0.7472	39	9.7799
Post test	31.55	5.2180	0.8250	39	

* **Significant at 0.01 level of significance**

From the table 4.3 it is observed that calculated't' value is significant at 0.01 level of confidence. Hence hypothesis H01 "There will be no significant difference between the mean achievement of the student teachers' in pre test and post test with respect to the treatment given through developed Activity Based Science Teaching

Programme" is not accepted. Which indicates that the there is a significant difference in the achievement scores of the student teachers' with respect to the given treatment. The achievement of student teachers is found to be more in post test as compare to the pre test.

Graph 4.1 Difference between the pre test and post test score of Student teachers on an Achievement Test



4.4.2 Difference between mean score of performance test of student teachers' before and after the treatment

Table 4.4: Significance of difference between Mean score obtained by the student teachers in performance test before and after the Treatment

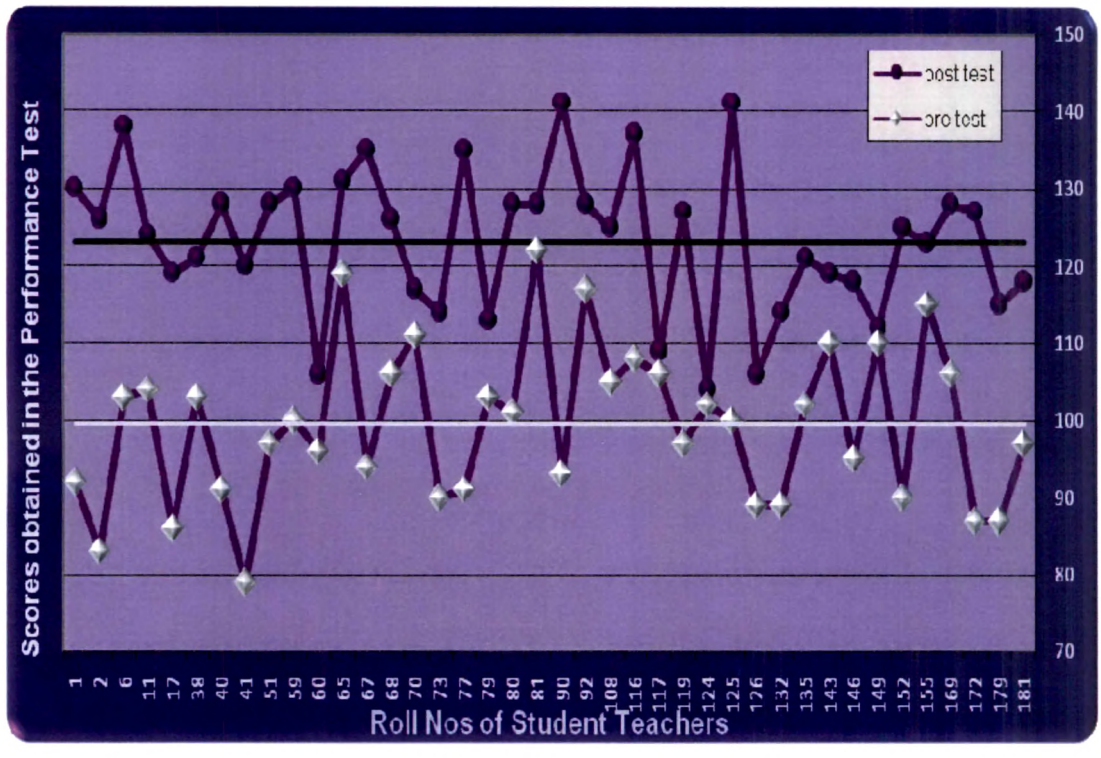
Performance test Total: 150 marks	Mean	S.D.	S.E.M.	Degree of freedom	t' value
Pre test	99.85	10.676	1.688	39	5.1496*
Post test	123.10	9.413	1.448	39	

* **Significant at 0.01 level of significance**

From the table 4.4 it is observed that calculated't' value is significant at 0.01 level of confidence. Hence hypothesis "There will be no significant difference between the mean score of experimental skills of the student teachers' in pre test and post test with respect to the treatment given through developed Activity Based Science Teaching Programme' is not accepted. Which indicates that the there is a significant difference

in the score of experimental skills of the student teachers' with respect to the given treatment. The score of experimental skills is found to be more in post test as compared to the pre test.

Graph 4.2: Difference between the pre test and post test score of Student teachers on a Performance test



4.4.3 Difference between mean score of nature of science Scale obtained by student teachers' before and after the treatment

Table No. 4.5: Significance of difference between Mean Score obtained by the student teachers on a nature of science scale before and after the treatment

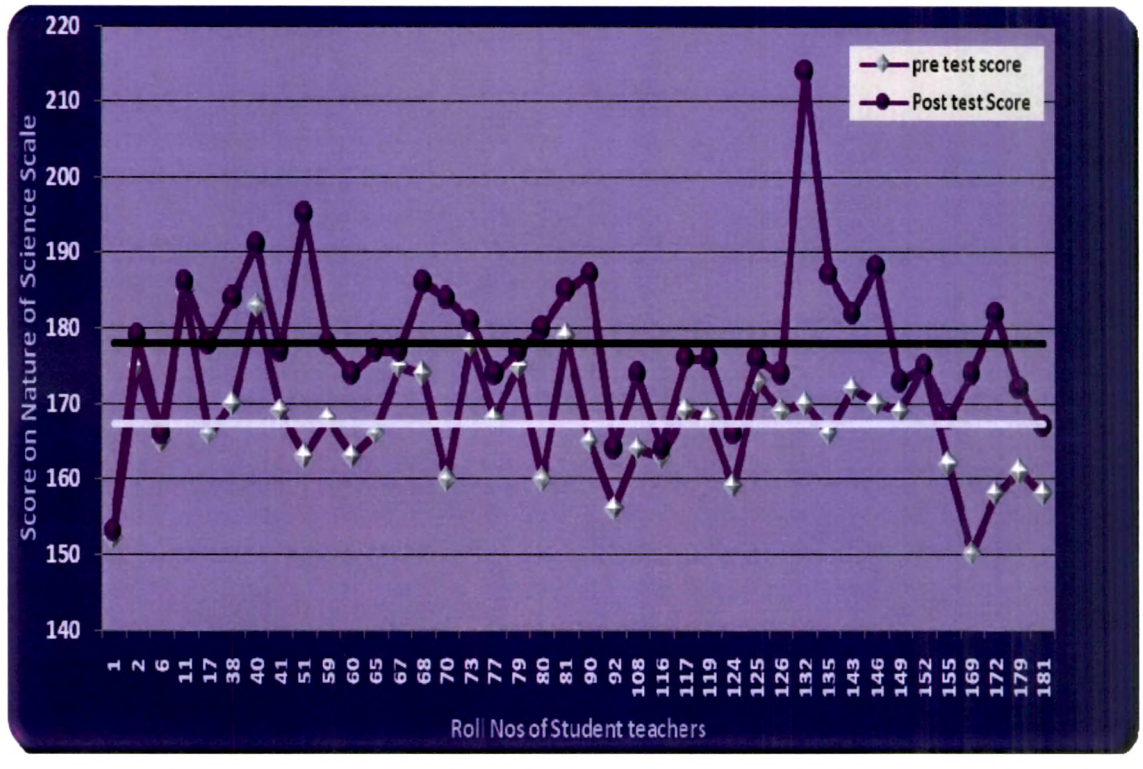
Nature of Science Scale	Mean	S.D.	S.E.M.	Degree of freedom	t' value at 0.01 level of significance
Pre test	168.7	9.65	1.5267	39	4.1396
Post test	176.7	10.04	1.5880	39	

* **Significant at 0.01 level of significance**

From the table 4.5 it is observed that calculated't' value is significant at 0.01 level of confidence. Hence HO3 hypothesis "There will be no significant difference between the mean score of nature of science scale of the student teachers' in pre test and post test with respect to the treatment given through developed Activity Based Science

Teaching Programme" is not accepted. Which indicates that the there is a significant difference in the score of nature of science scale of the student teachers' with respect to the given treatment. The score of nature of science scale is found to be more in post test as compared to the pre test.

Graph 4.3: Difference between the pre test and post test score of Student teachers on Nature of Science Scale



4.4.4 Difference between mean score obtained by student teacher on STQ scale before and after the treatment

Table 4.6: Significance of difference between the Mean Score of student teachers in STQ scale before and after the treatment

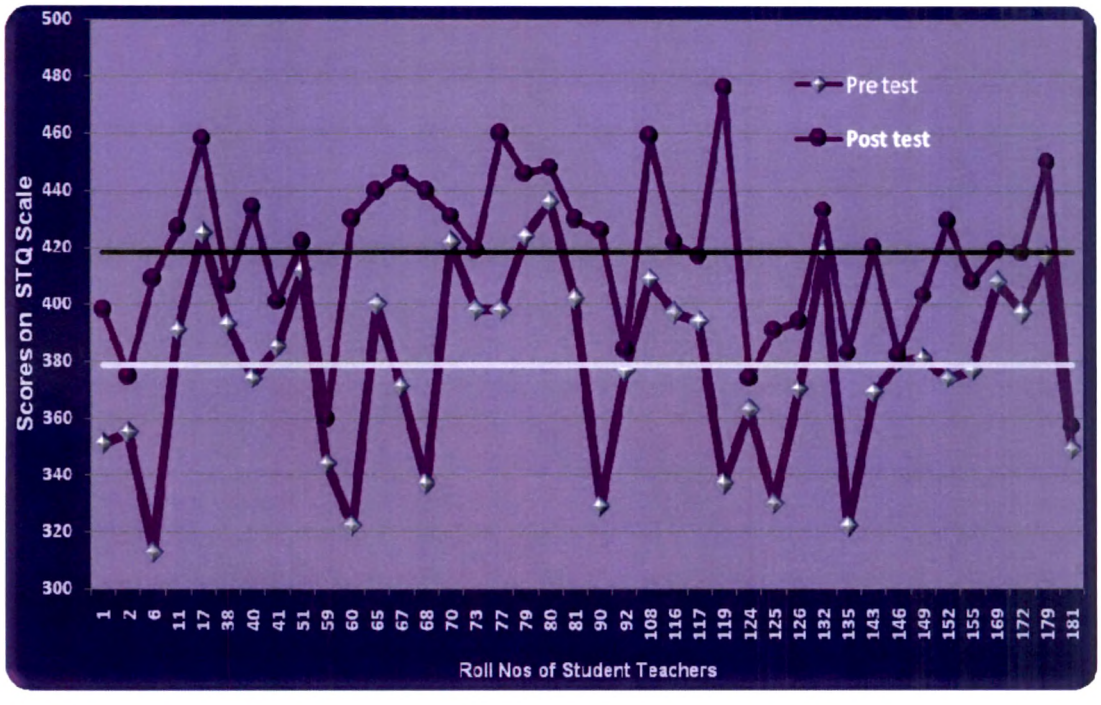
STQ scale	Mean	S.D.	S.E.M.	Degree of Freedom	't' value at 0.01 level of significance
Pre test	379.47	48.25	7.630	39	3.2038
Post test	409.75	35.22	5.56	39	

* **Significant at 0.01 level of significance**

From the table 4.6 it is observed that calculated't' value is significant at 0.01 level of confidence. Hence hypothesis H04 "There will be no significant difference between the mean score on a quality of science scale of the student teachers' in pre test and

post test with respect to the treatment given through developed Activity Based Science Teaching Programme is not accepted. Which indicates that the there is a significant difference in the mean score on a STQ scale before and after the treatment. The score of student teachers is found to be more in post test as compared to pre test.

Graph 4.4: Difference between the pre test and post test score of Student teachers on STQ Scale



4.4.5 Analysis of student teachers' responses on a Science Pedagogy Questionnaire.

A Science Pedagogy Questionnaire (SPQ) was administered to the student teachers to know their understanding about science teaching. The SPQ contained fourteen questions out of which first five questions were on their experiences about science and opinion about science teaching in schools to have idea on their entry behavior. Analysis of the first five questions was carried using content analysis of their responses to arrive at a picture of students' understanding of science teaching as given below.

- In response to the questions 'what is science?' there were varied responses from the student teachers. Student teachers were having idea that science is doing experiments, investigating new technology. It is study of nature and natural phenomenon, science is learning by doing, observation and drawing conclusion. Science is experimentation and investigation and a subject to be done in the

laboratory. Science as per one is problem solving and preparation for life. It is more difficult subject as per one response. It is most important subject to develop inquiry mind. Very few (six out of forty) respondents could answer that science is a systematic search for knowledge.

- With regard to the question do you think one should learn science and should science be a compulsory subject at secondary level?, student teachers unanimously agreed that everyone should have basic knowledge of science and for that learning science is important.
- When asked for the justification for the agreement, there were varied responses like; Science develops logical and rational thinking, make us acquainted with daily life, world around us and develop quality life, it makes the life better leading into peaceful and harmonious manner, teaches us common sense for life, it provides food shelter and cloths, it develops scientific habits. It also develops and satisfies the human curiosity and independent thinking. Science develops critical thinking, logical thinking, creative thinking, rational thinking and decision making, lateral thinking, cause and effect relationship, observation and experimental ability, sensitizes students for problem solving ability, removes blind belief, develops scientific attitude in students, and prepares the students for vocational life and higher studies.
- With regard to the question 'did you enjoy learning science?', most of them reported that they enjoyed learning science. Student teachers reported that learning science in laboratory was more interesting than in the classrooms. They enjoyed learning science because science is interesting subject. Other responses were repeated and similar with the responses of earlier questions, hence categorization was not done. Those who responded that they enjoyed learning science further responded that science was taught with activity, practical, field exposures and fun because of that it was interesting. Whenever teacher could link science with real life it was found more interesting for students. However Student teachers also responded that even though they like science, they could not enjoy learning because it was taught in a boring way. There was no clarity of content on the part of their science teachers and gradually at higher stage it resulted into lack of interest in science.
- When asked for the response to the question, did you find your secondary science classes interesting, out of forty, twenty two students responded that their science

classes were interesting because the teachers were teaching with interest, fun and more liveliness. Content was taught with simple examples from their daily life, given interesting homework, used models, charts, PowerPoint Presentations and seminars. Eighteen did not found their science classes interesting and they attributed it to the teachers' negative attitude for teaching. Many of them said that the common reason that teachers in such classes were using textbooks, reading and repeating the same content as given in the text book. Teachers did not explain the content at all and just completed the syllabus.

From the above analysis it is revealed whenever science is taught with variety of learning experiences it was found interesting for students and when reading from the textbook or lecture is used it was boring for them.

Rests of the nine questions were framed to check the differences in their pedagogical understanding for teaching a particular topic of General Science before and after the treatment. All the nine questions were open ended in nature and analysis was carried out qualitatively by comparing the difference in their opinions and responses before and after the treatment.

- They were asked about the qualities and skills acquired by them before and after the implementation of the ABSTP. It was found that there was enhancement of their understanding and they could come out with more skills and qualities after the treatment. In the pretest thirty eight various qualities and skills were reported by them while in the post test they could come out with fifty eight various skills and qualities which can be developed by science. List of table indicating the different skills listed in pretest and post test is appended in the annexure XXI.
- With regard to the question what are the different ways through one can learn science, it was found that student teachers could report fifty four different ways of learning science at the end of the implementation of the ABSTP as compared to their responses before the treatment. Before the treatment, they could identify thirty two different ways through which science can be learnt. Student teachers' understanding about the various modes of learning science was enhanced and the different methods suggested by them are presented in the table appended in the annexure XXII.
- Series of questions asked to check their understanding about teaching the topic " sources of energy" indicating how would the topic be introduced, specific objectives to be framed , learning experiences be designed, methods selected,

evaluation techniques adopted and home assignment given. Student teachers were having idea about the topic and they could suggest some general idea in the pretest that the topic can be taught through lecture, discussion and assignment method. But they could not provide suitable introduction, learning experiences corresponding evaluation technique and home assignments. They could provide alternatives for the lecture method as field visits and excursions. In the post test when asked the same question they could provide better ways of introducing a lesson, learning experiences using activity, play way and role play and evaluation techniques were also varied and more as compared to the pre test. Their pedagogical understanding about use of methods and corresponding evaluation techniques are also enhanced at the end of the implementation of the ABSTP.

- Series of questions asked to check their understanding about teaching the topic " reflection of light" indicating how would the topic be introduced, specific objectives to be framed , learning experiences be designed, methods selected, evaluation techniques adopted and home assignment given. Analysis of the pre test and post test responses showed enhancement in the pedagogical understanding of the student teachers. They could provide better and focused responses during the post test as compared to the pre test in terms of the introduction of the topic, learning experiences designed, resources utilized, methods adopted, home assignment given and evaluation carried out.
- When asked 'what is scientific attitude and scientific method?' student teachers could not provide the specific answer to the question but they could indicate the qualities of the person possessing scientific attitude. Almost fifty percent of the student teachers did not respond to the questions during pre test. Many of they could write down about the indicators of scientific attitude during the post test and even steps of scientific method correctly. This indicated the enhancement in the understanding about the nature of science as a discipline of knowledge.

4.4.6 Student teachers immediate responses about each of the activities during the implementation of ABSTP.

In order to study the effectiveness of each of the activities an 'Activity Evaluation Sheet' was used immediately after the implementation of the activity, which questioned on the worthiness, appropriateness, appeal and modifications if any, it also expected the student teachers to rate the activities on thirteen different indicators;

analysis of which is presented below for each of the activities. Number of respondents per activity vary because of non response or being absent during the activity.

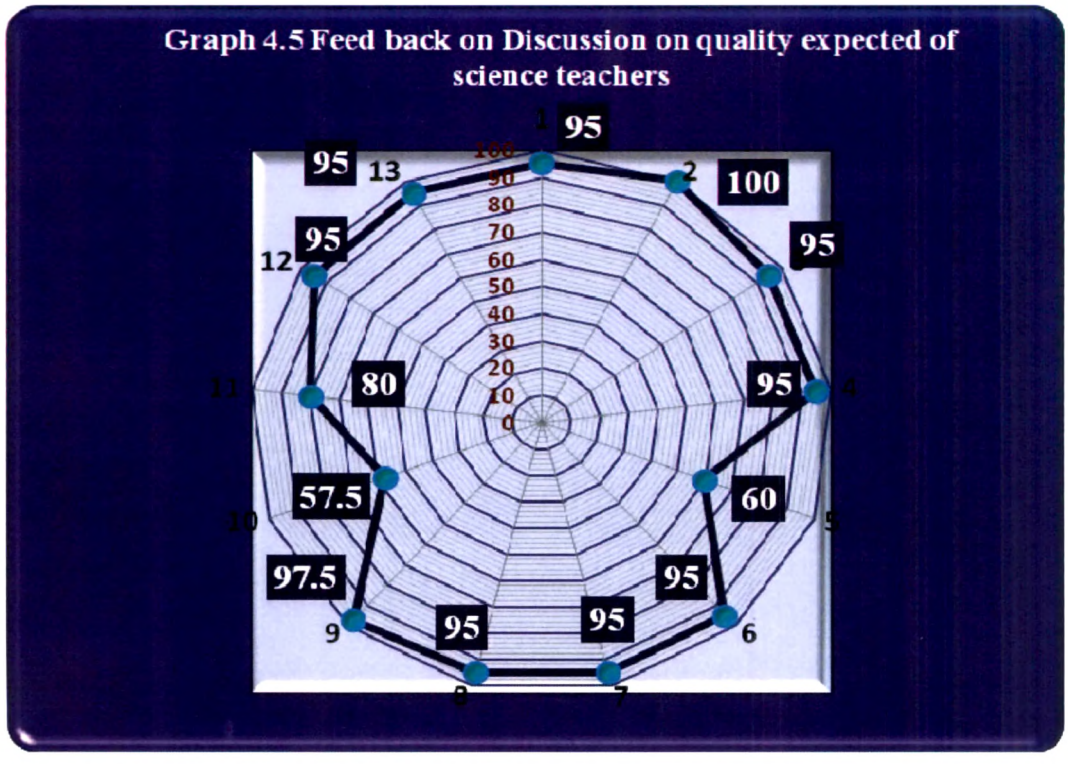
Activity one: Quality Expected from the science teacher

All the forty student teachers (100%) found this activity to be worthy, appropriate and appealing. Thirty six out of forty (90%) responded that the activity was implemented properly and had no scope of modification whereas rest of them (10%) found that scale could be more comprehensive while their responses on different indicators have been presented in the table 4.7 and expressed graphically. s

Table 4.7: Analysis of the responses for A1 on AES (Frequency and percentage)

A1	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	38(95%)	02 (5%)	
2	Actively involves students.	40 (100%)		
3	Stimulates students' understanding and skills.	38(95%)	02 (5%)	
4	Develop students understanding and skills.	38 (95%)	02 (5%)	
5	Stimulate students to connect with other disciplines.	24 (60%)	07(17.5%)	
6	Stimulate students to connect with real world.	38(95%)	02 (5%)	
7	Call for problem formation, solving and reasoning.	38(95%)	02 (5%)	
8	Promote communication among students.	38(95%)	02 (5%)	
9	Promote curiosity and interest in students.	39(97.5%)		
10	Suitable to apply in the daily classroom situation.	23(57.5)	14 (35%)	03(7.5%)
11	Practically possible to use for science teaching.	32(80%)	08(20%)	
12	Provide them field exposure.	38(95%)	02 (5%)	
13	Overall Rating of the activity	38 (95%)	02(5%)	

From the table 4.7 it is clear that the activity could engage student teachers' intellect to a greater extent, stimulate and develop their understanding about science teachers' qualities, actively involved all students and promoted curiosity and interest. However twenty three of them (57.5%) had doubt in its suitability to apply in the daily classroom situation. The deep grooves in the graphs points out that on indicator number five which is 'stimulates students to connect with other disciplines' and indicator ten 'the suitability of the activity in classroom situations' respectively are rated high by a relatively less number of student teachers however all agree to the potential of the activity on other indicators.



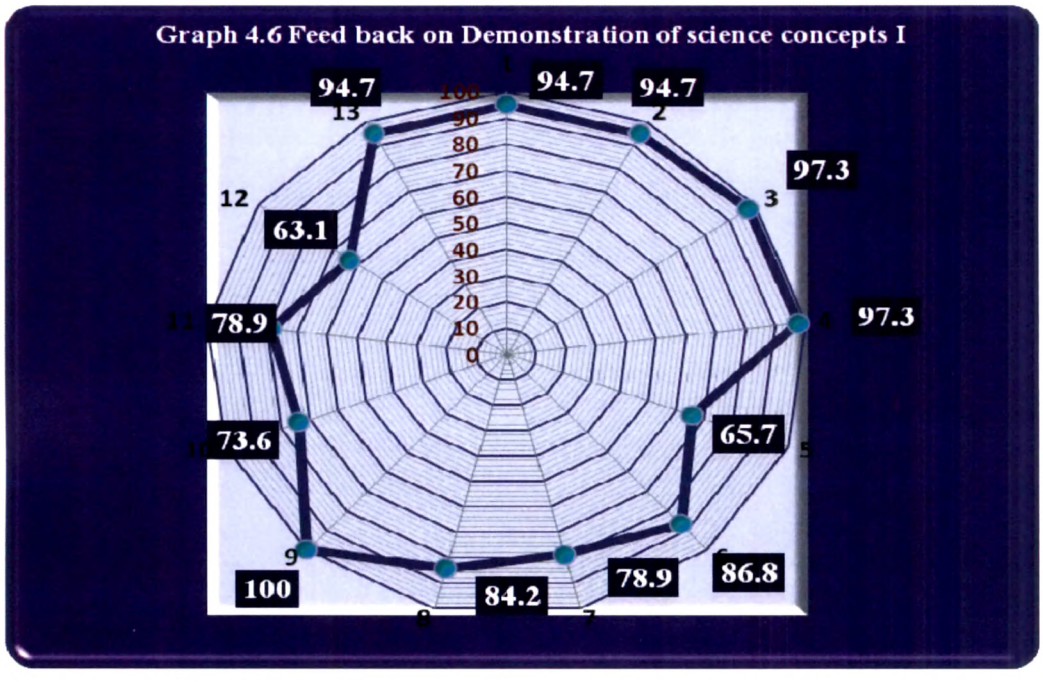
Activity Two: Demonstration of science concepts

All forty student teachers (100%) found this activity worthy, appropriate and appealing. Six (16%) suggested more time for the activity while twenty seven (72%) felt it required no modification. Student teachers reported an increase in confidence and improvement in experimental skills. To avoid repetition, cover all the concepts and have focused work they suggested the demonstration topics be given by teachers.

Table 4.8: Analysis of the response of A2 on AES (frequency and percentage)

A2	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	36(94.7%)	02 (5.2%)	
2	Actively involves students.	36(94.7%)	02(5.2%)	
3	Stimulates students' understanding and skills.	37(97.3%)	01 (2.6%)	
4	Develop students understanding and skills.	37(97.3%)	01 (2.6%)	
5	Stimulate students to connect with other disciplines.	25(65.7%)	10(26.3 %)	03(7.8)
6	Stimulate students to connect with real world.	33(86.8%)	05 (7.6%)	
7	Call for problem formation, solving and reasoning.	30(78.9%)	06 (6.3%)	02 (5.2%)
8	Promote communication /interaction among students.	32(84.2%)	06 (6.3%)	
9	Promote curiosity and interest in students.	38(97.5%)	00	
10	Suitable to apply in the daily classroom situation.	28(73.6%)	09(23.6%)	01(2.6%)
11	Practically possible to use for science teaching.	30(78.9%)	08(21%)	
12	Provide them field exposure.	24 (63.1%)	07 (18.4%)	07 (18.4%)
13	Overall Rating of the activity	36 (94.7%)	02(5%)	

The table 4.8 and subsequent graph depict the grooves at indicator number five; ten and twelve that talks of the feedback of the student teachers on the potential of the activity on these indicators. These are the potential of the activity to link with other disciplines, the classroom applicability in daily situations and scope for field exposure respectively. Owing to the nature of the activity we see these drawbacks in it.



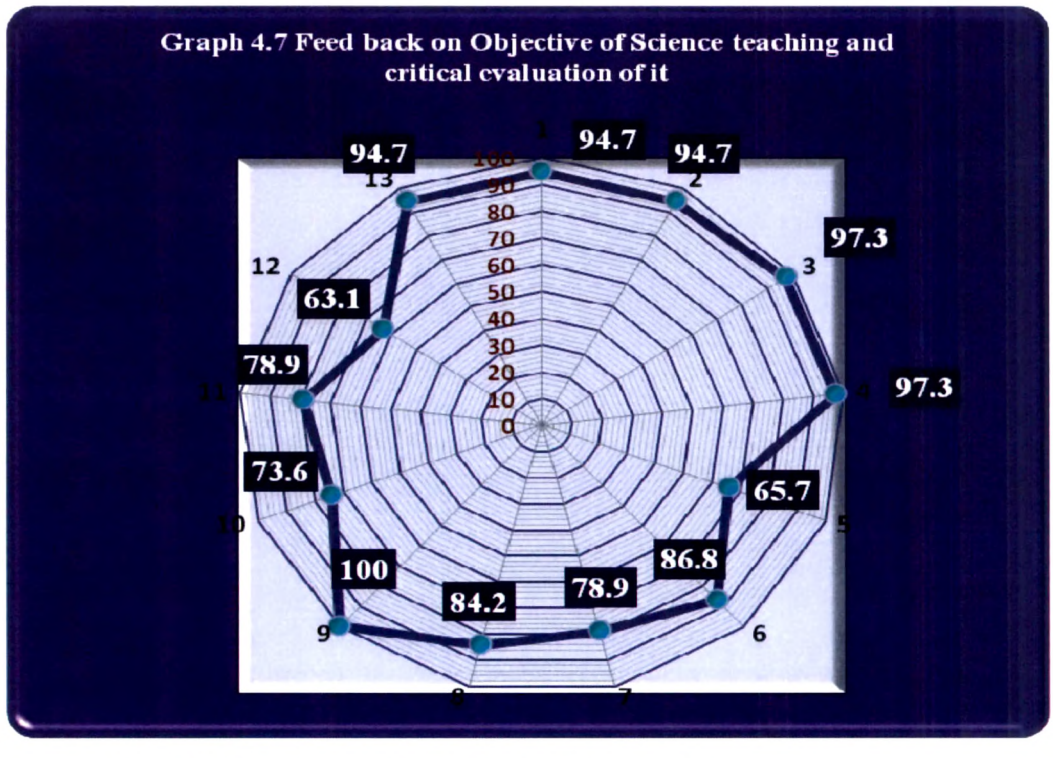
Activity Three: Objective of science teaching

All the thirty eight (100%) student teachers found this activity worthy, thirty four (89 %) found it appropriate and appealing for student teachers. Thirty two (84 %) felt the activity had no scope of modification while rest six (16 %) suggested reading material to be provided in advance for focused discussion.

The responses of the student teachers' on the different indicators have been presented in the table 4.9 and the subsequent graph. The table depicts that all (100%) felt that the activity could involve student teachers, engage their intellect, stimulate and develop their understanding about objectives of science teaching, divergent thinking promote curiosity, communication skills, problem solving ability. They reported that they could get comprehensive idea about scenario of science teaching and learn to frame the objectives of teaching science. In the graph the grooves on indicator number five, twelve, ten, seven and eleven are seen of which twelve is the deepest since the activity was not aimed at field exposure rather at critical thinking and hence the case.

Table 4.9: Analysis of the response of A3 on AES (frequency and percentage)

A3	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	36(94.7%)	02 (5.2%)	
2	Actively involves students.	36(94.7%)	02(5.2%)	
3	Stimulates students' understanding and skills.	37(97.3%)	01 (2.6%)	
4	Develop students understanding and skills.	37(97.3%)	01 (2.6%)	
5	Stimulate students to connect with other disciplines.	25(65.7%)	10(26.3 %)	03(7.8)
6	Stimulate students to connect with real world.	33(86.8%)	05 (7.6%)	
7	Call for problem formation, solving and reasoning.	30(78.9%)	06 (6.3%)	02 (5.2%)
8	Promote communication /interaction among students.	32(84.2%)	06 (6.3%)	
9	Promote curiosity and interest in students.	38(100 %)	00	
10	Suitable to apply in the daily classroom situation.	28(73.6%)	09(23.6%)	01(2.6%)
11	Practically possible to use for science teaching.	30(78.9%)	08(21%)	
12	Provide them field exposure.	24 (63.1%)	07 (18.4%)	07 (18.4%)
13	Overall Rating of the activity	36 (94.7%)	02(5%)	



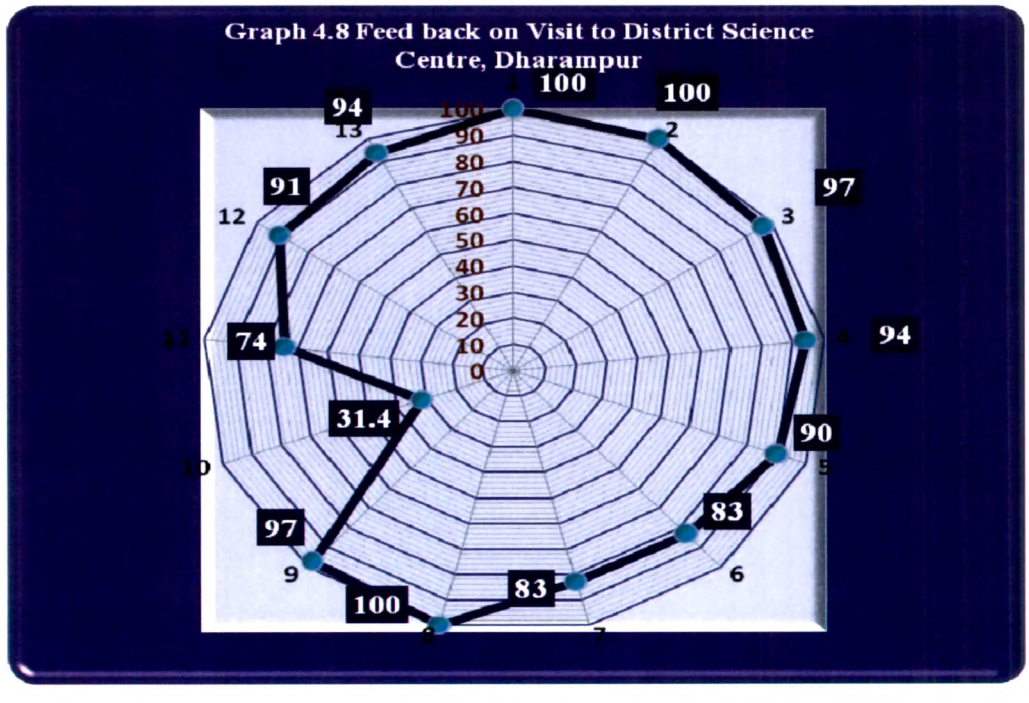
Activity Four: Field trip to District Science centre, Dharampur

All the thirty five student teachers (100%) found this activity worthy, appropriate and appealing. Thirty two (94%) suggested no modifications while two (6%) responded that it could be more effective if time provided for individual exhibits had been more. With regard to the responses of the student teachers' on the different indicators it is evident from the table that all students (100%) found the activity to be engaging their

intellect, involving all and providing ample scope for interaction however we see in the graphs a deep groove at indicator number ten which talks of its suitability in daily classroom situations.

Table 4.10: Analysis of the response of A4 on AES (frequency and percentage)

A4	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	35(100%)		
2	Actively involves students.	35(100%)		
3	Stimulates students' understanding and skills.	34(97%)	01 (3%)	
4	Develop students understanding and skills.	33(94%)	02(6%)	
5	Stimulate students to connect with other disciplines.	28(90%)	07(20%)	
6	Stimulate students to connect with real world.	29(83%)	06(17%)	
7	Call for problem formation, solving and reasoning.	29(83%)	06(17%)	
8	Promote communication /interaction among students.	35(100%)		
9	Promote curiosity and interest in students.	34(97%)	01(3%)	
10	Suitable to apply in the daily classroom situation.	11(31.4%)	14(40%)	10(28.6%)
11	Practically possible to use for science teaching.	26(74%)	04(12%)	05(14%)
12	Provide them field exposure.	32(91%)	03(9%)	
13	Overall Rating of the activity	33(94%)	02(6%)	



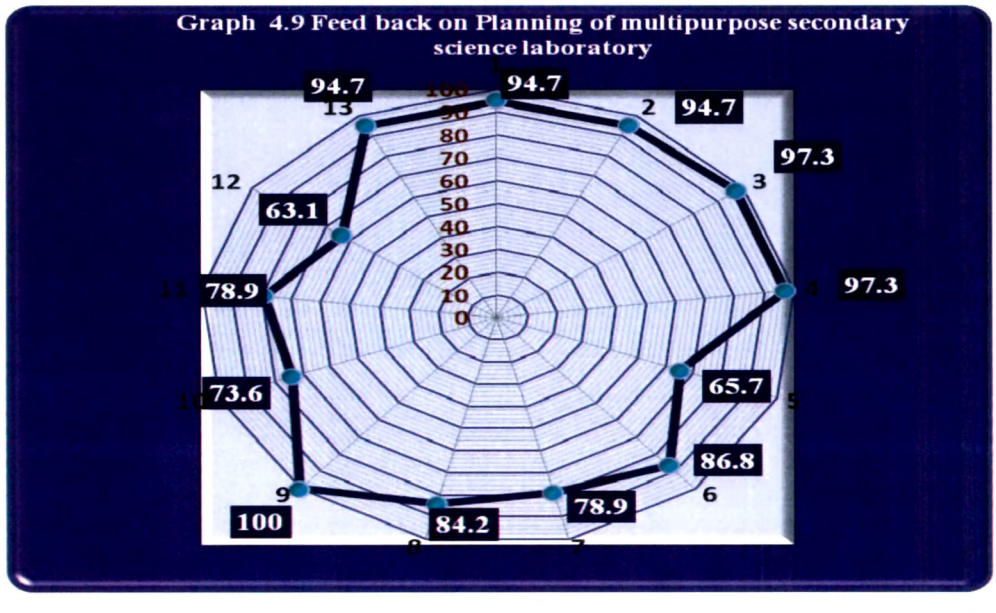
Activity Five: Science laboratory

Thirty two out of forty student teachers (80 %) found this activity worthy, thirty one (77.5%) found it appropriate and thirty eight (95%) found it appealing for student teachers. Student teachers enjoyed the group work and visiting the science laboratory,

preparing the lay out and discussing the budget for the proposed laboratory. They found the experience unique. Twenty four (60%) found that the activity required no modification while sixteen (40%) suggested that more time for discussion should be provided in the finalizing of the plan for ideal laboratory. Few of them also suggested that instead of random visit to schools, sampling of schools could be done to generate a systematic scenario of existing science laboratories. Like other activity this activity too got rated low on its suitability in daily classroom situations however they felt that it could develop in them a group feeling, enhance competitive spirit and a great learning experience, very important for would be science teachers.

.**Table 4.11:** Analysis of the responses of A5 on AES (frequency and percentage)

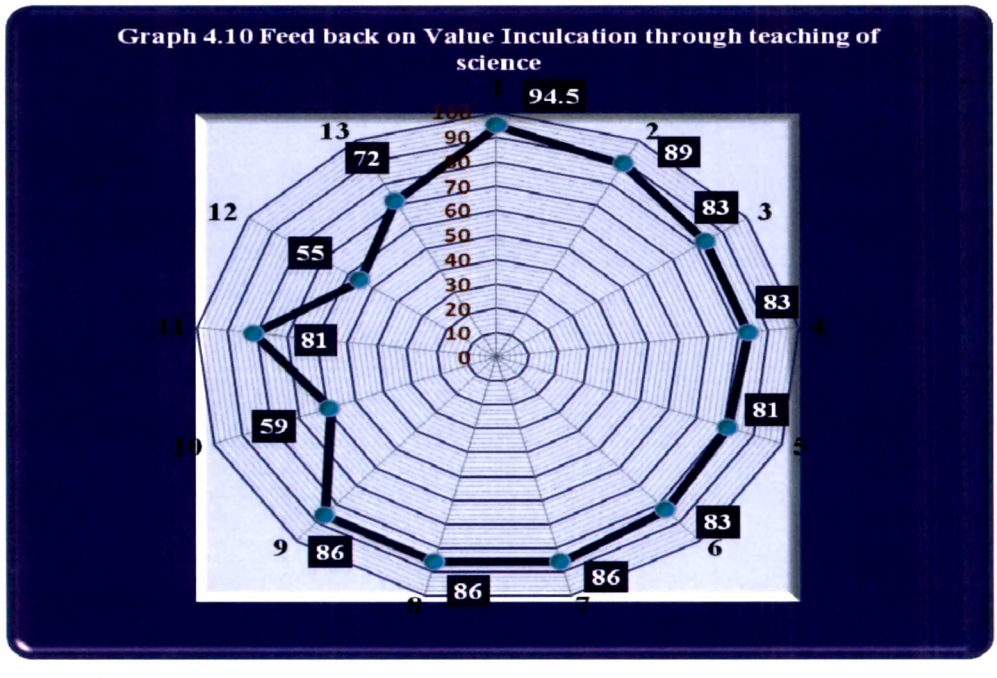
A5	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	38(95)	02(05)	
2	Actively involves students.	39(97.5)	01(2.5)	
3	Stimulates students' understanding and skills.	39(97.5)	01(2.5)	
4	Develop students understanding and skills.	37(92.5)	03(7.5)	
5	Stimulate students to connect with other disciplines.	36(90)	04(10)	
6	Stimulate students to connect with real world.	35(87.5)	05(12.5)	
7	Call for problem formation, solving and reasoning.	36(90)	04(10)	
8	Promote communication /interaction among students.	39(97.5)	01(2.5)	
9	Promote curiosity and interest in students.	39(97.5)	01(2.5)	
10	Suitable to apply in the daily classroom situation.	25 (62.5)	13(32.5)	02(05)
11	Practically possible to use for science teaching.	36(90)	04(10)	
12	Provide them field exposure.	32(80)	08(20)	
13	Overall Rating of the activity	40(100)	00	



Activity Six: Value Inculcation

Table 4.12: Analysis of the response of A6 on AES (frequency and percentage)

A6	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	34(94.5%)	02(5.5%)	
2	Actively involves students.	30(89%)	06(17%)	
3	Stimulates students' understanding and skills.	30(83%)	06(17%)	
4	Develop students understanding and skills.	30(83%)	06(17%)	
5	Stimulate students to connect with other disciplines.	29(81%)	07(19%)	
6	Stimulate students to connect with real world.	30(83%)	06(17%)	
7	Call for problem formation, solving and reasoning.	31(86%)	04(11%)	
8	Promote communication /interaction among students.	31(86%)	04(11%)	
9	Promote curiosity and interest in students.	31(86%)	04(11%)	01(3%)
10	Suitable to apply in the daily classroom situation.	21(59%)	12(33%)	03(8%)
11	Practically possible to use for science teaching.	29(81%)	07(19%)	
12	Provide them field exposure.	20(55%)	13(36%)	03(8%)
13	Overall Rating of the activity	26(72%)	10(28%)	



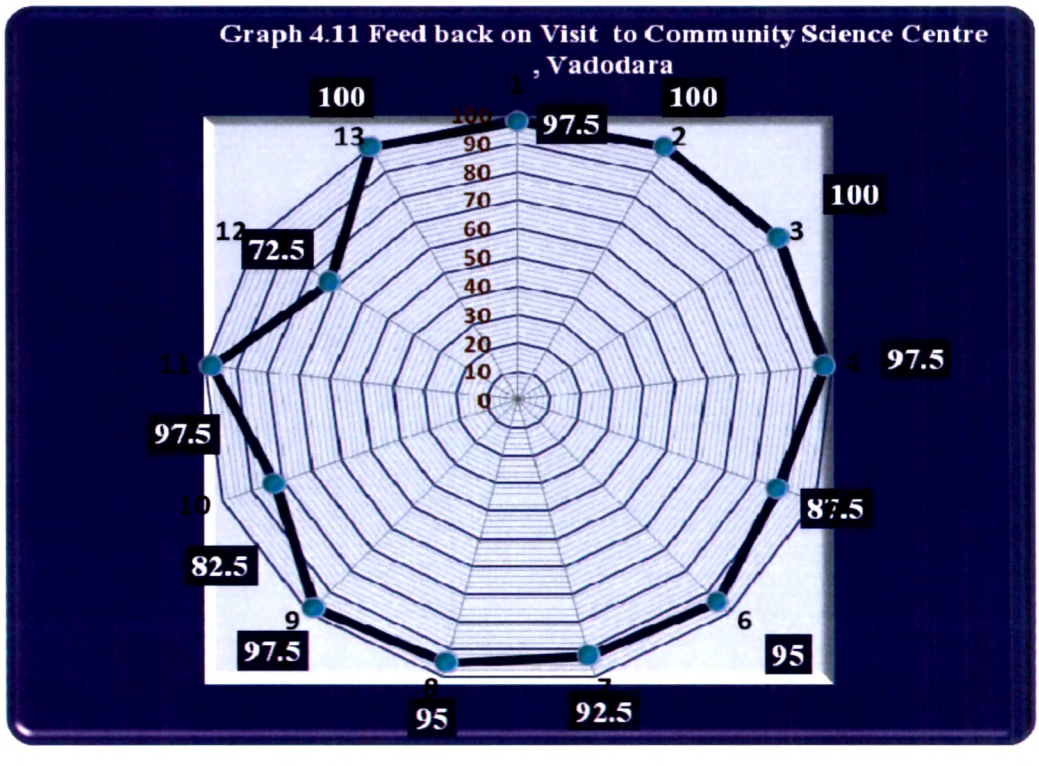
All the thirty six student teachers (100%) found this activity worthy, twenty eight (78 %) found it appropriate for student teachers and thirty four (94.4%) found it appealing. Thirty out of thirty six (83%) found that the activity required no modification where as six student teachers (17%) suggested that the activity be combined with the activity discussion on methods of teaching. The integration of values in teaching science helped them in dealing with the students effectively during

practice teaching. With regard to the response of the student teachers' on the different indicators it is clear that thirty (89%) of them felt that the activity could actively involve teachers, thirty four (94.5%) felt that it engaged their intellect, stimulate and developed their understanding about inculcating various values in science classrooms.

Activity Seven: Visit to community science centre, Vadodara

Table 4.13: Analysis of the responses of A7 on AES (frequency and percentage)

A7	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	39 (97.5%)	01(2.5%)	
2	Actively involves students.	40(100%)	00	
3	Stimulates students' understanding and skills.	40(100%)	00	
4	Develop students understanding and skills.	39(97.5%)	01(2.5%)	
5	Stimulate students to connect with other disciplines.	35(87.5%)	05(12.5)	
6	Stimulate students to connect with real world.	38(95%)	02(5%)	
7	Call for problem formation, solving and reasoning.	37(92.5%)	02(7.5%)	01(2.5%)
8	Promote communication /interaction among students.	38(95%)	02(5%)	
9	Promote curiosity and interest in students.	39(97.5%)	01(2.5%)	
10	Suitable to apply in the daily classroom situation.	33(82.5%)	07(17.5%)	
11	Practically possible to use for science teaching.	39(97.5%)	01(2.5%)	
12	Provide them field exposure.	29(72.5%)	09(22.5%)	02
13	Overall Rating of the activity	40(100%)	00	

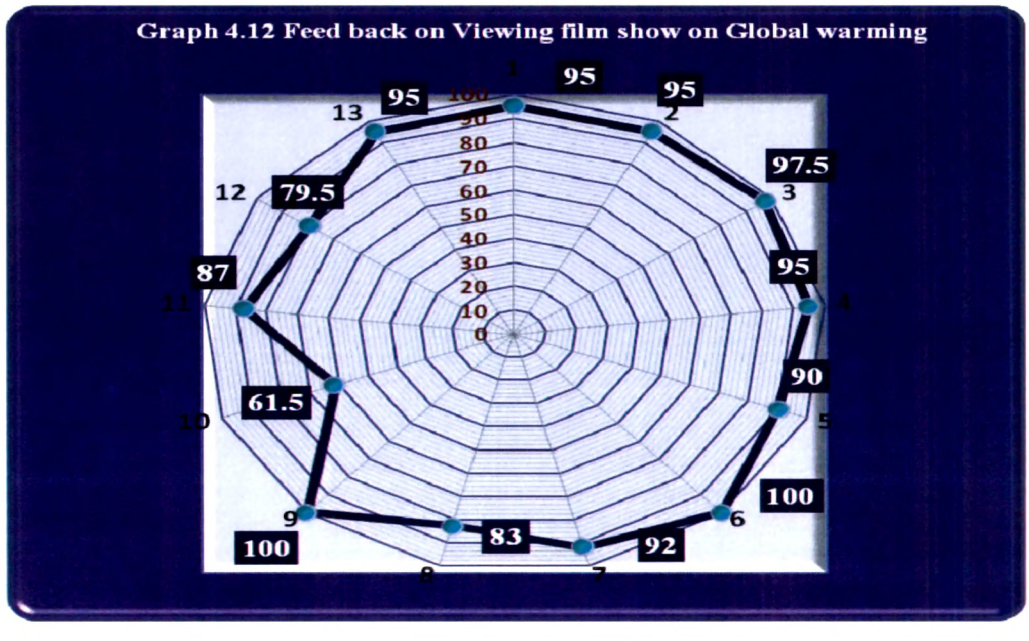


All the forty student teachers (100%) found this activity worthy, appropriate and appealing. According to thirty out of forty (75%) student teachers the activity required no modification while ten (25%) suggested that number of visits be increased and time given for the visit should be more. Many of them suggested that experts with whom they interacted in CSC should be invited to the Department. With regard to the responses of the student teachers on different indicators all (100%) felt that it actively involved students, thirty nine (97.5%) felt that it engaged their intellect, stimulate and develop their understanding on many science concepts

Activity Eight: Film show on global warming

Table 4.14: Analysis of the response of A8 on AES (frequency and percentage)

A8	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	37(95%)	02(5%)	
2	Actively involves students.	37(95%)	02(5%)	
3	Stimulates students' understanding and skills.	38(97.5%)	01(2.5%)	
4	Develop students understanding and skills.	37(95%)	02(5%)	
5	Stimulate students to connect with other disciplines.	35(90%)	04(10%)	
6	Stimulate students to connect with real world.	39(100%)		
7	Call for problem formation, solving and reasoning.	36(92%)	03(8%)	
8	Promote communication /interaction among students.	32(83%)	06(15%)	01(2%)
9	Promote curiosity and interest in students.	39(100%)		
10	Suitable to apply in the daily classroom situation.	24(61.5%)	13(33.5)	02(5%)
11	Practically possible to use for science teaching.	33(87%)	06(13%)	
12	Provide them field exposure.	31(79.5%)	06(15.4%)	02(5.1%)
13	Overall Rating of the activity	37(95%)	02(5%)	



All the thirty nine (100%) student teachers found this activity worthy and appealing, thirty seven (94%) found it appropriate too. Thirty five of the thirty nine (89%) suggested no modification where as four (11%) suggested that more time could be devoted for the discussion They felt that it created sensitization removed lot of misconceptions about global warming.

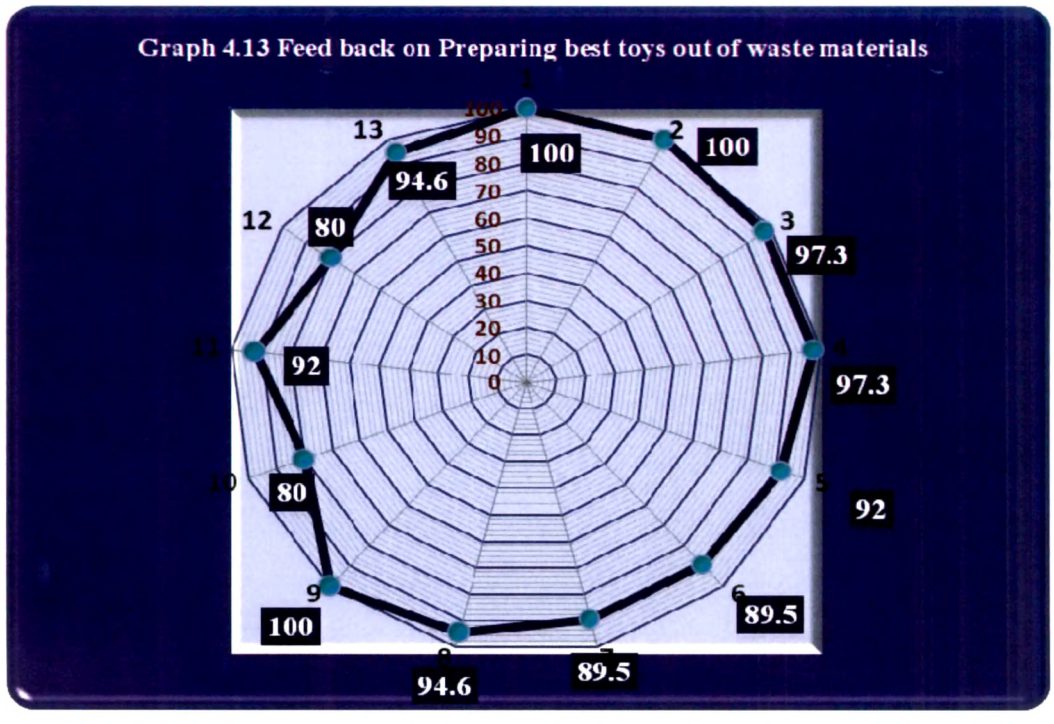
From the ratings on the different indicators it is clear that all of them (100%) felt that the activity had potential to connect to the real world, promoted curiosity and interest except that it may not find application in daily classroom situations the graph and the table both depict the higher rating of the activity by large number (95%) of the sample.

Activity Nine: Best out of waste

Table 4.15: Analysis of the response of A9 on AES (frequency and percentage)

A9	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	38(100%)		
2	Actively involves students.	38(100%)		
3	Stimulates students' understanding and skills.	37(97.3%)	01(2.7%)	
4	Develop students understanding and skills.	37(97.3%)	01(2.7%)	
5	Stimulate students to connect with other disciplines.	35(92%)	03(8%)	
6	Stimulate students to connect with real world.	34(89.5%)	04(10.5%)	
7	Call for problem formation, solving and reasoning.	34(89.5%)	04(10.5%)	
8	Promote communication /interaction among students.	36(94.6%)	01(2.7%)	01(2.7%)
9	Promote curiosity and interest in students.	38 (100%)		
10	Suitable to apply in the daily classroom situation.	30(80%)	07(17.3%)	01(2.7%)
11	Practically possible to use for science teaching.	35(92%)	03(8%)	
12	Provide them field exposure.	30(80%)	07(17.3%)	01(2.7%)
13	Overall Rating of the activity	36(94.6%)	07(17.3%)	

Thirty seven (97%) found the activity worthy, twenty nine (76%) found it appropriate and thirty seven (97%) found it appealing. Twenty seven out of thirty eight (72%) found the activity to continue without modification where as eleven (28%) of them suggested that more sessions of such type of activities should be arranged. Time allotted for the activity should be more and discussion on the scientific principles used could be conducted. One student teacher suggested that there should be exhibition after the workshop where every student teacher will exhibit his/her toys and explains the concept. Few of them felt that toy making from waste material was the wonderful activity which provided us an opportunity to think creatively.



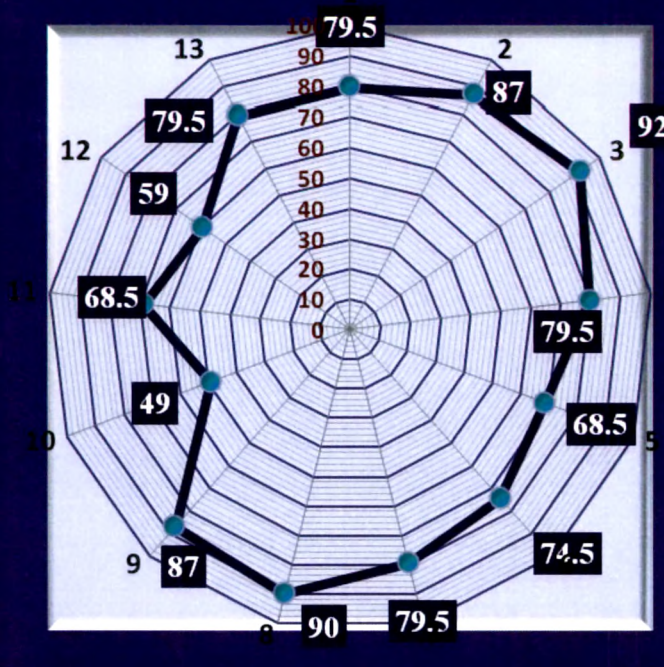
With regard to the responses of the students on the different indicators it can be said that the activity was largely appreciated and the graph also has no significant grooves. All of them felt that the activity could actively involve all student teachers, engage their intellect, stimulate and develop their understanding and skills, promote curiosity, creativity, communication skills, problem solving ability and excellent for future science teachers.

Activity Ten: Viewing video recording and discussion

Table 4.16: Analysis of the response of A8 on AES (frequency and percentage)

A10	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	31(79.5%)	07(18%)	01(2.5%)
2	Actively involves students.	34(87%)	04(10.5%)	01(2.5%)
3	Stimulates students' understanding and skills.	36(92%)	02(5%)	01(2.5%)
4	Develop students understanding and skills.	31(79.5%)	08(20.5%)	--
5	Stimulate students to connect with other disciplines.	27(68.5%)	11(28%)	02(5%)
6	Stimulate students to connect with real world.	29(74.5%)	08(28%)	02(5%)
7	Call for problem formation, solving and reasoning.	31(79.5%)	06(15%)	01(2.5%)
8	Promote communication /interaction among students.	35(90%)	03(7.5%)	01(2.5%)
9	Promote curiosity and interest in students.	34(87%)	04(10%)	01(2.5%)
10	Suitable to apply in the daily classroom situation.	19(49%)	15(38%)	04(10%)
11	Practically possible to use for science teaching.	27(68.5%)	10(26%)	02(5%)
12	Provide them field exposure.	23(59%)	11(28%)	05(13%)
13	Overall Rating of the activity	31(79.5%)	07(18%)	01(2.5%)

Graph 4.14 Feed back on Viewing video recording of science demonstrations



Thirty seven (97%) student teachers found this activity worthy, thirty four (88%) found it appropriate for student teachers and thirty five (90%) found it appealing. Thirty two out of thirty eight (82%) found the activity to be eye opener as they could see their own performance and rectify their mistakes while six (18%) felt that there was no need to show all the video recording only few good demonstrations could be shown to the group. It is clear from the table and graph that the activity does not stand the test on almost all different indicators and has shown very deep grooves at number ten, twelve, and five. This could be understood from the nature and objective of the activity.

Activity Eleven: Science Process Skills and their evaluation

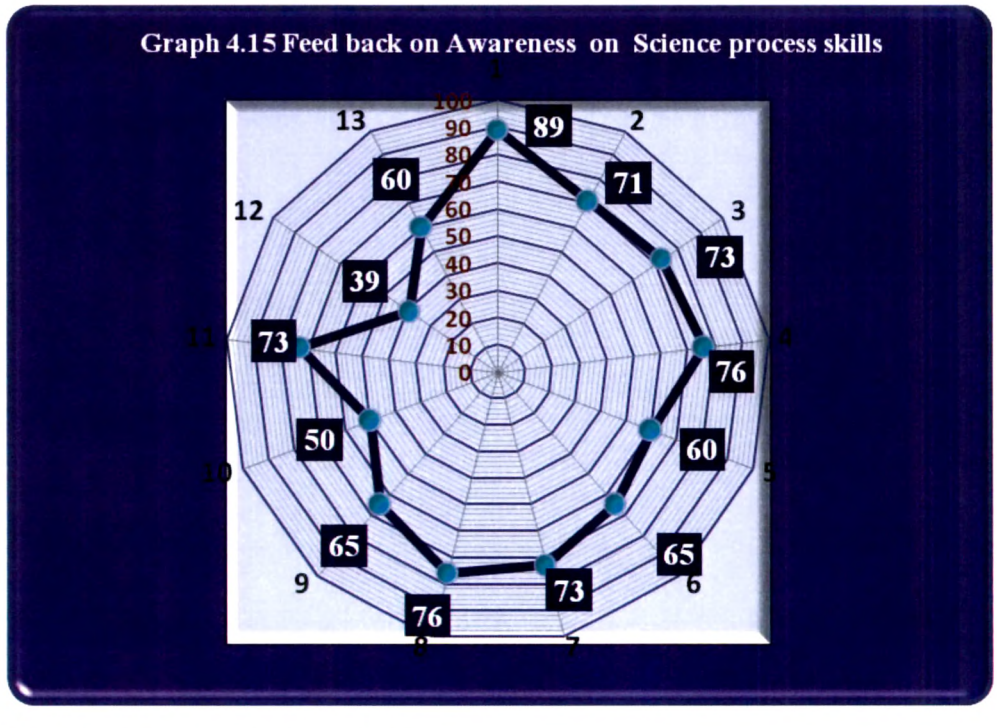
Out of thirty eight, thirty four (89%) found this activity worthy, twenty six (68%) found it appealing and thirty two (80%) found it appropriate for student teachers. Thirty one (82%) found that the activity was implemented properly while seven (18%) remarked that the power point presentation was interesting and interactive while the whole session was not. They suggested need for more clarity on the integrated process skills.

With regard to the rating on the different indicators, it can be said that although the activity was a learning experience of self evaluation was not largely appreciated

which is evident from the shrunken graph on all ends and very deep grooves at indicator number nine ten twelve and thirteen. This could be because of the length of the activity and the lack of interaction during the activity.

Table 4.17: Analysis of the response of A11 on AES (frequency and percentage)

A11	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	34(89%)	03(8%)	01(2.5%)
2	Actively involves students.	27(71%)	10(26.5%)	01(2.5%)
3	Stimulates students' understanding and skills.	28(73%)	09(23%)	02(5%)
4	Develop students understanding and skills.	29(76%)	07(18%)	01(2.5%)
5	Stimulate students to connect with other disciplines.	23(60%)	11(29%)	02(2.5%)
6	Stimulate students to connect with real world.	25(65%)	10(26%)	04(10%)
7	Call for problem formation, solving and reasoning.	28(73%)	07(18%)	03(8%)
8	Promote communication /interaction among students.	29(76%)	06(16%)	03(8%)
9	Promote curiosity and interest in students.	25(65%)	11(29%)	02(5%)
10	Suitable to apply in the daily classroom situation.	19(50%)	17(45%)	02(5%)
11	Practically possible to use for science teaching.	28(73%)	07(18%)	03(8%)
12	Provide them field exposure.	15(39%)	16(42%)	06(16%)
13	Overall Rating of the activity	23(60%)	11(29%)	03(8%)



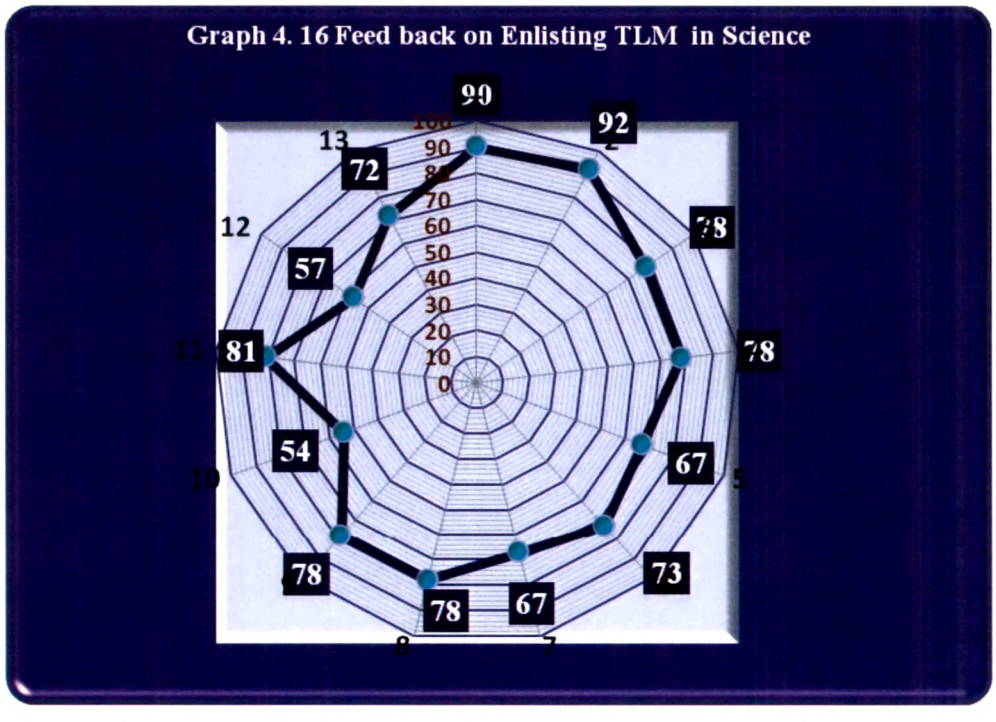
Activity Twelve: TLM in science

Thirty six student teachers (97%) found this activity worthy, twenty nine (78%) found it appealing and thirty four (91%) found it appropriate for student teachers. Thirty two

out of thirty seven (87%) felt the activity required no modification while five (13%) of them felt it required modifications but could not suggest any.

Table 4.18: Analysis of the response of A12 on AES (frequency and percentage)

A12	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	33(90%)	04(10%)	
2	Actively involves students.	34(92%)	03(8%)	
3	Stimulates students' understanding and skills.	29(78%)	08(22%)	
4	Develop students understanding and skills.	29(78%)	08(22%)	
5	Stimulate students to connect with other disciplines.	25(67%)	12(32%)	
6	Stimulate students to connect with real world.	27(73%)	10(28%)	
7	Call for problem formation, solving and reasoning.	25(67%)	11(30%)	01(3)
8	Promote communication among students.	29(78%)	08(22%)	
9	Promote curiosity and interest in students.	29(78%)	08(22%)	
10	Suitable to apply in the daily classroom situation.	20(54%)	15(40%)	02(6)
11	Practically possible to use for science teaching.	30(81%)	07(19%)	
12	Provide them field exposure.	21(57%)	15(40%)	01(3)
13	Overall Rating of the activity	27(72%)	10(28%)	



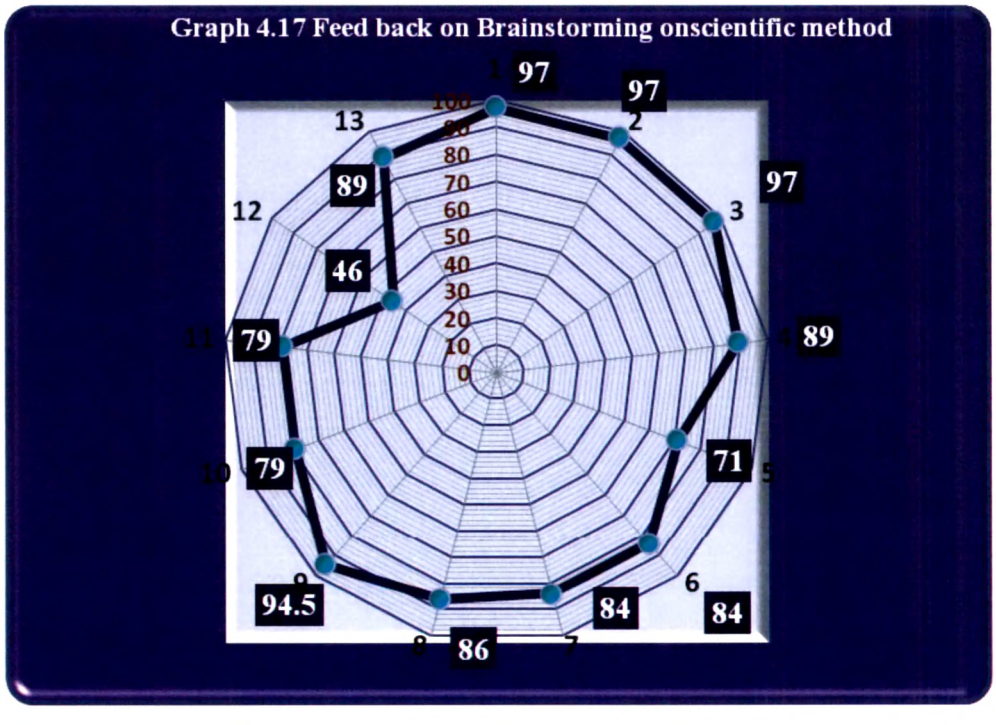
The responses of the student teachers' on different indicators make it clear that the activity was liked by most of them. It could involve the student teachers actively to greater extent, stimulate their thinking and enhance their analytical ability. Social interaction and group feeling were developed at the end of the activity. The activity

could generate interest and curiosity in the student teachers. However we could not see any enthusiastic result which is why graph in this case is also shrunk like the previous one and shows deep grooves at number ten and twelve.

Activity Thirteen: Brainstorming on scientific Method

Table 4.19: Analysis of the response of A13 on AES (frequency and percentage)

A13	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	36(97%)	01(3%)	
2	Actively involves students.	36(97%)	01(3%)	
3	Stimulates students' understanding and skills.	36(97%)	01(3%)	
4	Develop students understanding and skills.	33(89%)	04(11%)	
5	Stimulate students to connect with other disciplines.	26(71%)	11(29%)	
6	Stimulate students to connect with real world.	31(84%)	06(16%)	
7	Call for problem formation, solving and reasoning.	31(84%)	06(16%)	
8	Promote communication among students.	32(86%)	05(13%)	
9	Promote curiosity and interest in students.	35(94.5%)	02(5%)	
10	Suitable to apply in the daily classroom situation.	29(79%)	08(21%)	
11	Practically possible to use for science teaching.	29(79%)	08(21%)	
12	Provide them field exposure.	17(46%)	14(38%)	05(13%)
13	Overall Rating of the activity	33(89%)	04(11%)	



All thirty seven student teachers except one (97%) found this activity worthy, thirty four (92%) found it appropriate for student teachers and thirty one (84%) found it appealing. Thirty six out of thirty seven (97%) found that the activity required no

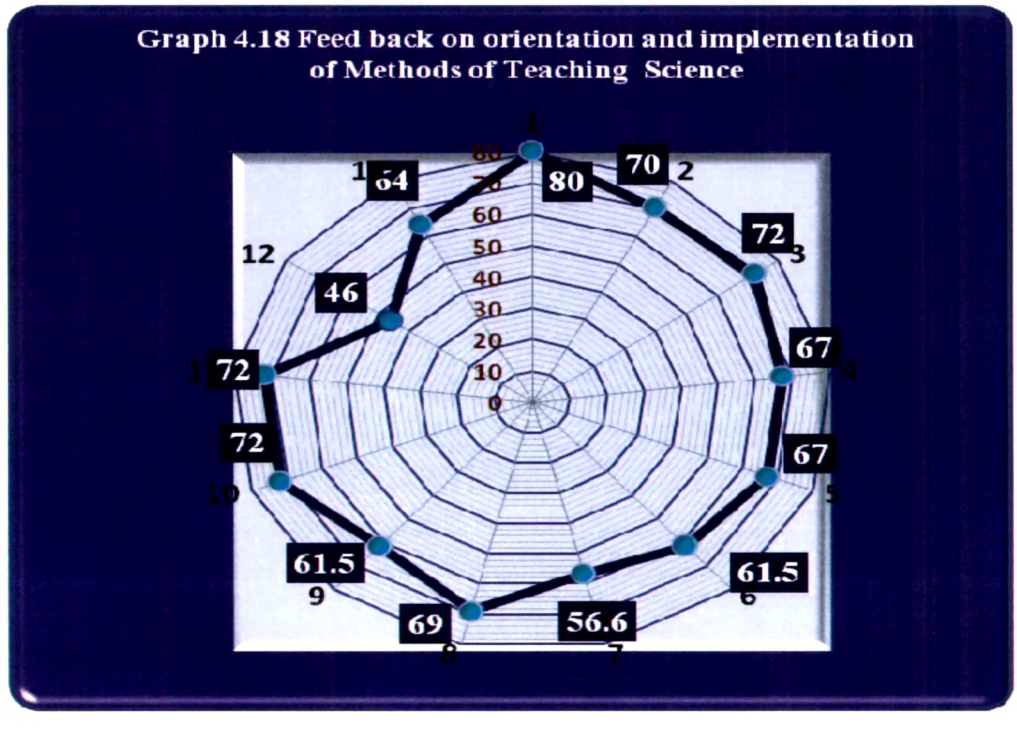
modification only one student suggested that some more topics from the science textbooks could make it more effective. Student teachers found it very energetic and recharging experience to learn about scientific method of inquiry.

It is clear from the table that the activity did not provide any field exposure and therefore was scored by less number of respondents on that indicator. Social interaction and group feeling were developed at the end of the activity.

Activity Fourteen: Methods of teaching and instructional material of it

Table 4.20: Analysis of the response of A14 on AES (frequency and percentage)

A14	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	31(80%)	8(20%)	
2	Actively involves students.	27(70%)	10(25%)	02(5%)
3	Stimulates students' understanding and skills.	28(72%)	10(25%)	01(2.5%)
4	Develop students understanding and skills.	26(67%)	12(30%)	01(2.5%)
5	Stimulate students to connect with other disciplines.	26(67%)	11(28%)	02(5%)
6	Stimulate students to connect with real world.	24(61.5%)	11(28%)	04(10%)
7	Call for problem formation, solving and reasoning.	22(56.6%)	15(38%)	02(5%)
8	Promote communication /interaction among students.	27(69%)	09(23%)	04(10%)
9	Promote curiosity and interest in students.	24(61.5%)	14(36%)	01(2.5%)
10	Suitable to apply in the daily classroom situation.	28(72%)	09(23%)	02(5%)
11	Practically possible to use for science teaching.	28(72%)	10(35%)	02(5%)
12	Provide them field exposure.	18(46%)	14(36%)	07(18%)
13	Overall Rating of the activity	25 (64%)	13(33.5%)	01(2.5)



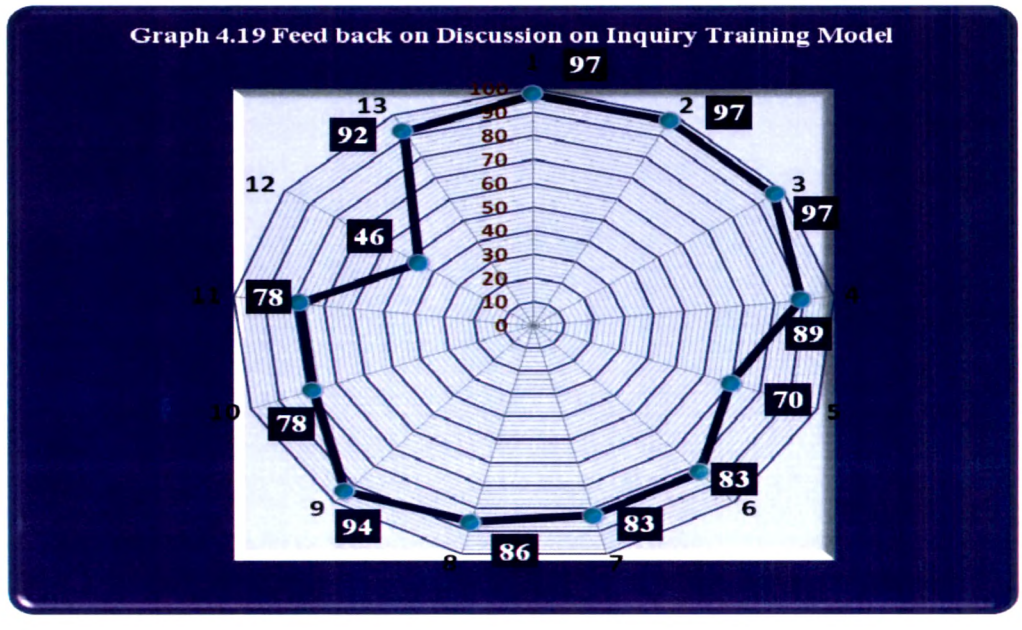
All the thirty nine student teachers (100%) found this activity worthy, thirty six (89.4%) found it appropriate for student teachers and thirty five (90%) found it appealing. Thirty two out of thirty nine (82%) recommended no modification while seven (18%) looked forward to extending the activity to preparation of lesson plan on the method selected and teaching in simulated conditions to group members.

It is clear from the table that the activity was liked by many student teachers since it prepared them for future however it lacked the field exposure.

Activity Fifteen: Inquiry training Model

Table 4.21: Analysis of the response of A15 on AES (frequency and percentage)

A15	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	36(97%)	01(3%)	
2	Actively involves students.	36(97%))	01(3%))	
3	Stimulates students' understanding and skills.	36(97%))	01(3%))	
4	Develop students understanding and skills.	33(89%)	04(11%)	
5	Stimulate students to connect with other disciplines.	26(70%)	11(30%)	
6	Stimulate students to connect with real world.	31(83%)	06(17%)	
7	Call for problem formation, solving and reasoning.	31(83%)	06(17%)	
8	Promote communication /interaction among students.	32(86%)	05(14%)	
9	Promote curiosity and interest in students.	35(94%)	02(06%)	
10	Suitable to apply in the daily classroom situation.	29(78%)	08(22%)	
11	Practically possible to use for science teaching.	29(78%)	08(22%)	
12	Provide them field exposure.	17(46%)	14(38%)	05(16%)
13	Overall Rating of the activity	34(92%)	03(8%)	



Thirty six student teachers (97%) found this activity worthy; thirty one (83%) found it appropriate and thirty four (91%) found it appealing. Thirty six out of thirty seven (97%) found that the activity was implemented properly and has no scope of modification. Student teachers appreciated the classroom transaction and the puzzling situation provided to them. They could understand the potential and the goals of the model in delivering scientific concepts through inquiry.

It is clear from the table that the activity was liked by most of them. It could involve the student teachers actively to greater extent, stimulate their thinking and enhance their analytical ability, problem solving and critical thinking. It created curiosity and generated excitement for learning science. It also enhanced their reasoning.

Activity Sixteen: Role play on status of science club in schools

Thirty two student teachers (84%) found this activity worthy; thirty (78%) found it appropriate for student teachers and twenty five (65%) found it appealing. Thirty out of thirty eight (79%) found that the activity was implemented properly and has no scope of modification whereas eight student teachers (21%) responded that it has scope for modification. Student teachers enjoyed viewing the role play and enacting the situation of science club. It was a new mode of learning to them. They suggested that the role play could be done before their practice teaching phase. One student suggested that costume would add charm and color to the whole activity.

Table 4.22: Analysis of the response of A16 on AES (frequency and percentage)

A16	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	33(86%)	05(13%)	
2	Actively involves students.	31(81.5%)	05(13%)	02(5%)
3	Stimulates students' understanding and skills.	30(78%)	05(13%)	02(5%)
4	Develop students understanding and skills.	29(76%)	07(18%)	01(2.5%)
5	Stimulate students to connect with other disciplines.	27(71%)	09(24%)	01(2.5%)
6	Stimulate students to connect with real world.	30(79%)	08(21%)	
7	Call for problem formation, solving and reasoning.	22(58%)	13(34%)	01(2.5%)
8	Promote communication /interaction among students.	33(87%)	04(10%)	01(2.5%)
9	Promote curiosity and interest in students.	30(79%)	07(18%)	
10	Suitable to apply in the daily classroom situation.	24(63%)	07(18%)	
11	Practically possible to use for science teaching.	23(60%)	13(34%)	06(16%)
12	Provide them field exposure.	24(63%)	09(24%)	04(10%)
13	Overall Rating of the activity	31(81.5%)	08(2.51%)	01(2.5%)

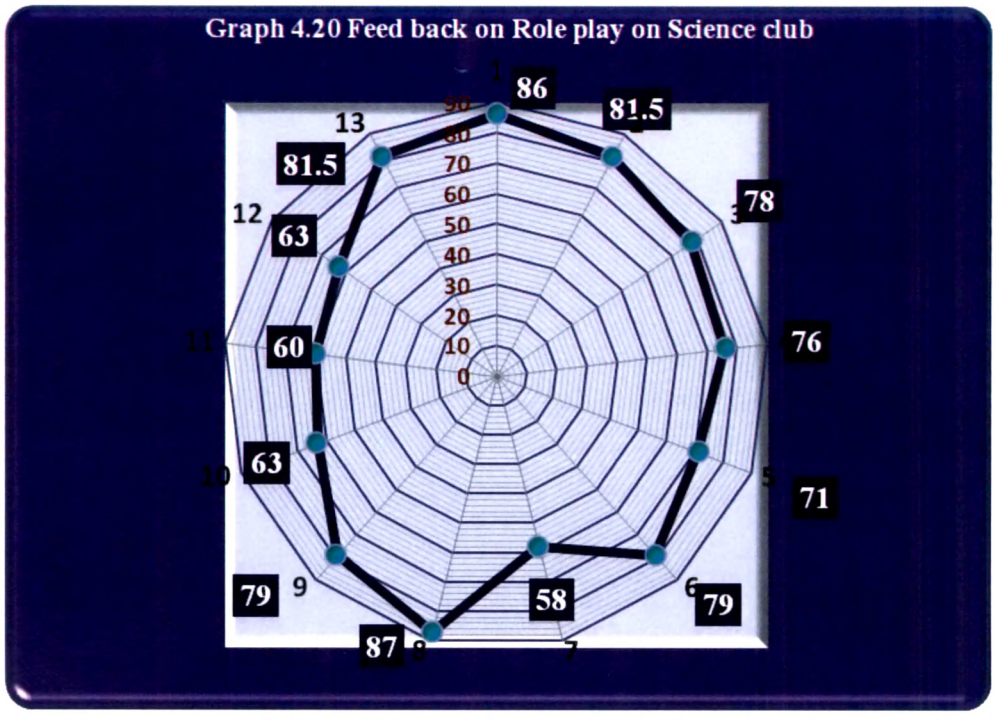


Table provides the detail about student teachers ratings on different indicators. It is clear from the table that the activity was liked by most of them on almost all indicators except seven which talks on the potential of the activity for problem solving.

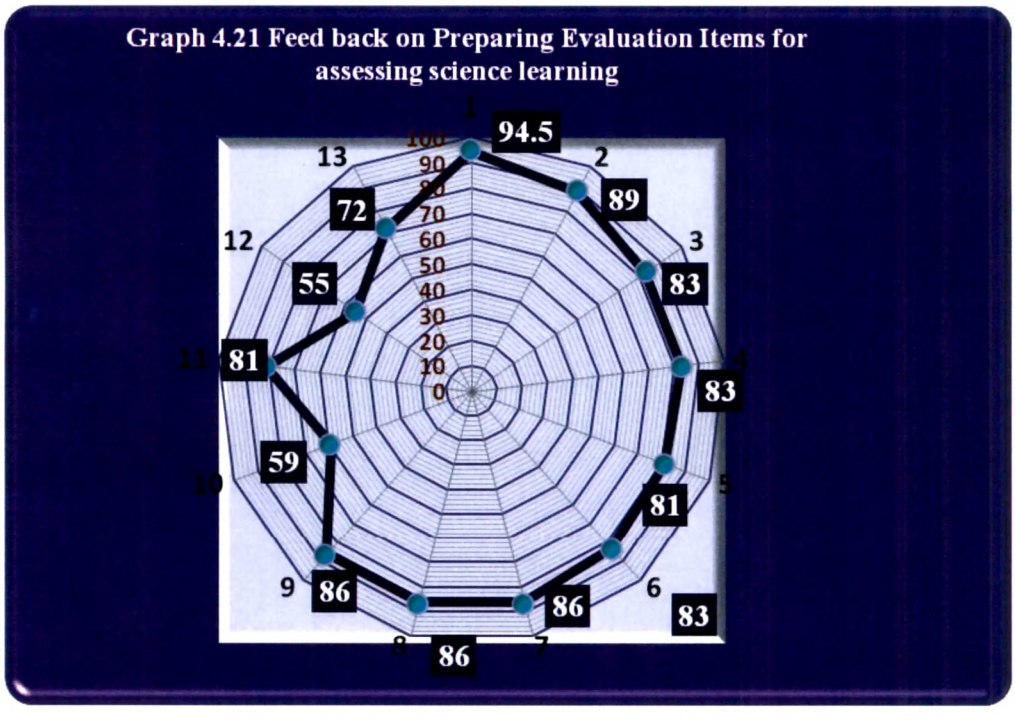
Activity Seventeen: Evaluation techniques and tools for science learning

Table 4.23: Analysis of the response of A17 on AES (frequency and percentage)

A17	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	34(94.5%)	02(5.5%)	
2	Actively involves students.	30(89%)	06(17%)	
3	Stimulates students' understanding and skills.	30(83%)	06(17%)	
4	Develop students understanding and skills.	30(83%)	06(17%)	
5	Stimulate students to connect with other disciplines.	29(81%)	07(19%)	
6	Stimulate students to connect with real world.	30(83%)	06(17%)	
7	Call for problem formation, solving and reasoning.	31(86%)	04(11%)	
8	Promote communication /interaction among students.	31(86%)	04(11%)	
9	Promote curiosity and interest in students.	31(86%)	04(11%)	01(3%)
10	Suitable to apply in the daily classroom situation.	21(59%)	12(33%)	03(8%)
11	Practically possible to use for science teaching.	29(81%)	07(19%)	
12	Provide them field exposure.	20(55%)	13(36%)	03(8%)
13	Overall Rating of the activity	26(72%)	10(28%)	

All the thirty six student teachers (100%) found this activity worthy, thirty four (94.5%) found it appealing and twenty eight out of thirty six (78%) found it

appropriate for student teachers. Thirty (83%) out of thirty six responded that the activity required no modification while six (17%) suggested that more time could be devoted for the preparation of the items by individual student teacher after its presentation. Student teachers learnt various innovative techniques from the activity. They responded that they never thought of using story, crossword puzzles for assessing science learning. They liked the rubrics and scales introduced to them. They found it very useful for student teachers because many new techniques were provided to them.



With regard to the rating of the students on different indicators except on indicator number ten and twelve on all indicators almost all the student teachers rated the activity high. It could involve the student teachers actively, stimulate their understanding and develop innovative ideas and enhance their creative thinking, divergent thinking and critical thinking. It created curiosity and generated excitement for assessing the learning of science through various new techniques. They found it very useful for them as well as any science teachers.

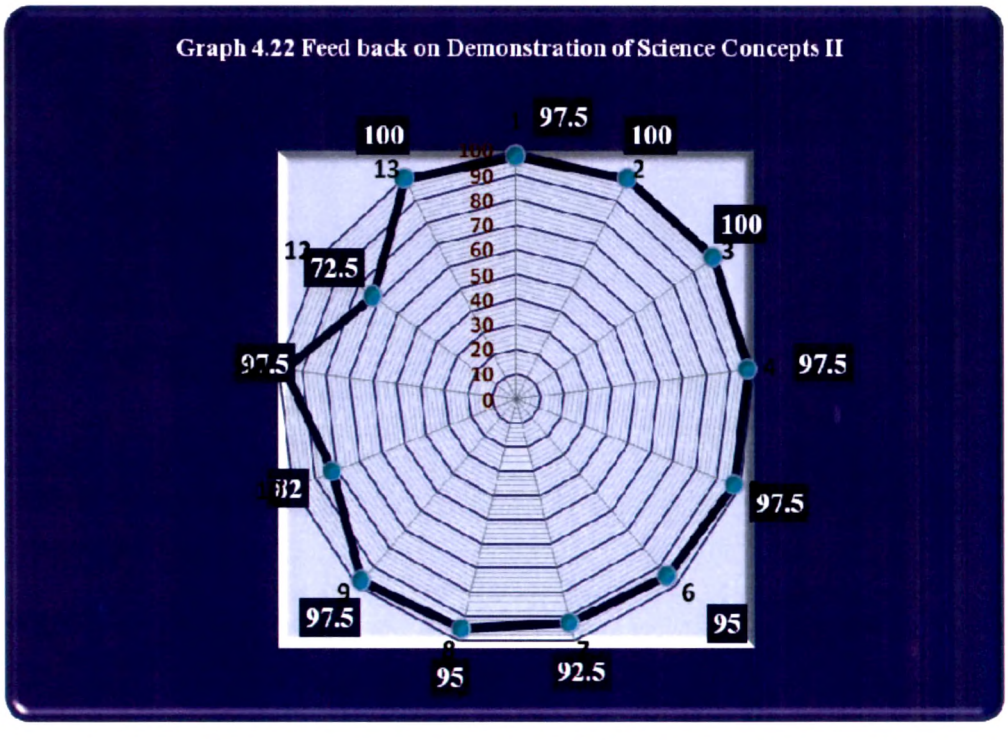
Activity Eighteen: Demonstration II

All the student teachers (100%) found this activity worthy, appealing and appropriate. All the forty (100%) student teachers have opined that the activity was implemented properly and has no scope of modification. Student teachers have reported that this

activity was very effective and involved all, increased their confidence level, improved experimental skills and developed understanding.

Table 4.24: Analysis of the response of A14 on AES (frequency and percentage)

A18	To what extent the activity could	Very Much (%)	Average (%)	Not Much (%)
1	Engage students' intellect.	39(97.5%)	01(2.5%)	
2	Actively involves students.	40(100%)		
3	Stimulates students' understanding and skills.	40(100%)		
4	Develop students understanding and skills.	39(97.5%)	01(2.5%)	
5	Stimulate students to connect with other disciplines.	35(87.5%)	05(12.5%)	
6	Stimulate students to connect with real world.	38(95%)	02(5%)	
7	Call for problem formation, solving and reasoning.	37(92.5%)	03(7.5%)	
8	Promote communication /interaction among students.	38(95%)	02(5%)	
9	Promote curiosity and interest in students.	39(97.5%)	01(2.5%)	
10	Suitable to apply in the daily classroom situation.	33(82%)	07(18%)	
11	Practically possible to use for science teaching.	39(97.5%)	01(2.5%)	
12	Provide them field exposure.	29(72.5%)	09(22.5%)	02(5%)
13	Overall Rating of the activity	40 (100%)		



From the table it is clear that the all of them felt that the activity could involve student teachers to a greater extent, engage their intellect, stimulate and develop their understanding about science concepts, demonstration ability and thinking skills, promote curiosity, communication skills, problem solving ability and very good for

future science teachers to learn. The activity could enhance their confidence, content clarity on science concepts as well as get exposure to variety of demonstrations.

When the demonstration I is compared to demonstration II on the same indicators we find that even between the two there is significant improvement on the different indicators.

4.4.7 Student teachers' responses about each of the activities at the end of the Implementation of ABSTP

To study the actual learning outcomes that have taken place in student teachers at the end of the implementation of ABSTP a Programme Evaluation Sheet was administered. Student teachers were expected to write the level of actual learning outcomes that have taken place in them due to particular activity in terms of gaining knowledge, awareness, and sensitization, interest, curiosity, and change in attitude if any.

Table 4. 25: Activities of ABSTP with lowest to highest rating as per PES

A03	Obj. of Science Teaching	3.325
A10	Viewing video recording of demonstration	3.625
A06	Value Inculcation	3.7
A13	Brain Storming on Scientific Method of Inquiry	3.87
A01	Science Teachers Qualities	3.9
A16	Role Play on Science Club	3.95
A11	Science Process Skills	4
A12	Enlisting Teaching Learning Material in sci.	4.05
A09	Best toys on science concepts out of Waste	4.1
A14	**Methods of Teaching**	**4.2**
A15	Inquiry Training Model	4.225
A05	Plan of multipurpose secondary Science Laboratory	4.225
A04	Visit to District Science Centre, Dharampur	4.5
A07	Visit to Community Science Centre, Vadodara	4.575
A17	Preparing evaluation items for assessing science learning	4.575
A08	Film show on global warming	4.65
A19	Formation of online group	4.65
A02	Demonstration of science concepts I	4.7
A18	Demonstrations of science concepts II	4.75

Student teachers have also rated each of the activities on the five point rating scale. The five different categories very good, good, average, poor and very poor were assigned rating five, four, three, two and one respectively from which average rating was calculated for each of the activities as given in the table twenty three. From the table it is clear that the most effective activity was the demonstration of the science concepts-II with the highest rating 4.75, whereas the least effective activity was

preparation of objectives of science teaching with the rating of 3.325 and rests of activities were rated in between the two values. None of the activity was rated as poor and very poor in effectiveness. The activities are categorized in two; one with very high rating more than or equal to 4.2 and liked more by the student teachers and the second category activities with the rating less than 4.2 and rated as good or average. Most of the activities with high rating were unconventional, group based or field based activities. Most of the activities with less than 4.2 rating were group work in the classrooms followed by individual work. The rating presented in table 4.25 indicates the average rating of each of the activities and provides a comparative rating of the activities of ABSTP.

The responses of student teachers about learning outcomes sustained in them at the end of the implementation of ABSTP are described as follows.

Activity One: Quality Expected from the science teacher

There were five student teachers who felt that they gained knowledge about variety of qualities expected from science teachers; whereas nine student teachers felt that they gained some awareness. Activity could sensitize to six students and nine students realized the qualities to be developed /enhanced in them, nine students found changes in their attitude towards teaching science and eight responded that they find some changes in their behavior after realization of the qualities of science teachers. Majority of the student teachers have reported that this activity has given them chance for self evaluation and enhanced their self evaluation ability which they never did earlier.

Activity Two: Demonstration of science concepts

With regard to the actual changes that have taken place through this activity most of the student teachers found enhancement in their demonstration ability (eighteen responses), experimental skills (twenty responses). Three students felt that they gain knowledge about various concepts of science; four of them developed interest in teaching science due to this activity. Twenty responses indicated that many of the science concepts got cleared during the activity. Five responses indicated the change in attitude towards teaching science, presentation skills enhanced as per six respondents, communication skill increased as per twelve respondents and seven of them felt sensitization towards the use of demonstrations in classrooms. There were many who realized their own ability to perform the experiment in front of the group.

Activity Three: Objective of science teaching

This activity was a small group activity. Seven student teachers responded that it created awareness in them for objectives of secondary science. Thirteen felt that it provided lot of knowledge regarding development of science in India as a teaching subject after independence. Five of them felt that interest for science teaching is developed in them. Six noticed change in their attitude towards teaching science and they became more focused in framing the objectives. Three of them realized the importance of science teaching and got sensitized about teacher's role in achieving the objectives. Thus, the activity mainly could generate interest in student teachers about teaching science.

Activity Four: Field trip to Dharampur science centre

This was a field based group activity which provided hands on experience to many science concepts in play way mode. Fifteen respondents felt that experiential learning was provided which gave them opportunity to interact with the exhibits in the centre. Twelve of them gained knowledge about various science concepts; nineteen felt that science concepts got clear during the discussion with group; five of them felt that it created awareness about the DSC Dharampur and its functioning. This activity could sensitize to four students regarding the importance of science centers and experiential learning provided to them. Many of them could realize that they had never been to such places during their schooling and promised themselves to take their students when they will be science teacher in future. Thirteen of them felt that it created curiosity for many of the science concepts which were not clear to them. Apart from all these seven of them found change in their attitude towards science and towards their group members.

Activity Five: Science laboratory

This activity was field based small group activity followed by presentations. Thirteen student teachers' planning ability (thirteen responses) is enhanced during this activity. Twelve of them felt that due to this activity they could know about the status of science laboratory for secondary grades. Further it created awareness in nine student teachers about materials and other requirements for establishing science laboratory. It created confidence in the nine student teachers through the interview with teachers and presentations in class. As per five respondents it enhanced their measurement and observation ability and estimation ability while planning for the laboratory. It could

change the attitude of five student teachers towards group learning and social skills in two were enhanced.

Activity Six: Value Inculcation

This was the activity based on group discussion and then individual execution. It mainly created awareness in student teachers about various values and sensitization for its integration in science teaching. Awareness was created in thirteen student teachers about values and nine of them were sensitized. Twenty one of them felt it was great exposure to discuss about the values that resulted in ability to integrate them in classrooms and eight of them responded that they could integrate it in the classrooms. Seven of them felt change in their attitude towards science teaching; six of them responded that they developed analytical ability and creative thinking while deciding the values for particular content.

Activity Seven: Visit to Community Science Centre, Vadodara

This was a field based activity followed by discussion with experts of particular subject. Eighteen student teachers found increase in their knowledge about science concepts and community science center, Vadodara. Eleven of them learnt many science concepts from CSC, Vadodara. It created awareness in ten student teachers, resulted in content clarity in eleven students. It could generate curiosity in four of them, interest in learning science in six of them, and change in attitude for teaching science in two of them. The activity made five of them realize the importance of CSC for learning science and six of them felt sensitized and promised to be regular active member of CSC when they will be teachers.

Activity Eight: Film show on global warming

This was a film show on the movie 'the inconvenient truth' on global warming. Student teachers found it very effective and many of them responded that it could sensitize them. Eight of them responded that they knew many concepts related to global warming. In seventeen of them the activity could create awareness and seven of them realized about the challenges of global warming and promised to work on it. Eighteen of them felt that it sensitized us, it made their minds think for the preventing the planet earth from global warming. Five of them reported that they found change in their behavior after watching the movie especially, about the use of plastic bags was minimized by them. Six of them reported that they have shown the movie to their secondary students during their practice teaching phase and promised to continue the

same for future. Fifteen student teachers reported that it was very heart touching and gave long lasting effect on student teachers.

Activity Nine: Best out of waste

This was an indoor activity to expose the group to make toys from the waste material. Student teachers could prepare some more toys after this session was the major outcome for this activity. Nine of them learnt to use toys in teaching science. Fourteen of them found it very interesting and informative session about joyful learning. Ten student teachers enjoyed the lucid interaction and dialogue of the expert with the group which changed their outlook to deal with students effectively. Eight of them found it very innovative and student teachers could engage their mind in creative ideas to prepare the toys for their classes. Three of them reported that after this session they attempted to change my teaching style with more interaction with students with learning by doing. Three of them reported that they have used it in their practice teaching and found it more effective than other classes.

Activity Ten: Viewing video recording and discussion

This activity was based on the Video recordings of student teachers performance during demonstration I and some sample demonstration of better performances of previous years. Student teachers enjoyed viewing themselves on large screen and could realize their mistakes otherwise might not have accepted if told by someone else. Nineteen of them reported that it was a short of self assessment of science process skills executed by them. Five of them knew about many common mistakes and ten of them felt that it created awareness regarding the proper way of performing the demonstration. Twelve of them could realize and rectified their own mistakes in the later session. Four of them felt that this was a nice attempt which developed ability to perform better demonstrations in practice teaching and in the subsequent demonstration. One student reported that it was a good idea to record the performance and self evaluation.

Activity Eleven: Science Process Skills and their evaluation

This was an activity based on interactive power point presentation with visuals supported by discussion. Student teachers liked the presentation. Nineteen of them felt it very informative session about integrated and basic science process skills. Eighteen of them got awareness about the science process skills and its evaluation techniques. Twenty three of them realized that they never thought of many of the skills which can

be developed by teachers while teaching science. Six of them learnt the new style of interactive power point for effective learning.

Activity Twelve: TLM in science

This was a small group activity followed by discussion and submission of the worksheets. Many of them admitted that they never read the science textbook so keenly earlier and got knowledge as reported by eleven and awareness in nine about various topics which were allotted to them. By doing this activity in group many of them developed insight for new activities and TLM which alone might not generate in their mind. Six of them reported that they were charged in group activity and seven of them got better ideas through collective thinking. According to four students it was a social learning and they could prepare a list with very innovative activities few of which they have used in their classrooms. Nine of them felt that the list prepared by the group was helpful.

Activity Thirteen: Brainstorming on scientific Method

This was an experiential learning about brainstorming as a method of teaching with the example of learning steps of scientific method. Student teachers found the classroom climate charged with inquiry and energy. Six of them gained knowledge about the scientific method and seven of them felt that awareness regarding the brainstorming method was created. Five of them felt that interest for learning and experimentation was developed. Fourteen of them reported that it created curiosity in the group for inquiry. Nine of them reported that critical thinking was developed in them. Nine of them felt that they got an exposure to effective science class created by teacher. Four of them could find change in their attitude towards science teaching and actually they tried to create the same environment in their science classrooms.

Activity Fourteen: Methods of teaching and instructional material of it

This was a blend of self study followed by an orientation, group work, and discussion. Student teachers found the instructional material very useful informative and simple to understand. Ten student teachers gained knowledge and in fifteen of them awareness about various methods of teaching was created. Eleven of them could develop ability to integrate the appropriate methods in their classrooms. According to eight student teachers the instructional material helped in learning at their convenience. Six of them realized the importance of various methods of teaching and got sensitized for its use in classrooms. Six of them felt that they could develop the

lesson plans with heuristic and play way method and used them in their practicing classrooms.

Activity Fifteen: Inquiry Training Model

This was an experiential learning about Inquiry Training Model (ITM) with the general examples. Seven student teachers gained knowledge and in six of them awareness about the use of ITM in science classrooms. Nine of them to use the ITM with fun and five student teachers felt that ability of using in classrooms was developed. Eight of them felt that experiential learning helped them in realizing the actual environment needed for IT classrooms. As per five students divergent thinking was developed and three of them could develop positive thinking. Eight of them felt that it was very effective way of teaching that they understood the execution of ITM in classrooms step by steps without reading any theory and with long lasting effects. Twelve of them felt that they learnt the role of teacher while using the ITM in science class.

Activity Sixteen: Role play on status of science club in schools

This was a field work followed by enacting and presenting the field reports. Eleven of them felt that it was very informative and they gained knowledge about the science club activities in Vadodara city and its status. Fourteen student teachers found that it created awareness about the science club and its activities with enjoyment of role play. Many of them learnt about the real status of science club while visiting the schools. Eighteen of them felt sensitized by the role play and understood the effect of role play and its use as a mode of learning. They took oath to establish science club in their schools in future. Three of them who performed in the drama felt that their confidence level was raised and stage fear was removed in one student teacher.

Activity Seventeen: Evaluation techniques and tools for science learning

This was a discussion followed by small group activity and then developing evaluation items for assessing students learning. Twelve of them felt that their knowledge about the various unconventional evaluation techniques was increased and seven of them felt that awareness was created in them. Ability to construct the tool was enhanced in six students and seven of them felt that their creative ability was promoted. It developed interest in five student teachers and generated curiosity in five of them. Fourteen of them felt that it was a great exposure to various evaluation techniques which they did not know earlier and their concept regarding comprehensive evaluation became clear.

Activity Eighteen: Demonstration II

This was the individual performance followed by group discussion. With regard to the actual changes that have taken place through this activity fourteen of the student teachers found enhancement in their demonstration ability and experimental skills (twelve responses) compared to the earlier session. Eleven student teachers felt that they gain knowledge about various innovative experiments on similar concepts of science; eight of them developed confidence for performing in the group. Seven responses indicated the change in attitude towards teaching science, presentation skills enhanced as per eleven respondents, five of them felt sensitization towards the use of demonstrations in classrooms. Seventeen of them found refinement in their science process skills. Most of the student teachers realized the increased level of performance ability in them compared to their earlier performance.

Activity Nineteen: Formation of online group and its execution

This was a technology based activity which was initiated in the initial of the year and continued till end of the year and envisaged to be continued for ever. This was one of the most liked activities of ABSTP as per student teachers responses. Student teacher (fourteen) for the first time knew about the possibility of using online groups for academic purpose and how to use it. Few of the student teachers were not having their E-mail addresses when joined the course. Eight of them felt very happy to report that due to this they were made to create and actually using it actively for knowledge sharing. Online sharing was the new concept for the group; eighteen of them reported that they actually practiced it due to this activity. Six of them responded that they were using internet for information gathering earlier and this activity made them to share the gain information to others which was very beneficial to them during their teaching phase. Eight of them learnt to prepare documents and submit it online. Thirty of them felt that their info savvy and techno savvy skills were enhanced. Nineteen of them felt that it was an initiation towards the paperless society by making them submit the assignments online. They could realize that it was an attempt for academic networking forever. Researcher could see that though it was liked by many student teachers however participation of every student teachers could not be ensured every time.

The results obtained from the analysis of the data are presented in this chapter. The results need to be culminating into meaningful inferences and implications for further

dissemination. The detailed discussion of the results may pave the way for effective implications and inferences. The following chapter proceeds to present the major findings and discussion of the findings and deriving implications of the study.