CHAPTER V
MAJOR FINDINGS AND DISCUSSION

5.1 Introduction
The major findings were drawn based on the data analysis and interpretation presented in the previous chapter. The findings are presented in this chapter in three sections (i) status of Basic Science Process Skills before intervention programme (ii) acquisition of Basic Science Process Skills during intervention programme (iii) status of Basic Science Process Skills after intervention programme. The three sections of findings are as follows.

5.2 Status of BSPS before Intervention Programme

- Findings with regards to status of science teaching, it was found that, students seldom visited the laboratory. Most of the time students listened to science teacher lecture wherein teacher read and explain the science concept and definitions. The teacher very rarely demonstrated the experiments in the classroom and students did not do any science experiment in classroom or laboratory on their own either in group or individually.

- The students did not operate microscope, had not observed any preserved specimens of plants and animals, and chemicals in the laboratory. Also they did not use equipments and apparatus such as magnifying lens, and simple pendulum experiment, pipette, burette, measuring cylinders, thermometers to measure the objects and liquids.

- With regard to Observation Skill
  - 67.85% students’ observation skill was in beginning stage wherein students could not observe the similarities and differences between similar pictures, unable to observe the fine details of plant and animal specimens with the help of magnifying lens. Students did not employ all the sensory organs, and microscope during observations, for example colour of different chemicals was observed but smell, texture, and appearance of chemicals was not noticed by them.
  - 17.89% students’ observations skill was in developing stage wherein students observed very few similarities and differences between similar pictures. The magnifying lens and microscope were skilfully used for noticing very few fine details of specimens such as decayed bread, insects and sand to some extent.
4.91% students’ observation skill was in accomplished stage wherein students observed most of the similarities and differences, fine details of specimens by employing sensory organs, microscope and hand lens.

8.25% students’ observation skill was in proficient stage wherein students skilfully used their sensory organs and observed all similarities and differences between similar pictures. They noticed the colour, nature, appearance and texture of chemicals. They also observed the fine details of specimens of plants, animals and sand with the help of hand lens. They skilfully operated microscope and observed the human blood slides.

**With regard to Classification Skill**

33.33% students’ classification skill was in beginning stage wherein students incorrectly classified the objects, substances and organisms. Classification was not based on similarities and differences or common attributes.

49.89% students’ classification skill was in developing stage wherein very few objects, substances and organisms were correctly classified based on similarities and differences.

12.50% students’ classification skill was in accomplished stage wherein students skilfully classified most of the objects, materials, substances and organism under correct classification based on common attributes.

4.36% students’ classification skill was in proficient stage wherein things, substances, organisms correctly classified under correct classification based on the nature of substances, similarities and differences, common features, and similar attributes. For example, students classified magnetic and non magnetic, metals and non metals, conductors-insulators, acids and bases, pure and impure substances, hydrophytes, mesophytes, xerophytes, vertebrates and invertebrates, reptiles and amphibians, herbivores, carnivores and omnivores.

**With regard to Communication Skill**

42.63% students’ communication skill was in beginning stage wherein students could not draw line graph, bar diagram, pie chart, and tabular column correctly for the given data. They could not communicate through symbols, for e.g. they did not know the symbol for chemical elements and electric components. They drew diagrams correctly to some extent without labelling the parts.
35.71% students’ communication skill was in developing stage wherein students correctly wrote the title of the graph, X axis and Y axis in the line graph and bar diagram but the line graph, bar diagram, and pie chart plotted by them were incorrect and incomplete. To some extent they could correctly communicate through symbols, tabular column and diagram.

12.72% students’ communication skill was in accomplished stage wherein students almost plotted line graph, bar diagram and pie chart correctly. They drew tables correctly to some extent. Also they skillfully drew the diagram and labelled the parts correctly to some extent.

8.82% students’ communication skill was in proficient stage wherein students correctly plotted the line graph, bar graph, pie chart, tabular column and systematically displayed the data. They skillfully communicated through symbols and diagram.

With regard to Measurement Skill

54.16% students’ measurement skill was in beginning stage wherein students incorrectly measured the length, breadth, height, and angle of the object and diagram. They could not find out the area of irregular object (leaf) accurately. They were unable to measure the temperature of water accurately. The volume of liquids measured with the help of pipette and burette was not precise i.e. much higher or lower than precise. Similarly, the length of curved line diagram was incorrectly measured with the help of thread, and they were unable to find out thickness of single page.

13.69% students’ measurement skill was in developing stage wherein students followed measurement procedure while measuring the length, breadth, height, angle, volume, area and temperature correctly to some extent but the measurement was not precise. Students correctly followed measurement procedure while measuring the area of irregular object (leaf), volume of water however the measurement was inaccurate and not precise. They could not measure the length of curved line.

18.25% students’ measurement skill was in accomplished stage wherein students correctly measured breadth and height of the table but length of the table was not measured accurately. The volume of water and KMnO₄ solution was measured in the pipette and burette with lower meniscus. They
correctly followed measurement procedure while measuring the total area of irregular object (leaf) and volume of irregular object but the measurement was inaccurate. The length of the pendulum measured correctly but could not calculate the time period of oscillation.

➢ 13.88% students’ measurement skill was in proficient stage wherein students accurately measured the length, breadth, and height of the object. Exact volume of water measured correctly with the help of measuring cylinder. Weight of the object was measured correctly by using pointer balance. Students skillfully measured exact 75ml KMnO₄ solution in the measuring cylinder and 20ml of water using pipette. The temperature of water was measured accurately by using thermometer and length of curved line diagram was also measured accurately by them.

FAQ: With regard to Prediction Skill

➢ 54.91% students’ prediction skill was in beginning stage wherein students’ prediction was incorrect with regard to sinking and floating, miscibility and immiscibility, seed germination, time period of oscillation. For e.g. (i) Students’ incorrectly predicted that ice cubes sink in water and water level increase during melting of ice cubes (ii) Students incorrectly predicted that castor oil and honey floats in water (iii) they predicted that kerosene and castor oil mix with water (iv) evaporation takes place faster in water than petrol.

➢ 20.08% students’ prediction skill was in developing stage wherein students’ prediction was somewhat correct with regard to floating and sinking, miscibility and immiscibility of liquids, etc but they could not give any reasons for prediction. For e.g. (i) Students’ correctly predicted that ice floats in water and correctly predicted that petrol evaporates faster than water but could not justify their prediction scientifically.

➢ 18.75% students’ prediction skill was in accomplished stage wherein students’ prediction was correct and the reasons for prediction were also partially correct. For e.g. (i) based on the observations of simple pendulum experiment students correctly predicted the time period of oscillations and gave partially correct reasons. (ii) They correctly predicted that seed germinates faster in soil+ fertilizers and justified their prediction to some extent.
6.23% students’ prediction skill was in proficient stage wherein students correctly predicted the future events and occurrences based on the observations and experiences. They could give correct reasons for their predictions. For e.g. students correctly predicted ice cubes floats in water and (ii) castor oil and kerosene do not mix with water.

- **With regard to Inference Skill**
  - 72.23% students’ inference skill was in beginning stage wherein students could not derive inferences based on observations, instead they wrote observations of experiments, demonstration, videos and pictures. The students could not differentiate between observations and inferences.
  - 15.40% students’ inference skill was in developing stage wherein students derive few inferences correctly to some extent. However they wrote more observations of experiments, demonstration, videos and pictures.
  - 8.70% students’ inferences skill was in accomplished stage wherein students almost correctly derived inferences however few inferences could not be derived correctly and completely.
  - 3.57% students’ inference skill was in proficient stage wherein students’ correctly and completely derived inference(s) based on observations of pictures, experiments, demonstration and videos. They were able to differentiate inferences and observation.

### 5.3 Acquisition of BSPS during Intervention Programme

- It was found that students were actively involved in each stage of Kolb’s experiential learning cycle by doing science experiments and activities and acquired process skills.
- It was observed that students skilfully operated the apparatus and equipments such as microscope, pipette burette, measuring jar, weighing balance, simple pendulum and magnifying lens.
- It was observed that students constructed the science concepts through process skills which reflected their concept clarity.
- Students actively involved in preparing models and teaching aids with the help of waste materials. They presented it in the class and science exhibitions. These learning experiences developed students’ presentation skill, thinking skill and their creativity.
- It was observed that the learning experiences such as hands on experience, field visit, multimedia presentation, role play, simulation and demonstration gradually improved students’ science process skills in terms of
Observing the similarities and differences between similar pictures and objects, noticing fine details of plant and animal specimens, observing the texture, smell, appearance of the chemicals.

Classifying the things, substances and organisms into different category or groups based similarities and differences and presence and absence of certain features. For e.g. grouping the solids, liquids, gases; acids and bases; unicellular and multicellular; hydrophytes, xerophytes and mesophytes, etc.

Displaying the results through line graph, pie chart, bar diagram, tables, symbols and diagrams, etc.

Measuring length, breadth and height of the object, area of irregular leaf, volume of stone and temperature of water accurately.

Writing measurements with appropriate units.

Judging the range and capacity of measurement devices before use.

Measuring the liquids accurately without lower and higher meniscus.

Students correctly predicted the occurrences of events based on observations and experiences, also giving reasons for their prediction.

Students correctly derived inferences based on observations of experiments and activities. They were also able to differentiate between inference and observation.

The experimental skills were improved over a period of time.

5.4 Status of BSPS after Intervention Programme

With regard to Observation Skill

3.79% students’ observational skill was in beginning stage wherein students engaged in the process of observations but (i) could not observe any similarity and difference between similar pictures; (ii) could not use the magnifying lens and microscope for observing the fine details of the given specimens, and chemicals.

8.25% students’ observation skill was in developing stage wherein students somewhat skilfully used their sensory organs and observed few similarities and differences between similar pictures; to some extent the students effectively used magnifying lens and microscope for observing the fine details of specimens; they observed the colour, smell, texture and appearance of few chemicals by employing their sense organs.
18.08% students’ observation skill was accomplished stage wherein most of the similarities and difference between two similar pictures were observed. The Students observed most of the features such as colour, nature of body, number of body segment and body parts of the given specimens. The characteristics of chemicals in terms of smell, taste, texture, and appearance were also correctly observed.

69.86% students’ observation skill was in proficient stage wherein students observed (i) similarities and differences between two similar pictures (ii) colour, smell, taste, texture and appearance of the chemicals observed correctly. The fine details of the given specimens were noticed by use of magnifying lens and microscope, for e.g. colour, appearance and smell of decayed bread observed correctly. They skilfully operated the microscope for observing the shape, types and arrangement of blood cells and blood components.

**With regard to Classification Skill**

1.78% student’s classification skill was in developing stage wherein students somewhat able to classify the things, materials and substances into different categories or groups based on certain common characteristics or properties. For e.g. students correctly classified very few materials and substances into conductors and insulators; solids, liquids and gases; pure and impure substances; vertebrates and invertebrates, etc.

15.67% students’ classification skill was in accomplished stage wherein students classified most of the things, materials, substances, and organisms correctly based on similarities and differences, presence and absence of common features. For e.g students correctly classified most of them into conductors and insulators; magnetic and non magnetic; pure and impure substances; metals and non metals; soluble and insoluble substances; plants and animal based on common characteristics.

84.14% students’ classification skill was in proficient stage wherein students’ attained proficiency in classifying the things materials substances and organisms into different groups based on similar properties and characteristics. For e.g. students skilfully classified the things, materials and substances into different groups such as solids, liquids, and gas; conductors and insulators; magnetic and non magnetic substances, etc.
With regard to Communication Skill

- 1.78% student’s communication skill was in beginning stage wherein students could not draw pie chart, line graph and tabular column for the given data. They were unable to draw diagram and communicate through symbols.
- 13.61% students’ communication skill was in developing stage wherein students correctly plotted line graph, bar graph, pie chart and tabular column correctly to some extent but the plotted graph was incomplete (for e.g. X axis and Y axis written correctly students but plotted graph was correct to some extent pie chart was imperfect; drew inappropriate table and entered incomplete data). They could communicate through symbols, and diagram correctly to some extent.
- 22.54% students’ communication skill was in accomplished stage wherein students drew line graph, bar graph, pie chart and tabular column almost correctly with minor mistakes. For e.g. students drew graph for the given data with appropriate title, X axis and Y axis variables written correctly but the graph was imperfect. Similarly, pie chart was drawn correctly but partition was not made perfectly based on the data. The tabular column was drawn but data entered was incomplete.
- 62.05% students’ communication skill was in proficient stage wherein students correctly and completely plotted line graph, bar diagram, pie chart, tables and symbols and they skilfully drew diagrams.

With regard to Measurement Skill

- 3.57% students’ measurement skill was in beginning stage wherein students could not measure the length, breadth, and height of the object; volume of water; total area of irregular object. They could not use the thermometer skilfully to measure temperature of water and did not know how to measure volume of irregular object. The Students did not use the measuring instruments skilfully while measuring the object or liquids, temperature.
- 7.93% students’ measurement skill was in developing stage wherein students measured length, breadth, height, area, temperature, and volume of a given object or liquids correctly to some extent but committed minor measurement error while measuring the size of the object or volume of the liquids. For e.g. students committed measurement error while measuring the KMnO₄ solution and water.
- 14.68% students’ measurement skill was in accomplished stage wherein students skilfully used the measurement devices such as scale, tape, thermometer, protractor, pointer balance, measuring cylinder, pipette burette while measuring the length, breadth, height, temperature, mass (weight), time, thickness, area, and volume of object or liquids however committed minor error during measurement. For e.g. (i) students measured height and breadth of the table correctly but could not measure the length accurately (ii) students could not notice the lower meniscus while measuring the volume of liquids and KMnO₄ solution.

- 73.80% students’ measurement skill was in proficient stage wherein students accurately measured the length, breadth, height, angle, area, temperature, and weight of the given diagram. For e.g. (i) temperature of water was measured accurately (ii) volume of irregular object (stone) measured correctly (iii) volume of KMnO₄ solution and water was measured precisely with the help of pipette and burette.

**With regard to Prediction Skill**

- 11.38% students’ prediction skill was in beginning stage wherein students’ predictions were incorrect with regard to floating and sinking, miscibility and immiscibility, seed germination, etc. For e.g. students could not predict correctly about floating and sinking of different liquids such as kerosene, castor oil, honey and diesel in water.

- 15.17% students’ prediction skill was in developing stage wherein some of the predictions were correct but they could not give any reason or justification for the predictions. For e.g. students correctly predicted that ice cubes floats in water and level of water will be remain same while melting of ice cubes but they did not write any reason for their prediction.

- 22.09% students’ prediction skill was in accomplished stage wherein most of the predictions were correct and the reasons stated for prediction were also partially correct. For e.g. students correctly predicted that ice floats in water and level of water remains same while melting of ice cubes and gave partially correct reasons for it.
57.33% students’ prediction skill was in proficient stage wherein they correctly predicted regarding to floating and sinking of ice cubes and different object in water; miscibility and immiscibility of different liquids with water; on rain; evaporation of liquids; germination of seeds based on the evidences obtained through observations of experiments and past experiences. They also given correct reasons for their predictions.

With regard to Inference Skill

- 5.13% students’ inference skill was in beginning stage wherein students could not derive inferences based on observation of picture, experiments, and videos, instead they wrote observations. For e.g. students observed root, stem, leaf, CO₂, O₂ and sunlight in the picture of plant photosynthesis but could not derive any inference(s) on photosynthesis. Similarly, experiments were conducted; videos were shown but students could not derive any inferences. The students were able to differentiate between inference and observations.

- 8.14% students’ inference skill was in developing stage wherein students derived inferences correctly based on observation of experiments pictures and videos to some extent but they could derive inference(s) completely.

- 15.62% students’ inference skill was in accomplished stage wherein students derived inference(s) based on observations of pictures, experiments, demonstration and videos almost correctly however few inference(s) students unable to deduce correctly.

- 70.75% students’ inference skill was in proficient stage wherein students correctly and completely derived all inference(s) based on observations of experiments, demonstration, pictures and videos and they able to differentiate between observations and inferences.

With regard to acquisition of observation skill, it was found that there has been a significant difference in the observed and expected frequencies between pre and post intervention programme. Hence, the proposed null hypothesis Ho1 was rejected and it can be inferred that the intervention programme was effective in terms of acquisition of observation skill.
With regard to acquisition of classification skill, it was observed that there has been a significant difference in the observed and expected frequencies between pre and post intervention programme. Hence, the proposed null hypothesis Ho 2 was rejected and it can be stated that the intervention programme was effective in terms of acquisition of classification skill.

With regard to acquisition of communication skill, it was found that there has been a significant difference in the observed and expected frequencies between pre and post intervention programme. Thus, the null hypothesis Ho 3 was rejected. From this it can be inferred that the experiential learning intervention programme was found to be effective in terms of acquisition of communication skill.

With regard to measurement skill, it was observed that there has been a significant difference in the observed and expected frequencies between pre and post intervention programme. Hence, the null hypothesis Ho 4 was rejected. It can be concluded that the intervention programme was effective for the acquisition of measurement skill.

With regard to acquisition of prediction skill, it was found that there has been a significant difference in the observed and expected frequencies between pre and post intervention programme. Hence, the null hypothesis Ho 5 was rejected. It can be inferred that the intervention programme was effective in terms of acquisition of prediction skill.

With regard to acquisition of inferences skill, it was found that there has been a significant difference in the observed and expected frequencies between pre and post intervention programme. Hence, the null hypothesis Ho 6 was rejected. It can be said that intervention programme was effective in terms of acquisition of inference skill.

With regard to achievement of basic science process skills, it was found that there has been a significant difference between pre and post intervention programme. Hence, the null hypothesis Ho 7 was rejected. The difference was that the mean score was found to be higher in post test (33.33) as compared to the pre test (9.42). From this it can be inferred that the intervention programme found to be effective in’ students achievement on basic science process skills.
With regard to teachers’ opinions towards experiential learning, teachers opined that experiential learning intervention programme provided concrete learning experiences for the students to acquire knowledge and process skills.

With regard to students’ opinion towards experiential leaning intervention programme, the learning experiences such as hands on experience, multimedia presentation, group work, field visit, simulation, demonstration, laboratory visit and role play developed basic science process skills and science concepts.

The Parents and siblings opinion regarding hands on experience, field visit, role play, multimedia presentation was that these are the learning experiences beyond traditional lecture method of teaching, it de-emphasis the rote memorisation of concepts, and also develops interest towards science. It is very useful in their later stage of education.

Findings presented in this chapter give the clear picture of status of basic Science process skills before, during and after the intervention programme.

5.5 Discussion
Science is endless process; scientific knowledge and skills can be learned through various ways but there are some factors which influence the science learning such as motivation, attitudes, interest, learning environments and learning experiences, and learning materials. In addition to the above factors science learning greatly influenced by instructional strategies and evaluation. How school students learn science best? School students always desire to do experiments by their own. Learning becomes concrete and meaningful when there is interplay between learner and learning experiences. Science teaching should provide rich learning experiences to learner. If it fails to provide such opportunity for the students, then the learning becomes mechanical and monotonous. Present science teaching in schools largely dominated by textbook. Teacher continuously delivers content into students’ minds; they often end up memorising the concepts. Teaching of science neglects the process of science, no practical experiences for the students, as a result students lacking behind even in simple process skills. Before implementation of intervention programme present study findings revealed that most of the students status of science process skills was in beginning stage.
wherein (i) they were unable to observe the differences and similarities between two similar objects or picture (ii) they could not observe the fine details of specimens with the help of microscope and hand lens (iii) they could not classify the object, substances and organisms based on similarities and differences (iv) most of the students could not measure the length, breadth, temperature, weight, volume and area accurately and (v) they were not able to communicate through line graph, bar diagram, pie chart, diagram, tables, symbols. They could not predict correctly the future events based on the experiences and observations and they could not derive inferences based on their observations and experience. Students of upper primary stage were in a position to observe, classify, communicate, measure, predict and infer. It was unfortunate that the students of upper primary not expert in basic science process skills such as observation, classification, communication, measurement, prediction and inference.

It can be inferred from the above findings that the science teaching rarely or did not expose the students in “learning by doing” method. Teachers were trained to read and understand the science concepts from textbook. Most of the time students copied answer from textbook and the same presented in the examination. Teaching was not constructive based, it was declarative and authoritative based. Malhotra (1998) and Umasree (1999) study findings indicates that teachers often use lecture method and students are rarely given opportunity to do science, students observe the teacher’s lecture rather than actively participating in the classroom. The examination system also focussed only cognitive aspects of science, process part of science not focussed. Teachers did not engage the students to make simple teaching aids by using waste materials. Teaching aids were not used or rarely used by teachers. Students were not engaged in the process aspects of science. Science equipments, apparatus and materials were not touched by students. Hands on learning experiences and activities were not emphasised by teachers, also they were not having enough competency to employ process skills. Variety of learning experiences such as field visit, role play, hands on experiences, model making, multimedia presentation, group activity were not provided by the teachers. Students did not do science experiments by own. Science equipments’ and apparatus, preserved specimens, magnifying lens, chemicals and microscopes were unseen or rarely seen by students; as a result students were very poor in employing basic process skills.
Science laboratory is most important for science learning. Simple experiments, investigation in the laboratory, field visit, role play and teaching aids provides rich learning experiences to students. It is teachers’ role to engage the students in appropriate learning environment for acquiring knowledge and skills. Children’s process skills are limited and unsystematic in the beginning of upper primary stage; it is part of teachers’ role to develop these skills so that when they get older, students approach the world in a systematic way. Unconsciously children at upper primary stage use basic process skills superficially at the time of exploration of the world. Science teachers’ should identify the individual students’ process skills status; accordingly opportunity should be provided to practice the skills regularly. Continuous assessment also required to know students process skills. Examination should focus more on process aspects of science. The assessment should not be confined to paper pencil test. Teachers need to use variety of assessment tools and techniques such as performance based test, situational test for assessing student’s science process skills status.

Teachers also should have enough competencies in science process skills. It was stated by UNESCO (1992) in its document on “Teacher Competency” that process skills development is one of the important competencies for teachers. All policies and national level curriculum including NPE, 1986; NCF 2000 and 2005 made recommendation that teaching of science should develop process skills. Process skills cannot be acquired over a night; there should be experiments and activities, field visit, projects, demonstration, simulation, projects for the students to acquire necessary skills.

Why science teaching should emphasis more on process skills? What is the need of developing basic process skill at upper primary students? Process and products are inseparable from science. The products of science are outcome of process skills. By employing the process skills students constructs and reconstructs the concepts, modify the ideas. Harlen (1995) stated that if these process skills are not carried out in a rigorous and scientific manner then the emerging ideas will not necessarily fit the evidence. Basic process skills are the foundation for integrated process skills. The students who are proficient in basic process skills, they can exercise integrated process skills skilfully. Observation is starting point for science experimentation and investigation, it is crucial for making sense of the world at an early stage. Observation provides the children to explore the objects
and their relationship. Observation promotes scientific thinking and it helps the children to understand the physical and biological world. During observation students employ all senses to collect qualitative and quantitative information such as noticing similarities and differences, fine details etc. Observation enables the students to use other basic process skills. Observation skill is not only for observing the events and fine details but also for sorting or classifying the things, objects, substances and organisms in a systematic manner based on similar characteristics. Classification skill develops divergent thinking and it promotes creativity. It also enables the students to give reason and to see the pattern of relationships that are the basis for concept development and generalisations.

Communication is important in science. The observed findings and results should be communicated to others through verbal and non verbal methods such as graph, pie chart, tables and symbols. It is not only conveys the information but also helps for retrieve the informations whenever required. Students clearly can understand the results by looking at the symbols, posters, charts, and pie diagram and they able to compare the relationships pattern. Measurement in science is obvious. Measurement is act of using numbers to describe the objects and events. Students must understand the attributes that are measurable such as length, breadth, height, temperature, weight, angle and volume. They must know standardisation of measurements and appropriate measurement devices. Before measurement they must know the capacity of measuring devices, and accuracy in measurement. After measurement students must know how to write with proper measurements units. Measurement skill helps to sharpen their observations. Calculation is the part of measurement. It is therefore required by the students to know standard metric systems and to know process of conversion, for e.g. conversion of centimetre into millimetre vice versa; Celsius to Fahrenheit, etc.

Students come to schools with rich experiences which can help to predict the future events and occurrences. Students very often guess without any base or observations. Predictions have strong basis or evidences, for e.g. before an experiment they can make prediction what will happen and during an experiment also they continue to predict about the events. But they do not have a well defined understanding of why things happen so. It is very necessary to have reason for their predictions. It is necessary that students should be engaged to carry out experiments and investigations to verify the prediction through which
students come to know the cause and effect for the prediction and they acquire other process skills as well. Inference is an attempt based on observation of picture and experiments. It is common that students write observation instead of inferences, they observe the picture, experiments but cannot derive inferences based on available evidences. It is quiet difficult for the students to derive inferences based on experimentation and thorough observations. Teachers need to provide opportunity for the students to derive inferences by engaging them in an experiments and investigation regularly. Such activities develop inference skill and it stimulates higher order thinking skills, problem solving skills and metacognition process which have application in real life situation. Germann & Aram (1996) study findings indicate that development of science process skills enables students to construct and solve problems, critical thinking.

Process validity enables the students to solve problems, think critically, make decision, find answer, promote creativity and it increases the permanence of learning. It was stated by NCF (2005) that process validity is an important criterion since it helps in ‘learning to learn’ science. But present study finding reveal that most of the time science teachers read the textbook and explain the concepts. Students listen to the teachers lecture. There were no direct hands on learning experiences for the students to explore process skills. When the students exposed in experiential learning intervention programme, gradually they acquired the skill of observation, classification, communication, measurement, prediction and inference. Intervention programme provided opportunity for the students to employ the sensory organs and observed the colour, smell, texture, appearance of chemicals. They classified the things, substances and organisms based on similarities and differences. Students communicated the results observations through line graph, bar diagram, pie chart, tables, symbols and diagram. They skilfully used the measurement devices such as scale, measurement tape, thermometer, pipette burette, measuring jar for measuring the length, breadth, weight, volume, area of objects. Students predicted correctly with regard to future events and occurrences and they could derive inferences based on the observations and experiences.

Before implementation of intervention programme, present study findings reveal that most of the students science process skills status was in beginning stage wherein after intervention programme most of the students science process skills
was in proficient stage. Students’ achievement on science process skills also increased significantly after intervention programme. It indicates that the intervention programme facilitated the students to acquire basic process skills, also they understands the concepts of science process skills. This is due to the following learning experiences such as hands on experience, multimedia presentation, field visit, role play, demonstration, and simulation. The Kolb’s experiential learning facilitated the students to observe, experiments, reflects. The same findings were reported by Arnold and Warner (2006) that experiential learning offers (i) quality experience (ii) the active engagement and reflective observation useful for comprehensive understanding of knowledge and skills. Gorden (2006) study findings also reported that hands on science experience improved science process skills. Findings further reported that the students observe and classify the objects in home. Research study findings also reveal that process skills cannot learn by lecture method. From the above observations it can be said that traditional chalk and talk method cannot enhance process skills. Learner centred, constructive based approach is needed. Kasinath (2000) in his study used inquiry approach for developing process skills, the study findings reveal that inquiry model was more effective than the conventional method for fostering process skills. Ramkumar (2003) study findings reports that environmental approach developed process skills. Bhaskar (2010) employed constructivist approach; the findings reveal that the constructive approach enhanced process skills among students. Hence, it is recommended that science teaching of science should discard lecture method. Instead, experiential learning method should be adopted to develop knowledge and skills. Process skills domain should be included in the teacher education curriculum so that pre-service teacher can nurture these skills in young students. Amin (2011) used activity based science teaching among pre-service teachers. Findings reveal that the demonstration and multimedia are thee learning experiences improved science process skills.

Jean Piaget stated that children learn from an interaction between their experiences and their ideas. From a constructivist view of science, learners’ personal involvement and experiences are ultimate principle; such learning is more concrete instead of hearing or reading. There are some constructivist approaches such as cooperative learning, activity based learning, inquiry
learning, ICT aided approach etc which were adopted by various researchers for developing science process skills and the findings reveal that the methods found to be effective (Ramkumar, 2003; Amin, 2011; Kasinath, 2000). Similarly, experiential learning is one of the constructive based learning approaches wherein students can acquire basic process skills and concepts by their own. In a nut shell, experiential mode of learning needs to be adopted to learn science concepts and skills.