

## *Chapter 6*

# *Major Findings, Discussion and Suggestions*

## **CHAPTER 6**

### **MAJOR FINDINGS DISCUSSION AND SUGGESTIONS**

#### **6.0 INTRODUCTION**

The present chapter deals with the findings of the study along with suggestions for further research and discussion based on the findings of the present study. The findings of the study are presented objective wise.

#### **6.1 MAJOR FINDINGS OF THE STUDY**

The major findings of the study are presented under three categories namely findings based on situational analysis of classroom observation, findings based on the responses of the students while implementing the instructional strategy and findings based on the t test for experimental and control group on the six chapters individually as well as overall and also t value for science comprehension of all the four stories.

##### **6.1.1 Findings based on situational analysis of classroom observation**

- ☐ In sixty percent classroom observation it was found that science was taught by reading the content from the textbook. It was found that the teachers read the content in the text book aloud or in some cases the teacher made the students read the content given in textbook followed by explanation or vice versa. Science which is to be taught by learning by doing is taught by 'TU PAADH' (Now You Read). In rest thirty percent of the classroom observation it was found that lecture method was used and only in ten percent of the cases demonstration or realia media was used.
- ☐ In all the 100 percent cases it was found that the introduction of the lesson was done by directly writing the topic on the black board or either asking question related to the content taught previously.
- ☐ It was found that after reading a particular paragraph twenty percentage of the teachers used to explain the concept in vernacular language or Hindi and when asked teachers opined that the students are not able to understand if the entire concept is explained in English.
- ☐ Three to four periods were utilized by the teachers to make the students write the workbook, chapter end exercise and write the journals.
- ☐ In few of the cases around thirteen percentage it was found that the teachers did not take pain to write the name of the chapter on the board, rather it was also found that the class was of science and there was another subject note like Gujarati content written on the board or mathematics sum on the board.

- ☐ All the teachers involved only those students who volunteered to answer. Teachers never involved the non-volunteers in the class. The questions raised by the teacher focused on recall and recognize type and none of the teachers asked question catering to understanding or application level.
- ☐ It was observed that majority of the teacher did not give time to students to think. It was observed that the teachers wanted the answer immediately after asking question(s).
- ☐ Experiments given in the journal were filled in by the dictation given by the teachers. In few of the instances the teachers made the students write the journal rather than the students doing the experiment and filling up the journal by their findings. The teachers dictated the apparatus required for conducting the experiment, method of doing the experiment and above all the students were also made to write the findings and conclusion of the experiment.
- ☐ Students were instructed to keep pencil in hand to underline hard words and the students were made to write hard words five times. When interviewed the teachers were of the view that the students are in the process of learning the language of science and therefore they need to know the technical terms of science. In order that the students know the technical terms of science it becomes necessary to make them write the hard words.
- ☐ In all the cases the language used for explanation of the terms was more focused to the language used in the text book. It was also observed that the teachers followed to teach the concept following the sequence in which the concepts have been presented in the textbook.
- ☐ In sixty percent of the classroom observation it was found that the teachers used to read out the content given in the textbook followed by explanation or explaining the concept first and then reading out the related paragraphs. In only ten percent of the case it was found that the teacher either used demonstration to explain the concept or used realia media to explain the concept. Hardly the teachers used teaching aid, models to explain the concepts. It was observed that teacher made use of the diagrams given in the textbook to explain the concepts.
- ☐ Students remained passive listeners in the class while teachers were explaining the concepts of science. Majority of time was taken by the teacher to talk and no time was given to the students to interact among themselves. Students

involvement was found when there were questions raised by the teacher otherwise the students were silently listening to the teacher.

- ☐ The students were never given opportunity to interact among themselves rather if the students were found interacting with each other they were told to keep quiet and listen to what the teacher is saying.
- ☐ No group work or group discussion was carried out in the classroom. The students were patiently listening to the teacher who was teaching. There was total silence expected in the classroom.
- ☐ In none of the classroom observation the activity based teaching, inquiry based teaching, problem solving method was used. None of the teachers divided the class into subgroups and made the students interact among themselves or conduct an activity in a group related to concepts to be learned.
- ☐ Certain topics were given to the students as their project work to be completed at home.
- ☐ All the teachers opined that if the students are to be made to do activities then the time period available will not be sufficient to complete the syllabus.
- ☐ Students were not given opportunity to handle the apparatus and do some mistake and learn from the mistake done rather the theory was already told to the student. Even the text book presents the material in the form of presenting the information rather than providing a climate of inquiry or exploration.
- ☐ The question asked in the examinations were more of the knowledge level barely touching upon understanding level questions.
- ☐ Some of the teachers also were found to be lacking in the concept clarity. In one of the classroom observation researcher found the teacher telling the student who had raised the query about what is velocity that velocity is the scientific term for speed and gave example that *when I speak fast you all are telling me that madam your speed is fast this is known as velocity in science terminology. The teacher further added that velocity is distance divided by time.* Another instance where the teacher told the students that the leaf of the tree is not in motion rather it is in locomotion. One more instance where it was found that the teacher lacked content mastery is worth mentioning. The teacher while teaching the concept of motion and explaining that when a body changes its position with respect to another stationary object the body is said to be in motion cited example of feeling which the person sitting in train has

when observes the tree, sun and outside objects through a moving train. The teacher further said that if one is sitting in the train one feels that trees are moving, sun is moving and so on to which one of the students in the class raised the query as to whether the sun moves and very surprising to the researcher the teacher responded that all the celestial objects are in motion.

- ☐ Teachers instead of procuring the required material for conducting the experiment relied on the students to bring the material and as the students forget to bring the material the experiment or the activity was not conducted.
- ☐ The teachers did not give any challenging, innovative, creative homework to the students which really would make the student interested in the subject as well as develop scientific attitude among the students. In majority ninety six percent of the cases it was found that homework was to write about concept of science or draw the diagram or learn particular concept and in rest six percent there was no homework at all.
- ☐ The teachers opined that there were lots of spelling mistakes in the textbook. For instance the word message was typed as massage in many places in the very first chapter. The diagram of the measuring cylinder containing coloured liquid was not clearly given. The ray diagram for the reflection of light was having incorrect labeling.

#### **6.1.2 Findings based on the responses of the students while implementing the instructional strategy**

- ☐ The students were able to draw the magnetic field lines before conducting the experiment but after actually conducting the experiment there was change in the perception of the students on how the actual magnetic field lines look like and thus there was refinement in the drawing of magnetic field lines. There was distinct difference seen in the drawings before the actual conduct of the experiment and after the conduct of the experiment.
- ☐ The students were made to do the activity of stretching their arm for two minutes horizontally straight. All the students, hundred percent students reported that after some time they feel pain in their hand. Few of the students reported that they felt as if their hand will come out of their body, few said that the hand was gradually coming down. When asked the reason for the effect majority of the students responded that arm was in air and there is no support to arm and therefore it pains and gradually comes down.

- Students opined that there is something like magnet which is pulling the paper pieces towards itself. After doing the activity students could find that rubbing causes some effect which makes the paper attracted towards the scale. The students could also infer that the scale loses its effect after sometime. This shows that students were able to comprehend the concept of electrostatic force.
- All the groups reported that the writing on the paper becomes light because the oil on the paper sticks the pen and makes it slippery and does not allow the ink to flow through the pen and therefore after writing few sentences the sentences becomes light and after some time it is difficult to write. Thus it is inferred that the concept of frictional force was very clear to all the groups.
- It was found that the students were able to calculate the speed by dividing the distance in meter by the time taken in second to cover that distance. Here the researcher noticed that few students were facing problem to put the decimal points, few were facing problem in division. Thus it is deduced that the concept clarity of mathematics is very much required when the students were to solve numerical.
- Students of all the groups except one were able to classify the lever into three categories based on the position of the load, effort and fulcrum. It was found that the students were unable to classify those levers where in there was not apparent fulcrum visible.
- All the groups were able to determine the coins required to balance the lever for the different position of load arm keeping load constant.
- It was found that ninety three percent of the students could correctly measure the length, the breadth and the height of the given cassette cover while seven percent students made error in measuring either the length or the breadth or the height. The error committed by the student was few of the seven percent wrote length instead of breadth and some made mistake in measurement of the height.
- Though ninety percent of the students were able to measure the length, breadth and height of the given objects correctly it was found that only forty six percentage of the student were able to calculate the volume of the object correctly. There were fifty four percentage of the student who committed error in calculation of volume.

- ☐ Eighty nine percent of the students could correctly measure the length the breadth and the height of the given match box. In case of eleven percent who made error in measurement the error was in the measurement of the height.
- ☐ In the measurement of length, breath and height of science textbook, eraser and box of colgate toothpaste the percentages of students who committed error was fifteen, six and four respectively.
- ☐ More than seventy six percent of the students were able to measure the mass of the given object correctly.
- ☐ Except for group three and group five rest all the groups were able to come to the conclusion that the measure of angle of incidence and measure of angle of reflection are equal.
- ☐ The students who were initially not participating were found to participate in the interaction and started asking question. The researcher was asked by one of the student when the density of the object is less than that of the liquid in which it is dropped then the object float otherwise it sinks what if the density is equal.
- ☐ The students were very much enthusiastic to conduct the activities when they were involved in conducting the activity.
- ☐ The students said their madam will teach the theory part and the researcher will make them do the activities

### **6.1.3 Findings based on the t test for experimental and control group**

- ☐ The mean gain score of experimental group on comprehension for chapter motion, force and speed was found to be higher (7.82) than the mean gain score (5.30) of control group on comprehension for the chapter motion, force and speed. The t value was 6.25 and was significant at 0.01 level of confidence. This indicates that the instructional strategy was effective for the chapter motion, force and speed.
- ☐ The mean gain score of experimental group on comprehension for chapter lever was found to be higher (6.61) than the mean gain score (4.88) of control group on comprehension for the chapter lever. The t value was 4.16 and was significant at 0.01 level of confidence. This indicates that the instructional strategy was effective for the chapter lever.
- ☐ The mean gain score of experimental group on comprehension for chapter water was found to be higher (6.88) than the mean gain score (4.69) of control

- group on comprehension for the chapter water. The  $t$  value was 5.46 and was significant at 0.01 level of confidence. This indicates that the instructional strategy was effective for the chapter water.
- The mean gain score of experimental group on comprehension for the chapter measurement was found to be higher (4.65) than the mean gain score of control group (3.33) on comprehension for the chapter measurement. The  $t$  value was 5.45 and was significant at 0.01 level of confidence. This indicates that the instructional strategy was effective for the chapter measurement.
  - The mean gain score of experimental group on comprehension for chapter reflection of light was found to be higher (7.67) than the mean gain score (5.21) of control group on comprehension for the chapter reflection of light. The  $t$  value was 8.27 and was significant at 0.01 level of confidence. This indicates that the instructional strategy was effective for the chapter reflection of light.
  - The mean gain score of experimental group on comprehension for chapter curved mirror was found to be higher (5.84) than the mean gain score (3.21) of control group on comprehension for the chapter curved mirror. The  $t$  value was 10.44 and was significant at 0.01 level of confidence. This indicates that the instructional strategy was effective for the chapter curved mirror.
  - The mean gain score of experimental group on comprehension for all the six chapters was found to be higher (39.5) than the mean gain score (26.64) of control group on comprehension for all the six chapters. The  $t$  value was 9.52 and was significant at 0.01 level of confidence. This indicates that the instructional strategy was effective for the all the six chapters.
  - There was a significant improvement in the post-test performance of students in both the groups over the pretest, there was significant improvement in post-test performance over pretest performance in higher ranges of scores particularly in the case of the experimental group
  - The mean gain score on science comprehension of a story thirsty crow of experimental group studied through instructional strategy (10.67) was higher than the mean gain score of (6.40) of control group studied through traditional method of teaching. The  $t$  value was 6.45 and was significant at 0.01 level of confidence. This indicates that the instructional strategy was effective for

science comprehension of a story. The comprehension of experimental group students was higher than that of control group students.

- The mean gain score on science comprehension of a story foolish donkey and clever salt merchant of experimental group studied through instructional strategy (7.28) was higher than the mean gain score of (4.62) of control group studied through traditional method of teaching. The t value was 7.34 and was significant at 0.01 level of confidence. This indicates that the instructional strategy was effective for science comprehension of a story. The comprehension of experimental group students was higher than that of control group students.
- The mean gain score on science comprehension of a story cap seller and monkeys of experimental group studied through instructional strategy (8.13) was higher than the mean gain score of (4.52) of control group studied through traditional method of teaching. The t value was 7.32 and was significant at 0.01 level of confidence. This indicates that the instructional strategy was effective for science comprehension of a story. The comprehension of experimental group students was higher than that of control group students.
- The mean gain score on science comprehension of a story clever gardner of experimental group studied through instructional strategy (7.86) was higher than the mean gain score of (4.47) of control group studied through traditional method of teaching. The t value was 8.44 and was significant at 0.01 level of confidence. This indicates that the instructional strategy was effective for science comprehension of a story. The comprehension of experimental group students was higher than that of control group students.
- The students of experimental group could list out more number of scientific principles involved in the stories as compared to students of control group.

## **6.2 DISCUSSION**

Science has been accepted as a foundation of advanced technology and for understanding of nature. It is well accepted fact that scientific methodology could enhance mode of thinking and way of life. Within the larger education system, science education can be viewed as a subsystem. Improving science education is part of a systematic education reform. The nation cannot meet the challenges of the future unless today's youth have a better understanding of the world and how it works. Science education which provides literacy in science, mathematics and technology is

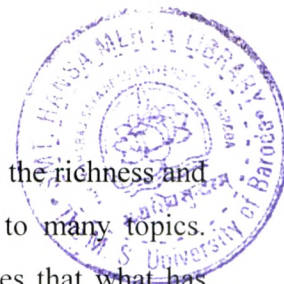
thus very much essential for the primary school children as they are the future of our country. Science is an endless quest and unceasing exploration of nature and natural laws, whereas technology is the application of this understanding to make human life healthy and happy. This nature of science and technology must get reflected in the teaching of science. Unfortunately the schools are unable to satisfactorily fulfill the objectives of teaching science and technology. In order to find the research evidence on the way science and technology is taught in the schools the researcher observed seventy five lessons transacted by the teachers teaching science and technology at class VII in Vadodara city.

From the situational analysis carried out during the present study to find out the instructional processes used in the class room it was observed that the classroom interaction was predominantly teacher centered, where information was constantly being imparted most didactically with little participation on the part of the students. The content was treated as essentially product oriented. Science was rarely represented as a body of thought, activity and investigation. It was wrongly depicted as merely a body of information. The same has been supported by National Focus Group on teaching of Science (2006) "though activity-based teaching has been accepted as a paradigm for science education and is also reflected in some measure in the textbooks developed at the national and state levels, it has hardly been translated to actual classroom practice". Sharma (1979) also found similar results after analysing 120 science teachers to get their classroom behaviour through the Flanders Interaction Analysis Category System and found that science teaching was not satisfactory since the teachers dominated the class and the students got neither encouragement nor the opportunities to add their own ideas. Sharma (1978) also found that most of the teachers used traditional methods for teaching natural sciences, some tend to make natural sciences teaching at primary level of central school of Punjab activity oriented, the teachers were not well equipped for teaching science, it was admitted by most of the teachers that activity should be the basis of teaching natural sciences at primary level. Swaranamma (1978) also found that most teachers resorted to lecture demonstration method in teaching of biology in upper primary classes, and found overdependence of teachers on the textbooks.

The present study found that the language used for explanation of the terms was more focused to the language used in the text book. It was also observed that the teachers followed to teach the concept following the sequence in which the concepts have been

presented in the textbook. Similar findings were by Menon (1986) who found that the textbooks were the only curricular material through which the curriculum guidelines percolated up to practising schools. Weiss (1987) also found that the teachers rely heavily on textbooks which account for ninety percent of instructional materials in use in grades four through six.

It was found during the situational analysis phase that three to four periods were utilized by the teachers to make the students write the workbook, chapter end exercise and write the journals. The objective of teaching the subject science and technology is to make the students develop process skills like observation, estimation, measurement, prediction, classification and communication which gets curbed when the teacher is making the students write the answer which the student is expected to memorize and reproduce in the examination to fetch good marks. During the interaction with the school teachers teaching science and technology at class VII all the teachers agreed that activity based teaching would be the best way to teach science but at the same time all of them opined that if the students are to be made to do activities then the time period available will not be sufficient to complete the syllabus but the researcher calculated that there are approximately eight to nine classes available for teaching one chapter so if the teachers do not utilize three to four classes in making the students write the chapter end exercise and workbook as well as journal then this time could be constructively utilized by the teacher to involve the students to perform number of activities. At the same time the researcher agrees with the teachers that, if the students are to be given the role of constructor of knowledge definitely the time period available will not be enough and therefore the researchers feels that policy makers should keep in mind the concept of less is more which is prevalent in America at present. The idea was applied to education bySizer (1984) that focuses on improving US secondary schools. It was then picked up by the American Association for the Advancement of Science in its Project 2061 (AAAS, 1990) and then by the National Science Education Standards. Thus, for science education at all levels, there is now an emphasis on science's "big ideas" and the charge for teachers is to address fewer concepts in greater depth, with more emphasis on understanding and less emphasis on the recall of vocabulary. As a guiding principle in planning units and lessons, "less is more" means depth is preferred over coverage. When teachers try to cover too much content, their students tend to get stuck at lower level of thinking, which is all that is needed for simply remembering



information. It is rather more important that the students comprehend the richness and complexity within a few topics than being superficially exposed to many topics. Studying in depth leads to better retention and increases the chances that what has been learned will be applied in new situations. Instead of being overwhelmed by too many facts and new terms, students engaged in indepth studies are more likely to experience the satisfaction of mastering some particular content. Newmann (1988), “Unfortunately few students today have the intellectual experience of reaching the point in their studies where they can perceive the limits of knowledge and where they can generate new questions that lead them into creative inquiry”. Bajracharya (1986) found similar results that all science teachers had expressed that the time available for teaching science was not enough for demonstration and other activities in the class. All the teachers were of the opinion that there was a need for more time per day. Arons (1983) understanding science concept takes time, one cannot assimilate the abstract concepts and modes of thought that characterize scientific thinking through quick memorization. Bhide (2002) With the exponential growth in knowledge, particularly connected with science and technology, there grew a tendency to ram into the brains of children more and more in less and less time. With this not only the gravitational load in the form of books and notebooks increased but it also created an unbearable load of non-comprehension. The gravitational load is heavy and sometimes backbreaking but the load of non comprehension becomes almost crushing. Some students can compromise with the situation and can go ahead, whereas a larger number and the more sensitive ones amongst them cannot compromise with non-comprehension and they finally give up.

One of the findings of the present study is in sixty percent of the classroom observation it was found that the teachers used to explain the concept given in the textbook and then read it out from the text book or read out the content given in the textbook followed by explanation. In only ten percent of the cases it was found that the teacher either used demonstration to explain the concept or used realia media to explain the concept. The same is supported by Bajracharya (1986) who found similar results. According to him the techniques of teaching science which were practised in most of the schools were traditional. The only teaching aid used in the classroom was the blackboard and chalk. Some methods such as discovery and free choice activity were not known to many teachers, the prescribed textbook contained inappropriate topics and diagrams. The textbook reflected only reading skill and did not provide for

practical skill and concept development. Bajracharaya and Shrestha (2002) support the same by opining that although science curriculum demands school science teachers to be more open minded and accomplish teaching learning process with student centered approach the science teachers tend to run science classes only by lecture method depending totally on the written text available in the prescribed science text book only. Even Malhotra (2006) holds similar views stating that “teachers often provide lecture and students largely observe the teacher rather than actively participating in the classroom”. Bybee et. al. (1989) also found that instruction focuses on factual information that is disconnected from experience and concept development.

It was found during the classroom observation that certain topics were given to the students as their project work which according to the researcher should be given in group and the students may be asked to do that project work in the school itself under the observation of the teacher. The review of the question papers of the different schools revealed a common picture, where in majority of the questions asked were eliciting factual information ignoring the process questions. Similar findings were found by Menon (1986) questions mostly tested the product aspects and not the process aspects.

During the classroom observations of seventy five lessons of teaching science and technology at class VII in Vadodara city in all the 100 percent cases it was found that the introduction of the lesson was done by directly writing the topic on the black board or either asking question related to the content taught previously. The similar findings were reported by Umashree (1999), who found that of classroom observation of 240 lessons in secondary science, in 185 cases, seventy seven percentages the lesson was introduced by simply writing the topic on the blackboard and recounting the previous day's lesson.

It was found by the present study that students remained passive listeners in the class while teachers were explaining the concepts of science. Around twenty five to twenty seven minute of time was taken by the teacher to talk and no time was given to the students to interact among themselves. Students involvement was found when there were questions raised by the teacher otherwise the students were silently listening to the teacher. The students were never given opportunity to interact among themselves rather if the students were found interacting with each other they were told to keep quiet and listen to what the teacher is saying. Bajracharya (1986) also found from the

class teaching that teaching in most of the schools was very dry. There was no interaction between students and teachers which could help pupils to develop their interest in and attitude towards science learning. According to Umashree (1999) eighty percentages of the classes observed revealed the fact that the students participated only as a passive listener. The student participation if any was limited to seeking clarification on the teaching point. The teachers also felt that when it comes to examination, the students are expected to reproduce some sections of scientific information contained in the textbook, and hence they did not see the essentiality of conducting discussion sessions or participatory sessions. Muddu (1978) for eighty five percentages of the teacher instructional procedures followed by them were not according to the aims and objectives of biology teaching. Sixty six percent teachers were found to give priority to knowledge objectives in dealing with the topics in biology while application and interest aspects were accorded least preferences.

One of the findings of the present study reveals that in none of the classroom observation, the activity based teaching, inquiry based teaching, problem solving method was used. None of the teachers divided the class into subgroups and made the students interact among themselves or conduct an activity in a group related to concepts to be learned. This may be because the teachers are not oriented to teach using different instructional strategies and if oriented then the orientation given may be theoretical not making the teachers understand how exactly different instructional strategies may be used in the classroom. The same is supported by Arons (1983) most elementary teachers have never been exposed to effective inquiry based instruction, they have no model on which to draw for their own students. In addition most have probably had limited opportunities to study and reflect on the various ways in which students learn science and how to design and adapt materials and strategies to accommodate different learning styles. But Hick (2008) found that most science teachers still teach in traditional ways and found it true even for new science teacher whose teacher education programs have emphasized reform based instruction. This requires further investigation by interacting with the teachers and finding out the reasons from them for not using innovative ways to teach. Similar findings are found by Umashree (1999), in large classroom it was not convenient to have discussions, lecture method was used in seventy percentage of cases, lecture cum discussion method in ten percentage and lecture cum activity teaching strategy in six percentage of the cases and non conventional approaches were observed in the remaining

fourteen percentage of the classes i.e. reading aloud, a brief explanation and silent reading, the instructional activities operating in the secondary schools at Vadodara in the classroom transaction were centered around the textbook. In none of the classes under observation, problem solving or inquiry based teaching had been noticed. Learners were not assigned any project work. Mukherjee (2007) If we look at the evolution of school science in India, we see a clear trend of including more and more content — overwhelmingly in the form of factual information — in the syllabus. Laboratories have declined, and even demonstrations, once common, are now confined to elite schools. Thus the factual information that dominates the syllabi is not supported by any kind of activity, which can make it plausible or even comprehensible. Students therefore have no option but to memorize the facts. The consequence of this is that students find science not only difficult but also boring.

It was found that students were not given opportunity to handle the apparatus and do some mistake and learn from the mistake done rather the theory was already told to the student. Even the text book presents the material in the form of presenting the information rather than providing a climate of inquiry or exploration. The same is supported by National Curriculum Framework. NCF (2005), the textbook still is not making the students take the role of the constructor of knowledge as the content presented in the text book is not providing scope to the students to explore while conducting activities, hypothesize, predict, estimate, measures as the textbook consist of the explanation as to what will be the outcome given a situation.

It was also found during the present study that the teachers did not give any challenging, innovative, creative homework to the students which really would make the student interested in the subject as well as develop scientific attitude among the students. In majority of the cases it was found that homework was to write about concept of science or draw the diagram. Bajracharaya and Shrestha (2002) Science teachers often see science as a subject that requires learning to simply be a matter of knowing, being able to use the right formula, or being able to balance equations. School science teachers fail to arouse curiosity and motivate to observe scientific principles in and around our environment. Bhide (2002) the present system of science education in our schools and colleges doles out uncorrelated information about science to be learnt by heart for vomiting in examination.

In the present study it was found that few teachers are lacking in the concept clarity. In one of the classroom observation researcher found the teacher telling the student

who had raised the query about what is velocity that velocity is the scientific term for speed and gave example that “when I speak fast you all are telling me that madam your speed is fast this is known as velocity in science terminology”. Similarly in two more instances the teachers were found to lack content mastery. The similar view are given by Arons (1983) who pointed out that in their understanding of science, many elementary school teachers start out being not much different from the students they teach.

The present study also found that the scores obtained by control group students were less indicating that the comprehension in science among these students was less as compared to the experimental group students. The same is supported by Rao (1988) who found that the learning process scores and concept scores were low indicating to the science educator that comprehension was not achieved by giving children bits of information about scientific facts. Science achievement test indicated that very little was retained by children by rote memory.

The present study found that the students of experimental group had greater mean gain score on achievement test based on comprehension as well as science comprehension test in the form of a story than the control group students. This reveals that the students have understood better in comparison to those taught by traditional method of teaching. Similar findings are found by Sharma (2000) significant relationship was found between the quantitative achievement and conceptual understanding of secondary school subjects. Muddu (1978) also supports the same there was a definite improvement in the pass percentage in case of the experimental group, the sound pictures helped to a great extent the above average students to comprehend the subject matter in biology. Ravindranath (1982) also supports the same in his study where in activity and hands on experiences, demonstrations, discussion were the component of the instructional strategy. The instructional strategy was effective to the extent that seventy percent of the experimental group students obtained sixty percent and above in all the unit tests and comprehensive test, the experimental group students performed better than the control group on the comprehensive test and also on the annual examination conducted by the school authorities.

The present study found that the students who were taught through traditional method of teaching could not do very well on the test of comprehension in science through stories. This requires that teachers reflect on the way they teach and try to relate it

with the objectives of teaching science as recommended in various documents. Teachers being a part of the educational system should take up the moral responsibility of ensuring the objectives of teaching science. In order to fulfill their responsibility the teachers' needs to revamp their teaching methods and include some important components in the teaching learning process based on the research evidences. Similar are the views in the Report of India's first National Science Survey (2004) about a third of the students said they did not study science as they did not feel motivated enough. This is where the role of science teachers becomes crucial. Since every generation of top quality scientific manpower starts at the school level, a lot also depends on the way science is taught at school levels. The study found that while close to two thirds of the students in classes six to eight are satisfied with the quality of science teaching, this falls to just forty percentages in classes eleven and twelve, clearly indicating a lack of availability of good and motivated teachers at higher levels. The report further adds that science education needs to be strengthened in terms of methods of teaching, teacher quality, and infrastructure. This observation has been found valid for all regions of the country.

### **6.3 SUGGESTIONS**

The researcher attempts to put forth certain suggestion for improving the quality of science teaching. The suggestions given are at two levels namely suggestions for teachers and science teaching and suggestions for policy makers. This is followed by suggestion for further research.

#### **6.3.1 Suggestions for teachers and science teaching**

- ☐ Teachers need to bring in paradigm shift from teacher centered methods of teaching to student centered methods, making the students move away from rote memorization to learning by doing, learning by exploring, learning by cooperation.
- ☐ Teachers should make effort to reduce teacher dependent learning situations allowing more space to the students to learn by observation, prediction, estimation, measurement.
- ☐ Group activities prove to be effective for development of comprehension and should be used at all the levels right from kindergarten till class twelve. Teachers need to provide conducive environment to the students wherein there is scope of interaction among the students. The students should be provided to put up his/her view and then explore using low cost apparatus whether

whatever predictions were made turns out to be true and also should try to reason out if the predictions and the actual happening contradict each other. Thus exploring the reason for a particular event to happen as it happens.

- ☐ More emphasis should be laid for processes of science rather than product of science. Learning using activity or hands on experiments proves itself to be highly effective and therefore use of activity or hands on experiment should be done irrespective of level of education.
- ☐ Teacher should find out some innovative ways of teaching and similar ways of evaluating the students such that the students never feel burden of examination. The students should feel joy of learning.
- ☐ Teachers needs to relate the content area of science to students day to day activities by giving examples from the environment so that the students feel that science is in everyday life.
- ☐ Teachers need to help students internalize the scientific process, by establishing clear and consistent routines and expectations around the type of genuine laboratory work and assessments that students would be expected to complete. Students should be expected to turn in written work that applies to laboratory, but is not a formulaic laboratory report. This can be done by answering critical thinking questions about the laboratory results or redesigning the experiment, using justification from the results.
- ☐ Teachers need to understand that students in the concrete operational stage require an abundance of concrete experiences to create meaningful and deep learning. Many times then, concrete operational students require experiences with materials to do relational thinking. This does not mean, however, that they can never think logically in the absence of materials. There should be emphasis on experimentation in teaching learning of science.

### **6.3.2 Suggestions for policy makers**

- ☐ Even though there has been changes brought about in the textbook still the didactic approach continues in schools because of the following reasons
  - ✚ Lack of science equipments/kits and science laboratories
  - ✚ Overcrowded classes
  - ✚ Teachers lack of confidence in teaching the subject
  - ✚ Rigid timetable
  - ✚ Assessment procedures reinforcing memorization of facts and concepts

- ✦ Lack of professional development programme for teachers both pre-service and in-service

- ✦ Absence of resource material to support teachers in teaching

Policy makers should make provision of science kits made mandatory in all the schools. There needs to be a check done so as to determine whether science laboratories along with required equipment are in the schools. Policy makers needs to bring about some change in the teacher student ratio in the schools reducing it to 1:30 if possible so that each teacher can make the students do number of activities. Teachers can make the students do hands on activities by dividing them into subgroups only if the teacher student ratio is less.

- ☐ Regular frequent and quality inservice training programmes needs to be organized for teachers at primary as well as upper primary level to develop their confidence by improving their content mastery and assisting them in organizing group activities and also enabling them to use of appropriate evaluation tool.
- ☐ Teachers' guide and students workbook needs to be prepared to support teachers in their efforts to improve the quality of science teaching.
- ☐ Primary school science coordinators must be appointed to supervise, support and promote best practices in science teaching at schools.
- ☐ A comprehensive action plan should be worked out for capacity building. Teachers should be trained in content and methodology. A joint effort is needed for this task by different ministries, research organizations and INSA.
- ☐ There needs to be change brought about at the teacher training programmes both at primary and secondary level in order to make the student teachers understand the different ways of making the teaching student centred by actually demonstrating the student centered method of teaching rather than providing theoretical input which is the case at present.
- ☐ Appropriate incentives needs to be provided to the creative teachers to motivate them by making their work known to the rest of the teachers to implement it in their schools also.
- ☐ Textbook needs to be designed to make the student explore science rather than making the students learn the facts and concepts of science. Textbook needs to be in the form of activity book where in the students may fill up one's own findings by conducting experiments using low cost material.

- ❑ The development of a literate citizenry in science does not result from the teaching in a single grade nor is it the product of any one course. It can be better achieved with a carefully planned kindergarten through class twelve in which there is a vertical as well as a grade level coherence within the science curriculum and other disciplines. Therefore curriculum improvement in science should be viewed from kindergarten through grade twelve, and must also interrelate with other subject matter.
- ❑ It should be understood by the policy makers and the textbook developers that the rigor of the curriculum will be enhanced, not by simply increasing the sheer volume of content knowledge of the students, but by involving the students in more complex and demanding genuine scientific investigations.
- ❑ There needs to be a proper co-ordination between the teacher training institutions and the schools. There are changes brought at both the levels but in compartmentalized manner. It needs to be understood that both the teacher training institution and the schools should go hand in hand in order to bring in quality education.

### **6.3.3 Suggestions for further research**

- ❑ A longitudinal study can be taken up for development of comprehension in science for the group of students for a period covering entire upper primary classes (V, VI, VII and VIII).
- ❑ A qualitative study can be taken up taking tools like rubrics, portfolios, concept maps and using 5E and 7E learning models.
- ❑ Taking up quantitative techniques the effectiveness of the strategy can be found taking more number of control groups.
- ❑ The present study was delimited to only six chapters rather a study can be taken up covering entire content area.
- ❑ A study can be taken up to prepare modules for all the chapters of science and technology.
- ❑ A study can be taken up to compare the comprehension of the students studying under Gujarat state board and the students studying the syllabus of various boards.
- ❑ A case study can be taken up of students excelling in the competitive examination to find the learning styles of the students

- ☐ A study can be taken up to determine the science comprehension of the students of upper primary level and secondary level using different stories.
- ☐ There can be a study to develop a standardize tool to measure comprehension in science by identifying the components of comprehension in science.

#### **6.4 CONCLUSION**

Science in classroom is a dynamic field. When taught as active investigation it can be meaningful and stimulating for the students and teacher as well. By utilizing the natural impulses of students to investigate a science programme can transform classroom situation to the stimulating learning circumstances. The students will comprehend science and thus will be able to apply it in the day to day life situations. Satisfying the students' curiosity can be the means of attaining the worthwhile goals of science. Thus the aims and objectives of teaching science will be fulfilled to a large extent. The quality of education will improve and students will feel the joy of discovery and satisfaction.