CHAPTER 6

The Science Classroom

The last chapter was devoted to examining the science curriculum, the teachers’ handbook and the textbooks to understand the aims of science education in relation to concerns of the everyday, and the approach to the concept of matter. Both pedagogy and selection and organization of content were examined. In the overall selection of topics, a significant presence of ‘useful, applied science’ was noted in the middle school curriculum. In addition, a strong pedagogic orientation towards engagement with the everyday was also noted. Although social constructivism was discussed in the teacher’s handbook, there was comparatively less evidence of this influencing the selection and organization of content. The selection of topics within matter itself was quite conventional following the standard disciplinary approach, again there was little emphasis on theorization and abstraction/generalization which are also important to the discipline of science.

This chapter deals with the context of the science classroom. A Science classroom is a major site of pedagogical processes and an important context of learning that can be understood as a space intersecting between the everyday world of the child, the space of the school (an educational institution with teachers and their pedagogies), and the discipline of science (mediated through curriculum, textbooks and teachers) constituting a particular socio-cultural context of learning. Science classroom is also a complex setting where teaching and learning of science takes place through the interaction of diverse factors such as science curriculum and educational policy, classroom processes, textbook, the teacher and the learner. It is constituted by the persons enacting, activities involved in relation to the structure and setting of the classroom and resources involved.

The questions that the chapter tries to answer are:

1. What is the structure and what are the characteristics of the pedagogies that children experience in the science classroom?
2. What are the constitutive elements of ‘social’ and ‘cultural’ in relation to the process of teaching and learning of science in a science classroom?
3. What is the approach taken in the classroom to children’s everyday experience of matter?

Classroom observations were used as the method to understand the science classroom and its processes. Science classes were observed in grade V, VI, VII and VIII. The researcher sat along with the children at the back bench making observation notes in a field notebook. This chapter provides a detailed picture of science classroom—classroom process, the conversations, modes of instruction, aspects of the practical activities that were conducted in the classroom and socio-cultural dimensions of the classroom processes.

### Table 6.1 Details of classes observed

<table>
<thead>
<tr>
<th></th>
<th>No. of lessons observed</th>
<th>No of periods observed</th>
<th>Total time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle School</td>
<td>22</td>
<td>55</td>
<td>41.25 hrs</td>
</tr>
<tr>
<td>High School</td>
<td>3</td>
<td>11</td>
<td>8.25 hrs</td>
</tr>
</tbody>
</table>

### 6.1 Framework for Understanding the Process of Teaching and Learning in a Classroom

The following aspects were noted while making classroom observations. These were then analyzed.

1. Physical setting and features of the science classroom

2. Classroom process and activities
   a. The mode of teaching
   b. The classroom activities—conduction of experiments, activities and projects
   c. Use of instructional tools—textbook, writing materials, use and handling of concrete materials and equipments

3. Socio cultural dimensions of the classroom
   d. The participation of teacher and children in the classroom: the classroom talk with a focus on what teachers and children were saying, questions asked, etc.
   e. Children’s participation and role
f. Social interaction happening in the classroom during learning of science— the interaction between teachers and children, peer groups and children of different gender

6.2 Science Classrooms According to the Teacher Handbook

We saw in the last chapter that the science curriculum emphasized an activity oriented, process oriented, child-centered, environmental based and life oriented science learning approach. It was also noted that the new pedagogic approach is supported with detailed teacher hand books and in-service training programs. According to the teacher handbook book of Grade VII, the traditional method of teaching in a science classroom must be changed to an activity-based teaching and learning process that views children no longer as passive recipients/listeners of teacher’s lectures. Rather children must be active participants in the teaching-learning processes through participating in various activities, projects, classroom discussions, presenting seminars, conducting surveys in the community etc. The teacher’s role according to the handbook changed from that of transmitter of knowledge to that of a facilitator. The handbook directed the teacher to design and develop innovative activities and materials for science classroom teaching and learning from locally available materials/resources. Interactive learning, group learning cooperative / participatory learning were the concepts that got emphasized and were expected to be followed by the teacher in the science classroom (Teacher handbook, Grade VII-pp17).

The above was a major shift in the pedagogic approach, the implementation of which in a classroom was challenging for teachers who were used to a previous textbook/content oriented pedagogy.

The characteristics of a science classroom as given in the grade VII handbook are as follows:

- the seating arrangement should be attractive to the children, the classroom must be democratic and active in nature, children must be able to interact with teachers confidently and without fear, opportunity must be provided to conduct multiple activities and to work in group, classroom process must take into account individual child’s learning style, pace and ability to learn, needs of every individual child must be taken care, support and help must be provided to every individual child, availability of teaching-learning materials, availability of materials/toys that are designed and created by children/teachers from the locally available/natural resources, freedom to
speak, share ideas and experiences, the walls are decorated with attractive
pictures, recognition and motivation are given to children, positive, healthy,
motivating and happy classroom environment, the rights of children are
considered, teacher is tolerant to children’s problems and issues and think
from child’s point of view.

(Teacher handbook, Grade VII-pp17).

6.3 Science Classrooms of GVHSS-M: An Introduction

The Table 6.2 provides the grade wise enrolment for the years 2006-2007. As
can be seen, on the whole the class size was favorable with a Pupil Teacher Ratio
of about 30 students to a teacher. There were relatively more boys than girls. The
school had a total of four science teachers: two for the middle school and two for
the high school.

Table 6.2: Grade wise enrolment for the year: 2006-2007

<table>
<thead>
<tr>
<th>Grade</th>
<th>Total</th>
<th>Girls</th>
<th>Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 5</td>
<td>37</td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td>Grade 6</td>
<td>35</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>Grade 7A</td>
<td>29</td>
<td>11</td>
<td>18</td>
</tr>
<tr>
<td>Grade 7B</td>
<td>28</td>
<td>11</td>
<td>17</td>
</tr>
<tr>
<td>Grade 8A</td>
<td>29</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Grade 8B</td>
<td>30</td>
<td>16</td>
<td>14</td>
</tr>
</tbody>
</table>

The teacher selection was done through a Public Service Commission
examination and all the teachers of the school were well qualified and trained.
All the science teachers attended the two weeks teacher training conducted during
summer and those conducted during the beginning of the month. Thus in one
academic year all teachers attended 12 teacher training sessions.

Middle school science teacher:- The middle school science teachers were
held a qualification in Teacher Training Certificate after the Pre University (plus
2). They were supposed to teach all the middle school topics. But after teaching
one particular subject for one or two years the same teacher continues to handle
the specific subject. Among the two science teachers of middle school section,
one of them taught English and Science in Grade IV and V. The other science
teacher handled Social studies in grade V and science in grade IV, VI, and VII. The science classes of both the teachers were observed for this particular study. But during the course of this study one of the middle school teachers who handled science in grade V got transferred to a nearby school. Afterwards the same science teacher handled science for all the grades from IV to VII whose classes were mainly observed for this study and the chapter will focus as to how she handled her science classes.

The middle school teacher planned, structured and introduced the textbook topics according to the direction given in the teacher handbook and based on the guidance received during the teacher training. The teacher made an earnest effort to teach science according to the new mode of pedagogy. She invested time to plan and conduct all the experiments and activities discussed in the teacher handbook and textbook for all grades. She purchased chemicals/materials required to conducted activities and experiments for all the grades using the money provided by SSA, also maintained all the materials in a storage space inside the staff room. Science related books in Malayalam for the library were also purchased, (especially the KSSP books/publications) and collected science related articles from the newspaper, magazines etc and maintained it neatly in the science library. She planned each and every aspects of the classroom activities before every class and took materials and equipments required to the classroom. Also during the non-teaching hours she corrected children’s science notebooks, seminars, science projects etc. She imbibed the spirit of the new mode of pedagogy which according to her provided more scope for meaningful learning of science through experience as compared to earlier traditional methods. According to her children understand and enjoy science in the new method. She maintained a cordial relation with students. According to her a majority of the children belong to low income background and they receive training and guidance for learning only from teachers and school. Hence she ensured her students are learning well in the class and also took a very responsible attitude and role towards the learning and holistic development of the child. She encouraged and supported children to participate in sports, literary, art, club activities etc. She also interacted with children outside the classroom and paid attention to other aspects of children’s lives at school such as moral development, calling them to the staff room to enquire about issues faced by children at home/school, or whether their home is supportive for study, or give advice to children regarding their behavior etc in a friendly manner. The middle school children showed a good academic record for science. The middle school environment was very conducive toward learning and generally maintained a cheerful ambience, where teachers and children
maintained a cordial relation with each other. Teachers and children organized together various cultural, literary, gardening/club activities etc. that also contributed towards the positive and friendly relationship among teachers and children. Moreover teachers knew the family background, parents, homes etc as they all of them lived at the same nearby areas of the school; also the parents visited the school quite often or atleast once in month.

**High school science teachers:** There were two science teachers in the high school. Both the science teachers of high school section hold a B.Sc degree in Science and a B.Ed. One of the high school science teachers had specialized in chemistry (male teacher) for his graduation and taught physics in grade VIII, IX and X and chemistry in grade VIII and X. The other teacher (female teacher) had specialized in Biology and handled Biology for VIII, IX and X grades; and chemistry for grade IX. The high school teachers attended all the training sessions conducted at the CRC.

The high school biology teacher didn’t approve of the presence of a researcher in her class. Hence the science classes of chemistry and physics lessons (of the male teacher) were observed in the high school. He adopted a traditional lecture mode of pedagogy employing the science textbooks. He referred to the teacher handbook, but didn’t follow it closely for the teaching. Experiments were conducted occasionally. There was no science lab for high school, but stored equipments, chemical and materials required in a storage space in the staff room. Both of them approved of the new mode of pedagogy but found it difficult to implement in high school. The high school teachers maintained a formal relation with students. The teacher-student interaction happened only in the classroom. There was hardly any interaction observed outside the classroom nor did children meet teachers in the staffroom. Since the mode of teaching was lecture mode there was no planning of the activities or correcting of notebooks, science diary etc. observed.

**Observation:** - what we noted is a complete shift in teacher-student interaction from middle school to high school, as also a shift in the pedagogic approach and manner in which science was taught. In the previous chapter we also noticed a shift in the manner in which textbook treated the content and shift in the pedagogic approach of the textbook, the effect of which was observed in the science classroom processes and teacher student interaction which the following sections will elaborate upon. This shift influenced children’s performance in science. When all the middle school children scored
average and above for science, their performance showed a decline when they reached high school.

**Time table:** According to the time table in grades IV, there were a total of 7 periods per week for Environmental studies. Each period was 45 Min long and in grade IV, for environmental science there was single period on three days and double period twice in a week. In grade V and grade VI, there was one separate period allocated for environmental studies once in a week, with remaining six periods for basic science. Grade V and grade VI had one period per day for science with a double period once in a week. In grade VIII, there were separate periods allocated for physics, chemistry and biology; 2 period per week for each.

**Table 6.3:** Time division for science teaching: Grade III to Grade VIII

<table>
<thead>
<tr>
<th>Grade</th>
<th>Title</th>
<th>No. of periods/week</th>
<th>Total time/week</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>Environmental Studies</td>
<td>7</td>
<td>5.25 hrs</td>
</tr>
<tr>
<td>V-VI</td>
<td>Environmental Studies</td>
<td>1</td>
<td>45mins</td>
</tr>
<tr>
<td></td>
<td>Basic Science</td>
<td>6</td>
<td>4hrs 30 mins</td>
</tr>
<tr>
<td>VII</td>
<td>Basic Science</td>
<td>6</td>
<td>4 hrs 30 mins</td>
</tr>
<tr>
<td>VIII</td>
<td>Physics</td>
<td>2</td>
<td>1hr 30mins</td>
</tr>
<tr>
<td></td>
<td>Chemistry</td>
<td>2</td>
<td>1hr 30mins</td>
</tr>
<tr>
<td></td>
<td>Biology</td>
<td>2</td>
<td>1hr 30mins</td>
</tr>
</tbody>
</table>

Source: From school time table 2006-2007

**Observation on the time table:** What can be noted in the case of the timetabling is that each period or session comprised of 45 minutes each, which according to the science teachers is a limited time to teach science according to the new mode of pedagogy or conduct activities with children, or teach science in an inquiry mode that has several requirements such as grouping children, distributing materials required for conducting activity or taking children out of the classroom, conducting discussions, etc. By the time the groups were assigned to children and materials were distributed the 45 minutes time would have got over and there would not be any time left to conduct the rest of the activity or introduce the topic. Also every inquiry or exploratory mode of learning requires
its own time depending on the nature of the activity. So one of the major constraints noted towards the implementation the new mode of pedagogy is the strict time tabling of the school time into 45 minutes periods which teacher and children have to follow.

**Physical settings:** - The school building and classrooms looked fairly neat and clean; there was adequate space to accommodate all children, separating walls between classrooms and basic infrastructure facilities. The same classroom was used for teaching and learning of all subjects. Teachers changed depending on the time table but children remained in the same room. In each classroom, benches and tables were arranged in rows on either side of the classroom, one half for the boys, and the other half for girls. Children sat on benches and tables arranged in rows, with four to five children on each bench and with no free space to work in groups. Boys and girl had separate tables and benches, five rows for each group. The structure and arrangements of the classroom limited the possibilities of group activities/children working in teams on task and better peer interaction. Within the classrooms, there was no provision/ space available in the classroom to keep teaching-learning materials, or space to move around or sit around on the floor.

Every classroom had charts, pictures, children’s projects details, maps etc. displayed on the wall. Also each classroom had a black board. The science learning materials, kits, lab equipments, chemicals etc. were kept in a storage space adjacent to the staff room and teacher brought in the necessary materials required for each class. The front portion of the classroom had table and chair meant for the teacher that was used conduct experiment/demonstrations, to keep materials needed for classroom teaching and activities-textbook, materials required for demonstrating experiments to the whole class by the teacher.

**Observation on the physical setting of the classroom:** What is to be noted in the physical setting of the classrooms is that though the curriculum emphasized on a constructivist mode of pedagogy, (where arrangement of the science classroom should facilitate active and democratic participation of child where children and teacher work in groups, use of various concrete materials etc) the present science classrooms were not configured according to these requirements of a constructivist classroom. They didn’t have ample space or logistics required to conduct activities where children can sit together, work in groups or work independently on activities or the classroom wasn’t suited for a constructivist classroom where children and the teacher could work in a format that makes better interaction possible.
6.4 Preparation for Teaching

6.4.1 Teacher Training

Both the middle school and high school science teachers attended teacher training programs at the Cluster Resource Centers for two to three weeks during the start of an academic year. Sessions were also held once in a month at the cluster level at CRCs on first Saturday of every month. Onsite support was also provided once or twice a month by coordinators who visited the school and observed classrooms. The coordinators observe classroom instruction and help teachers reflect on what was observed. Also they examine children’s science diary, seminar notes, and evaluation sheets prepared by the teacher for the terminal exam. The coordinators and resource person were chosen from the schools that come under the CRC based on seniority and interest of the teacher. The DIET faculty and members of the SSA were also involved in the training. The training team was mainly comprised of the district team consisting of DIET Faculty, Programme Officer, District Coordinator, Trainer for each subject, and the BRC/CRC level team comprised of trainer for each subject and LSG members.

During the period of my field study, I attended and observed the teacher training or the cluster resource meetings that were held at the particular school on four occasions. The middle school science teacher of the school conducted the training sessions for all the other teachers of the cluster for the chapters on Elements and Compounds of Grade VI, Heat of Grade VII and The relation between chemical energy and Energy change of Grade VII. The reason for conducting the sessions at the particular school was that the school had resources and materials; also the teacher had the expertise required for conducting all the experiments and activities for these specific chapters which was found to be difficult by majority of teachers. The venue and trainee teachers were decided in the previous meeting. Also one of the middle school teachers (who taught English) functioned as a resource person for IT at school program for the block cluster. Hence teacher training for the 7th grade science chapter on Information and Communication Technology in daily life was also conducted at the school by this teacher. The block level coordinators were also present during the sessions. They observed and participated in the session and gave their feed back and suggestions.

The following description of a typical training session is based on my observations of four training sessions.
A training session at the cluster: The main components of a teacher training session were evaluation of the activities and classroom process of the previous month, lesson planning, discussing the topics to be taught and conduction of activities for the forthcoming month. Trial runs of the activities discussed in the textbook and handbook were done during these training sessions; also the manner in which the forthcoming units have to be taught was planned. Teachers also shared their classroom experiences of handling the previous unit with the group.

The resource teachers selected for science for the cluster handled the training sessions. The duration of a session was about 3 hrs and 56 teachers attended the cluster meetings (56 middle school teachers from schools that come under the Kothamangalam-Chelad CRC). The sessions attempted to train teacher to achieve the new pedagogic methods by focusing on the aspects of classroom implementation processes. This was done mainly through introducing teachers to the use of instructional aids, and teaching them how to conduct activities/experiments that were described in the handbook, based on the textbook, in the classroom. The resource teacher brought in the materials required for the activity. The materials required for the particular sessions observed were taken from the school. Both the textbook and handbook were used during these sessions for planning the activities of the forthcoming month and it is mainly the contents of the textbook that were discussed during the sessions. But the main focus of all the sessions observed were the conduction of activities and experiments. The sessions observed were also informal in nature where the resource teacher demonstrated the activities and others shared and contributed their ideas and experience; also there were active discussions regarding the manner in which each concept and activity has to be structured and demonstrated to the class. They also discussed in detail the content and concepts that can be introduced to children while demonstrating the activities.

Every session started with a review of the activities in the science classroom and the units taught in the previous month. There was a focus on aspects such as difficulty in conducting experiments, interesting observations regarding classes etc. The discussion was initiated by the resource person. This was followed by the preparation and planning for the forthcoming month. The review took approximately 20 to 30 minutes, whereas the planning and conduction of the activity took majority of the time i.e. approximately 2 hours. The sessions were for 3hrs duration with a 15 minutes break in between.
In one of the training sessions that dealt with the sixth grade chapter on *elements and compounds*, during the initial part of the session all teachers discussed together the major concepts of the chapter, afterwards examined all the experiments and activities given in the textbook and handbook. There were a total of seven experiments in the chapter and an activity of model building of molecules and atom. They discussed all the seven experiments and the model building in detail and categorized them into difficult ones and easy ones and reached a conclusion to do the experiments that were difficult and chose to do the activity of designing a water voltmeter which was the most difficult activity of the chapter. The resource teacher (from the school) brought in all the materials required for making a water voltmeter, demonstrated and explained every step of its construction that was prepared using a plastic bottle, iron nail, copper wire and a battery. She made the water voltmeter while others observed, helped and shared their ideas to complete the task. Once the water voltmeter was ready the teachers also demonstrated an experiment to find the components of water using the water voltmeter. The discussion focused on the difficulties that may be encountered while making the voltmeter and while doing the experiment, the aspects to be taken care and the concepts that can be taught through the experiment. The same structure was observed in another training session on a seventh grade chapter on heat where the teacher mainly focused on an experimental set up that demonstrate the conduction of heat through materials (where an iron scale in which nails were fixed using wax on a stand and heated one end of the iron scale) and expansion of solids (passing the metal ball through a ring without, and with heating the ring), liquids and gas. For this particular chapter, seven activities were conducted during the session and each of them was discussed in detail.

All the activities conducted were chosen from the textbook and were done according to the directions given in the teacher handbook. Teachers brought a copy of the textbook and teacher handbook for the training session. Thus teacher handbook was a major tool that was used during the teacher training session also.

Moreover it was understood from informal conversations with middle school teachers, that apart from subject matter and topics of each grade they also received training on themes such as the changed perspective of the pedagogy and the new curriculum, constructivist principles, gender and how to be gender sensitive in the class, how to evaluate children and conduct the continuous mode of evaluation and various aspects of pedagogy during these CRC training sessions. The DIET teachers and resource teachers handled the training sessions.
Observation on the teacher training: - The manner in which the state of Kerala implemented the new curriculum through a systematic, rigorous and compulsory in-service teacher training program is noteworthy. The process of implementation bringing in and coordinating with various bodies from the state level to the individual school level can be considered as a remarkable achievement. Teacher training helped the teacher to plan the classroom teaching and processes; also plan each unit of the textbook prior to teaching. This eventually helped teachers to implement the curriculum objectives in a systematic manner; also structure the classroom activities in discussion with the colleagues and sharing ideas with each other. The sessions trained the teacher on every aspect of pedagogy and trained to teach science keeping strict adherence to the processes suggested in the teacher’s sourcebook and contents of the textbook. The training sessions demonstrated to the teachers how to conduct science classes through activities and experiments. Teachers got a prior understanding of materials required, the method of setting up an experiment and how to introduce content in the classroom through activities and experiments. Thus it supported and contributed towards preparing the teachers for the classroom teaching, to implement the new curriculum and to use the handbook. Teacher training programs also attempted to enhance the teacher’s understanding of the new constructivist and student centered pedagogy; also transforming their attitudes towards children.

What can also be noted is that while the teacher handbook scripted the classroom processes for the teacher, the teacher training session trained the teacher how to follow the script. Thus every aspect of the classroom processes was controlled and predetermined by the curriculum designers and implanted systematically through a rigorous and compulsory teacher training processes. This in a way constrained the creativity and teacher’s own approach or thinking towards the science teaching to be exhibited which in a way put the agency and role of the teacher in question.

While textbook determined the content of what is to be taught, the teacher handbook determined the manner in which it has to be taught. It scripted and planned every aspects of the classroom transaction of the content and curriculum. What can be noted in the case of Kerala model of curriculum development is that, curriculum was devised at the state head quarters by team of experts and disseminated to schools via directives, guidelines, and teacher handbooks and enforced through resource people visiting and monitoring the
classroom processes, checking children’s science diaries, seminars reports, projects, answer sheets, evaluation sheets etc.

The curriculum developers specified the knowledge and skills required to implement the new curriculum and imparted them to teachers through rigorous in-service teacher training programs that were made compulsory for every teacher. The curriculum was spelt out in remarkable detail in the teachers handbook that provided lesson by lesson directions, manner of conducting every activity, experiments, projects, seminars and manner of evaluation, in an effort to render curriculum ‘teacher proof’ (Hodson & Barnett, 2004). This made the role of the teacher to that of a ‘performer’, whose job was to perform according to the script, teach in a way prescribed by others and assess students learning in a way that is designated by others.

This approach has been called as the “Engineering model of change” (Elliot, 1994 in Hodson & Barnett, 2004) which Hodson’s article illustrates as the tradition and model that existed during the 1970’s “The Engineer designs a system which will fulfill certain precise function or goals, and then supervises its implementation. The plan enables the engineer to control the process of development by communicating his/her requirements to the workforce, and providing criteria for monitoring and supervising progress” (Elliot, 1994)

6.5 The Classroom Process and Activities in the Middle School

The major tools used by the classroom for the teaching and learning of science were the teacher handbook, the textbook, equipment and materials. All children had the textbook copy and a notebook for science. In addition they had a second notebook which was maintained as a science diary.

Following are the science teaching techniques recommended by the middle school science teacher’s handbook for the teaching and learning of science:

1. Project method
2. Discussions
3. Out of school learning through field trip and study tour
4. Informal learning
5. Conducting experiments
6. Debates
As can be seen from this list, this is a varied and ambitious list of pedagogical strategies that are being recommended for science learning. I will be describing how many of these were actually conducted in the school. I will also be commenting on the extent to which these provide opportunities to structure science learning for the children towards the aims of the curriculum for knowledge construction, inquiry and integration with the everyday world.

6.5.1 The Mode of Classroom Teaching

The middle school science teacher (taught science in Grade V, VI, & VII) adopted lecture and activity method of teaching that comprised of explaining and discussing content of the textbook and demonstrating experiments with the whole class. Projects and seminars were also done after completion of a topic. Children maintained a science note book for making notes in the classroom and My Science Diary for writing projects, seminars and any interesting science related topics/observations.

Observations of the science classroom and discussions with the two middle school science teachers suggested that both of them were in consonance with the spirit of the new curriculum and pedagogic methods. They were making efforts, within the limits of existing facilities, to transact the curriculum according to the recommendations it was making to bring in child-friendly and exploratory ways of learning. The science teacher (whose class was observed) agreed with the new pedagogic methods, and considered that children would learn meaningfully if the activities were done. She collected all the materials, chemicals and apparatus needed for teaching every unit of middle school and stored them neatly in a storage space inside the teacher staff room. The non-teaching time was utilized by her for planning and preparing for the activities. It was also utilized for correcting children’s science diary, seminar and project
reports. This teacher did not report or discuss any difficulty in performing the
activities in the classroom. However she did indicate that she found
implementing this science curriculum difficult in the context of a government
school. The issues she raised were limited classroom spaces, limited teaching
learning resources, the 45-min class periods, and having to prepare children
for standardized examinations towards the end of the year. But most importantly,
what the teacher felt was that this curriculum required more support from
community, which they lacked. She felt that the amount of support received
for the teachers from village or community was minimal as most children of
the school belonged to low income groups. Also according to the teacher, parents
were suspicious about the new change, as they were more concerned about the
learning outcome and examination results, not with the manner in which
teaching learning happened.

Of all the instructional strategies that were recommended, the ones that
the middle school teacher was found to employ were four: demonstration,
discussion, projects and seminars. In the classroom process, even those
focusing on activity/demonstration primacy was given to teaching the content,
and the activity was treated as a method for making the content realistic and
interesting. The practical activities were done in the classroom to note down
observations, make phenomena more real, interesting and connected to the
everyday world-materials and instances, interesting for the children and
reinforce content of what is to be taught. The teacher initiated, controlled
and directed the discussions that happened in the classroom, and discussions
were structured around the content. The children responded to the teacher
initiated discussions.

The main teaching methods included:

1. Teaching with demonstrations and experiments combined with discussion
   in the whole class setting
2. Lecture mode combined with discussion with the whole class
3. Project to be carried out by children
4. Seminar by children
5. Maintaining a Science Diary.

Following table gives the details of the classroom observation and mode
of teaching in middle school.
Table 6.4: Mode of teaching in middle school

<table>
<thead>
<tr>
<th>Mode of teaching</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of lessons observed</td>
<td>22</td>
</tr>
<tr>
<td>Total number of sessions observed</td>
<td>55</td>
</tr>
<tr>
<td>Total time</td>
<td>41.25 hrs</td>
</tr>
<tr>
<td>Demonstration combined with discussion</td>
<td>30 sessions</td>
</tr>
<tr>
<td>Lecture mode combined with discussion</td>
<td>18 sessions</td>
</tr>
<tr>
<td>Project discussion</td>
<td>4 sessions</td>
</tr>
<tr>
<td>Seminar</td>
<td>3 sessions</td>
</tr>
<tr>
<td>Revising (Asking question and answers of a pervious topic)</td>
<td>1</td>
</tr>
</tbody>
</table>

(In addition to the above 55 sessions another 11 sessions were observed in high school for a total of 8.25 hrs, all the science classroom sessions of high school followed a traditional lecture mode of teaching using the textbook)

There were 30 sessions in which middle school teacher conducted demonstration combined with discussion, and 18 sessions was entirely devoted to lecture mode combined with discussion. Thus the content focus was retained on the whole.

6.5.2 Demonstration Combined with Discussion

Following were the major steps followed in a science classroom teaching-learning:

1. Demonstration of an activity/experiment by the teacher
2. Children noting down observation in tabular column given in textbook
3. Discussion-teacher initiated and directed discussion, adhering to the contents of the science textbook
4. Explanation of the content
5. Writing notes in the science note book (details of demonstration and discussion).

All lessons of the textbook contained a number of practical works and activities. Conducting of activity/ experiments and use of instructional aids in science classroom mainly represented the dimensions of the new constructivist pedagogy and tools employed to create a ‘joyful’ classroom environment. In the present case, demonstration means teacher demonstrating an experiment/activity
given in the textbook/handbook to the whole class, children seeing it and making observation notes in the tabular space provided in the textbook; later making detailed notes of the steps involved in the notebook. Teacher brought all the equipments and materials needed for the experiments to the classroom.

Children made notes of observations of the demonstrations in tabular spaces provided in the textbook. Demonstrations were followed by a discussion between teacher and children and the content was explained drawing on the demonstration. The conclusions of the demonstration were discussed; afterwards children prepared to write up the activities in notebook. Children maintained a notebook to write the details of the demonstration. The specific format in which observation has to be noted down was given by the teacher and was generally followed for all the units/themes. This was later written in *my science diary* and was submitted for scrutiny by the teacher. The teacher during non-teaching hours checked the entries and notes of children’s “My Science Diary”.

Children followed as specific format to make their notes in their notebook which is given by the teacher. Following is the general format that was followed to write about experiments in “My Science Diary”

1. Title and number of the Experiment (Pareekshanam-1)
2. Problem (Prashnam):-
3. Hypothesis (Ooham):-
4. Materials required:-
5. Method of conducting experiment:-
6. Observations: - (generally in tabular column)
7. Conclusion (Nigamanam).

The following episode is an instance of a science classroom that was demonstration combined with discussion and that illustrates how teacher conducted demonstration, discussion, use of concrete everyday materials and examples in the classroom. The excerpt is from a grade VI science class room observation while teaching the topic of elements and compounds.

**Episode 1 (Grade VI, 31/10/06)**

Topic-element and compounds

A science classroom-demonstration combined with discussion

Time: 10.15 am (period 1)

Children-34   Boys-18   Girls-16
Physical setting of the Classroom: Table and chair for the teacher in front portion of the classroom, children seated on benches and tables, 5 rows for boys, and 4 rows for girls, their text book and note book opened and kept on the table, classroom has blackboard, and display chart of various subjects on wall.

Activity conducted in the classroom-heating of sugar and observing decomposition of water into further components

Materials used-acidified water, two test tubes, nails, copper wire and torch which teacher brought with her from the staff room

Teacher noted the attendance and the class began by the teacher asking the whole class (recalling the contents of a previous chapter pure substance and mixtures)

Teacher: (to the whole class) do you know what are the characteristics of pure substance?

Boy1: (seated on the second bench) one which has same components in it....

Teacher: what are the characteristics of mixtures?

Boy1: which has different components in it,

Boy2: (seated on the third bench) when we build a house we use different components to build a house. Likewise mixtures have different component

Teacher: are materials made up of different substances or same substances?

Boys: (three to four boys) Different

Teacher: how about sugar?

Boys: (the above group) same

Teacher: today we can do an experiment to see the whether there is any other component present in sugar.

Teacher arranging the materials and equipments needed for demonstration, while children talking to each other. Teacher shouting to the whole class to remain silent and adding sugar in a test tube, heating it over a lamp. While heating the sugar teacher directed children to notice the changes happening.

Teacher: what we are doing is heating sugar in a test tube. You carefully observe the changes happening to sugar.

(In between one of the boy sitting on the second bench raising a question
“is this the way jaggary is been made”. But doesn’t received any attention)
Teacher brought to the attention of children “observe the gas coming out of
the test tube”. When the sugar turned to brown in colour teacher raised the
test tube and showing to the class “see now it turned to brown and this
stage is called caramel”. Afterwards she continued heating the sugar till it
turned dark. Once the sugar turned to black she raised the test tube and
asked “what can you see on the walls of the test tube?”

Children sitting in the front row got a chance to observe the water
vapor on the sides of the test tube. But none in the other benches observed it.

The teacher announced “what can we see on the sides is water vapor”

After the completion of the experiment
Teacher:  so what all did you observe while heating sugar?
Children:  (in chorus-majority of boys in loud voice and few girls sitting
in the first two rows in a low voice)
……….that sugar turned to brown and then black and it is called caramel
…..there was a gas that came out
Teacher:  what did you observe on the sides of the test tube?
Children:  water vapour
Teacher:  Now you know, what are the components of sugar….

Teacher elaborated:

……dark material we got at the bottom of the test tube is called
carbon and on the sides of the test tube is water vapour.

What this experiment proves is that sugar contains carbon and water
vapour. …..What you can do at home is heat some sugar with the help of
your mother and observe the changes happening to it. All of you have
observed how we did it here at the classroom. We saw sugar turning to
brown and then to a black substance. The black substance we got is carbon.

….. Carbon is an element. What do you understand when I say elements?

the components which it contains, like the way alphabets makes words
or small number makes big numbers, the lakhs and lakhs of substances
available in this nature are made up of some basic elements.
Can anyone tell me some examples for elements?

No response and teacher continuing

gold, silver, nitrogen, mercury etc are some other examples for elements

Teacher: Have you seen mercury?

No response

(But all children in the class were attentive to the teacher)

Teacher: Have you seen a thermometer

Boys: yes

(seated on the first and second bench)

Teacher: where?

Children: (in chorus) Hospital

Teacher: Have you seen a small ball in that?

Children: (in chorus) yes

Teacher: that is mercury, what are the other elements that you know?

After a pause

There exist many elements such as calcium, sulphur, sodium, potassium, phosphorous, bromine, zinc, magnesium. All these are elements

Teacher drawing a table on the board

Elements in solid state in liquid state in gaseous state

Teacher: which are the elements in solid state?

Boys(front bench): gold, copper, Iron

Teacher: there are still more

sulphur, manganese, zinc, magnesium

Teacher: Mercury is an element that is in liquid state

After a pause

Do you know whether there is any elements present in human body?

Boy: (seated on the second bench) yes, oxygen and sugar. If the amount of sugar comes down in the body we may fall sick

Teacher: also there are other elements such as phosphorous, calcium etc present in the human body

The bell rang

**Observation:** In this episode the teacher had a clear objective of establishing that materials are made up of different components and can be decomposed. She wanted to use this to introduce the concept of elements and discuss something about the distinctive characteristic of elements. This was the learning objective of the session. The class was structured to introduce the topic, conduct a
demonstration to establish the point and then move on to discuss elements. As can be seen, children’s contributions were invited to close ended answers that related closely to the objectives of the lesson and the phases of the lesson. Other observations of children were not engaged with. The teacher came into the classroom with the materials required for conducting the experiment and she had a predetermined plan regarding the concepts that needs to be introduced during the session. Hence whole of the classroom activity was structured and sequenced towards achieving this plan of the teacher. The answers from children are taken as prompts to continue the discussion. Also involving all the children’s participation for discussion of the class was not an aim. The discussion of the classroom happened mostly between the boys and the teacher. Girls were almost quiet during the whole of the session. The answers came from boys and these were children who were active in almost all sessions observed in the grade.

Also the structure and content of the above classroom and discussion adhered to content, examples and structuring of content of the textbook and directions of the teacher handbook.

The following excerpts are an instance of another session in Grade VII where the teacher initially conducted a demonstration and afterwards with all children in group wise; also gives a picture of how children noted the observations in their science textbooks and notebooks

**Episode 2 (Grade VII, Two sessions 9/10/06 & 10/10/06)**
Topic: Liquid Pressure
A science classroom-demonstration combined with discussion
Date: 9-10-06. Time: 10.15 am (period 1) Grade: VII A
No. of students: 25 (10Boys+15Girls)
Topic: Liquid Pressure (new chapter).
Physical setting of the Classroom: Table and chair for the teacher, benches and tables for children, blackboard, and display chart of various subjects on wall. Children seated on benches, their text book and note book opened and kept on the table; 5rows on either side (5 for boys, and five for girls.
Method of Teaching: demonstrations and discussion.
Materials used for experiment-A spring balance, weights, water.
Teacher after noting the attendance announced to the whole class: *we are starting a new lesson “Liquid Pressure”*
She began the lesson by asking:
*Who among you knows swimming?*
Almost all of the children in the class raised their hands.

Teacher: *have you tried going down to the water?*

Children: (in chorus) *yes*

Teacher: *Anyone tried taking a stone from the bottom of the water to the top?*

There is no response to the teacher’s question, but the children started talking to each other. Teacher, immediately bringing back the attention of the students to her and giving a warning, never try this in the river.

Teacher: *When you pull water from the well have you felt a weight difference?*

Boy1: *yes. When in water, it is easy to pull the bucket of water, after the water level it is heavy.*

T: *Do you know why the weight difference in air and water?*

No response

After a while

T: *Ok…to understand this we can do an experiment*

(Demonstration1)

Teacher brought in all the materials required for the demonstration with her from the staffroom to the class and demonstrated the experiment to the whole class standing near to her table at the front portion of the classroom.

Teach took the 200gm weight with the spring balance and weighed. She looked at the reading of the balance and announced to the whole class….. “See it shows the weight is 200gm”.

After this teacher directed children’s attention to the tabular column given in the textbook. *Examine the columns and note down the measures in the column*

Then she immersed the weight in water and took the measure in water and announced… “Now the weight is 150 gm”.

Repeated the same with another 500gm weight. It weighed 500gm in air and 400 gm in water and announcing the measure to whole class.

Children noting down the announced measures in their textbook at the tabular space provided.

T: *Now can you tell me why the weight is different in air and in water?*

A boy: *Water exerts pressure to the weight*

T: *So when you take water from well, the same phenomenon is happening*

T: *Is water, the only liquid that exerts pressure or any other liquid?*

No answer
T: What about kerosene?
(By the time bell rang, children stopped listening to what the teacher was saying)
Teacher shouting to the class to bring different types of liquids for the next science class - water, kerosene, oil, also a milk cover.

Session 2; 10-10-06; Time 11 Pm; Grade VII A; Students: 10Boys+15Girls

The same classroom
Teacher after marking the attendance
Teacher: Do you remember what we were doing in the last class? Any of you brought liquids?
A girl came forward and kept a bottle of kerosene on the table, another girl a milk cover.
Teacher looked at the bottle of kerosene: “this may not be sufficient for us, but I have some more with me”
(Teacher directing a boy to go to the kitchen and bring a packet of salt from there. Teacher had brought in a bottle of kerosene, oil and a big jar with her).

Teacher: all of you look at the tabular column given in the text book and read it carefully, examine what are the measures that you have find?

After a pause
Teacher: Yesterday, what was the weight that we measured in water and air?

A boy shouting: Weight in air is 200 gm and weight in water is 150gm

Teacher transferred kerosene, oil and the salt to three different jars. Added water to the salt and prepared salt solution. Took the 200 gm weight using the spring balance and dipped it in the jar of kerosene. Asked children to come forward bench wise to the table to take the measurement of weight in kerosene and make a note of it in the tabular column in their text book.

Boys from the front bench came forward, took measure in kerosene and announced it to the whole class that it is 175. They went back to the seat and noted on the table given in the text book 175
After the first bench of children completed the measure, children from each bench took the measures and all of them got 175 gm in kerosene (Actually there was a small difference in the weight which the teacher and I noticed later, but all of children of the class followed the measure shouted by first bench students , it was 2 scales different (177))

After taking the measure in kerosene, the same procedure was repeated for salt solution and coconut oil

After entire class finished noting down the measures, teacher continued the session and elaborated the concepts

Teacher:  *why the weight is different in different liquids?*

Boy1:  *liquids exerts a pressure to the above*

Teacher:  *do all the liquids exert a pressure?*

No answer

Teacher:  *Is the pressure exerted by all liquids same?*

Children (few):  *No*

Teacher:  *why pressure is different?*

Boy1:  *It is because, density of liquids are different*

Teacher:  *So from the experiment we can arrive at three conclusions*

*All liquids exert pressure*

*The pressures exerted by different liquids are different*

*The weight difference is due to the difference in density of the liquid. The densities of the liquids are different*

Afterwards teacher directed children to take the science notebooks and write the experiment and observation. There was a specific format which children followed to write the experiments in the notebook. Teacher directed children initially to write date and title first and recalled the format and briefed the experiment and conclusion quickly. Following is the manner in which the experiment was noted in the note book one of the students.

**Observations:** As we can see in the above episodes, for each class the teacher had a fairly clear lesson objective, and she followed it through to ensure that by the time she reached the end of the class, she had achieved her lesson objective. In the first episode it was components of sugar, and the concept of
elements. In the second episode it was the concept of liquid pressure ie all liquid exert a pressure

### 1. Flow of the lesson:

Teacher tends to begin the class by asking questions to the whole class and then moves on to teaching through demonstration or explanations. Given the emphasis and orientation of connecting everyday life to the content of science, the teacher invoked everyday world examples while teaching the topic. The textbook flow was designed to begin by drawing familiar examples from children’s everyday life which the classroom and teacher also followed. The materials that were employed for the experiments and activities were familiar materials chosen from the child’s everyday world. Towards the end the teacher emphasized the important conclusions from the experiment that children need to be remember. Also while activities were being conducted by the teacher, children knew what they were

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**Experiment-1 (pareekshanam-1) Problem (Prashnam):-** is the weight of a material same in water and air?

**Hypothesis (ooham):-** it is different in water and air

**Materials required:** stone, water, kerosene, salt solution, coconut oil and spring balance and weighing grams

**Method of conducting experiment**

Measure the weight of the stone using spring balance. Measure the weight of the same stone when it is fully immersed in water. Repeat the experiment using other liquids kerosene, salt solution and coconut oil.

**Observations:**

<table>
<thead>
<tr>
<th>Liquid</th>
<th>Weight in air</th>
<th>Weight in liquid</th>
<th>Weight difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>200</td>
<td>150</td>
<td>50</td>
</tr>
<tr>
<td>Kerosene</td>
<td>200</td>
<td>175</td>
<td>25</td>
</tr>
<tr>
<td>Salt solution</td>
<td>200</td>
<td>160</td>
<td>40</td>
</tr>
<tr>
<td>Coconut oil</td>
<td>200</td>
<td>170</td>
<td>30</td>
</tr>
</tbody>
</table>

**Conclusion (Nigamanam):-** Stone weighs more in air and less in liquid. The reason is that liquids exert pressure upwards.
expected to write in textbook tabular column or notebook, which was a general format followed for all lessons. Here it was not explicit in teacher’s instruction about when the children should make notes in the tabular columns of the textbook or write in the notebook. The process was understood by children from the previous lesson.

2. Presence of everyday related examples and episodes in the class:

In the above episodes we notice several references to everyday experiences of children. There were questions directed to children, typically at the beginning of the class, asking them about phenomena in their everyday life: the experience of pulling water from the river, the experience of swimming etc. Thus we can see that children’s everyday experience was being invoked by the teacher. It was already noted in the previous chapter that the textbook content included several examples from children’s everyday life. The textbook was replete with activities, everyday examples and phenomena. Teacher handbook supplemented the textbook by elaborating upon the methods to conduct these in the classroom. Teacher drew on and adhered to these examples and activities that were mentioned in textbook to transact the content. All the examples that were invoked by the teacher in the above episodes were described in the textbook and teacher’s handbook. Further, in the presentation of the content the main focus was teacher relating content to children’s experiences through examples from everyday world and transmitting the activities and content of the textbook in a manner that was recommended by the teacher handbook and according to the guidance received from the teacher training.

3. Comparison of the classes with the scripts in the teacher handbook:

The teacher and science classroom mainly focused on transaction of the content of the textbook in a manner as described by the teacher handbook. The science classroom treated the activity as having a particular outcome and conclusion and the activities were done as a simple proof to establish the facts. The activities chose materials that were familiar for children or those were from everyday world. It is the use of familiar everyday concrete materials or examples that gave contextual meaning to the science experiments and content. Teacher described and explained the experimental procedure in great detail while demonstrating. The tabular column provided in the textbook gave all the details that had to be observed. Thus while doing a demonstration the content of the textbook is translated into a set of physical activities by the teacher. In doing
all this, the teacher was following the procedure as explained in the textbook and handbook to demonstrate the content to the children. In other words, the teacher is following a script or recipe while doing science classroom activities. On no occasion did I observe any variation from the script of the handbook or textbook. Further, when children contributed observations that seemed to deviate, they were ignored by the teacher. Only those statements that furthered the objectives of the book were taken up by her. It also seemed that the outcome obtained or conclusion arrived at is accepted by children and there is no further questioning or probing about the conclusion.

4. Recontextualisation of everyday materials

In the above science classroom episodes what we notice is the use of everyday materials to introduce the concepts that are exclusive to the domain of science i.e. materials such as sugar, water etc was invoked and used in the context of a science classroom to introduce concepts such as ‘elements’ or ‘liquid pressure’. By this we can say everyday familiar world of the child is recontextualised in the context of a science classroom. What can also be noted is the translation of classroom activities, experimental procedure, conclusions and discussions into a written format in a notebook which is the manner through which children are integrated and trained to use the language and vocabulary of science. Moreover while converting these to a written format everyday example, concepts and language are being ‘recontextualised’ to that of language and procedures of science.

6.5.3 Lecture Method Combined with Discussion

It is not that every unit or sessions observed in the middle school were taught through demonstration or activities. There were eighteen sessions out of the fifty five sessions observed, in which teacher adopted lecture mode of instruction combined with discussion with the whole class. Teacher conducted activity or demonstration only if it was specified in the teacher handbook or textbook. Otherwise she adopted the lecture mode and the following episode3 is an instance of it.

What needs to be noted in this mode of teaching is the richness of everyday examples used to introduce the concepts and enrich the discussion.
Following excerpt is an example of a lecture mode of teaching combined with discussion

**Eposide 3 (Grade VI, 9/02/06)**

Children:-35 Boys:-19 Girls:-16
Topic: The science of changes
A science classroom-lecture mode combined with discussion
Time: 11.30 am (period 3)

Physical setting of the Classroom: Table and chair for the teacher in front portion of the classroom, children seated on benches and tables, 5 rows for boys, and 4 rows for girls, their text book and note book opened and kept on the table, classroom has blackboard, and display chart of various subjects on wall.

Beginning a new chapter,
There was some general discussion, afterwards teacher took the textbook and announced that it is a new chapter today

Teacher: *What are the examples for changes that you have observed around you?*

Boys shouting out the examples one after the other
(All the following responses came from boys; also the textbooks was opened in front of them and some of the examples were told looking at the textbook)
Boy1: (seated at third bench) *Blooming of a flower,*
*Budding of seed into a plant* (given in textbook)
Boy2: (second bench) *Sun set and sun rise, Day and night,*
Boy1: *Thunder,*
Boys: (three seated at the front row) *A ripened mango falling down,*
(given in the textbook)
*Blowing a balloon,* (given in the textbook)
*The motion of objects, The falling down of trees,*
*Birds flying*
Boy3: (second bench) *The motion of vehicles.*
*The change of colors...for example ripening of banana* (given in the textbook)
*Also when the color of water changes when we add color in to it*
The change that happens when a Newton ring rotates

Boy2: The decaying of vegetables (given in the textbook)

Teacher: We can classify these changes. Among this what are the changes that is happening in nature?
First let us look which are the ones that happens faster and which are the ones that happens slower

Boy: ripening of fruit is a slow process, also the rotting of vegetables

Teacher drawing a table on the board and writing in two columns
Slow changes Fast changes
Directed children to categorize and copy the table in their science notebooks and fill the table with the examples discussed.
Children drawing the table and categorizing the examples in the notebook along with the teacher who wrote it down on the board….
After completing the notes

Teacher: we can classify these changes again into those that changes shape, location, state etc.
Can you tell which are the examples of changes that change its shape?
(in the following case girls also began to participate in the discussion)
Boy1: frying a pappad,
Cutting firewood (given in the textbook)
Blowing balloon (given in the textbook)
Boy2: Making dough with wheat powder
Girl1: Powdering chalk (given in the textbook)

Dissolving salt in water (given in the textbook)
Melting of wax (given in the textbook)

Teacher: How about changes where location changes?
Boy: when the balls rolls,
pumping water,

Girl: when the mango falls down (textbook examples)
Boy: Rotation of tyre
Flowing of water
Also writing with pen

Teacher: next is example for state changing
Boy1: melting of ice (textbook example)
Boy2: when the vegetable rots
...dissolving of sugar (textbook example)
Also salt (textbook example)
Girl: melting of wax (textbook example)
Girl: making juice with fruits
Teacher: what is the state change there?
Boy: fruit is changed to liquid state

Teacher: how about changes that are happening in nature
Answer coming from different children from different parts of the class, even girls started shouting
....Blowing of wind
...night and day
..rising and setting of sun
..falling of leaves
...motion of earth

Teacher: what happen when earth rotates?
Girl: day and night are formed
Teacher: what is the name we call for earth moving on its own axis?
Girl: rotation
Teacher: how about when it moves around the sun?
Boy1: revolution
Boy2: earth quake is also an example
Boy3: Tsunami; also katrina are also examples then

Teacher bringing the attention of all children to her by directing children to draw columns in the notebook and write down the type of changes and its examples according to the discussion.

Children had written the notes in the notebook with the help of textbook and teacher. After the children complete the notes teacher is telling a girl seated on the third bench to readout to the class what was written in her note book

Children now adding more examples (all are examples out of the textbook)

A boy: We can also write ...the change of seasons
Boy2: ...also soil erosion
Girl: …the changes that happen to plants
Girl2: ...falling and formation of leaves
...formation of fruits.......ripening of fruits
Girl3: ...the growth of plants......formation of new branches.....
We can also write the changes that happen to human body
Boy1: Then we can also that happens to animals....the formation of tails
Girl: then disappearing of the tails of tadpoles
Girl2: the growth of animals, formation of different organs, the growth of hair, growth of tails
Boy: the change of color of a chameleon,
Birth and growth of human beings, growth of organs,
Also formation of intelligence

The bell rang…teacher announcing to children complete the notes before coming to the next class

6.5.4 Projects

Projects were included with an objective of bringing local or everyday life and experience into the classroom learning of science. It was intended to bring environmental, physical and community resources for science teaching learning process. The middle school teacher handbooks of Grade V, VI and VII emphasized project based teaching as one of the most appropriate and essential teaching method to be adopted for the teaching of science. It viewed project as a method that imbibes the method of science and that can help a child to develop process skills, methods of science and independent mode of learning.

The teacher handbooks elaborated six important stages for the conduction of projects which were 1) feeling the problem, 2) defining the aim, 3) planning, 4) execution, 5) report preparation and 6) project presentation. The handbook advised the choice of a naturally evolving question/problem that came from children while teaching of a topic in class as a project. Through the process of conducting a project children must be able to find solution for the problems. For e.g. according to the teacher handbook while teaching the topic of acid and alkali children can formulate project question in the class as what are the indicators that are found around also what are the plant based indicators found in local environment. Also there were many sub stages defined for doing a project such as refining the questions and aims, hypothesizing, choosing the methods and tools, survey, experimentation, tabulation of data, analysis, reaching at conclusion, application etc.
“Project is a self-learning strategy which can exert great influence on the overall development of the learner. Project as learning strategy is to be selected where a problem arises in any part of the curriculum. The students may be divided into groups and assigned different aspects of the problem. Each group works independently. Specific aspects of the problem such as data collection, classification, analysis, report preparation and presentation is to be undertaken by each of the members. Even though the work is divided among the members, it must be ensured that the execution of each and every activity is done with the active participation of all. After analyzing data collected from different sources, the learner arrives at a conclusion which helps to solve the problem. There by learner learns the topic through his own activity. The other advantage of these learning activities is that it helps the learner to scientifically handle any problematic situation. It helps in the development of scientific thinking and thereby builds up the students aptitude for the subject.”

Grade VII Science teacher handbook pg.49

Following is the time schedule provided by the grade VII science teacher handbook

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>Initial discussion, planning and grouping children</td>
<td>1 period</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Data Collection and survey</td>
<td>7 days</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Coding and Analysis of Data</td>
<td>1 period</td>
</tr>
<tr>
<td>Stage 4</td>
<td>Report preparation and submission</td>
<td>2 periods</td>
</tr>
<tr>
<td>Stage 4</td>
<td>Presentation and Discussion</td>
<td>1 period</td>
</tr>
</tbody>
</table>

Project given in the textbook and teacher handbook

Even though teacher handbooks of all the middle school grades directed teacher to conduct project based on a inquiry/question that arise in the class from children, in practice it was conducted only for the topics in which a project was mentioned in the teacher handbook or textbook. The following table 6.2, 6.3 and 6.4 will give the details of units for which projects were discussed for each grade in the textbook and teacher handbook, which were the only ones conducted in classroom.

What is evident in the project method was that it was conducted only for units that were related to environment, agriculture, health or applied science or the topics that had a direct relevance to the everyday world of the child which we can categorize/call as the topics that comes under STS (Science Technology and Society). Children didn’t perform any project or there wasn’t any project
mentioned for any of the units of fundamental science in the teacher handbooks or textbooks. When we examine all the units of grade V, grade VI, Grade VII and Grade VIII there was no project for any of the units on basic science/formal science. Only one unit in grade VIII on formal science had a project mentioned. What we can say is that project is a method that entered into the science curriculum for the STS chapters and here also curricular innovation did not get translated to the teaching of units on fundamental science. Or the implicit assumption of the curriculum seems to be that the teachers themselves should be innovating projects for the topics related to fundamental science.

Following table 6.2, 6.3 and 6.4 will give the details of the units on which projects were conducted and not conducted in the grades V to Grade VIII units.

Table 6.2 and 6.3 gives the details of the units for which project were conducted by the children. The entire units of grade V to VIII for which projects were performed (except one unit in grade VIII) can be categorized under STS.

**Units for which projects were done that come under the category of STS (Environment, health, agriculture and applied science)**

**Table 6.5:** Units for which project were conducted in Grade V and Grade VI

<table>
<thead>
<tr>
<th>Grade V Unit name and category</th>
<th>Project name</th>
<th>Grade VI Unit name and category</th>
<th>Project name</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) World of Plants (EVS)</td>
<td>Observe the plants around and find whether fibrous roots/tap root plants are more</td>
<td>(1) Flower to Fruit (EVS)</td>
<td>Conduct a project on method of seed dispersal.</td>
</tr>
<tr>
<td>(2) Animal Kingdom (EVS)</td>
<td>Field trip-take children to a zooActivity: Direct children to create a album with feathers of different birds</td>
<td>(2) Preserve without damages (Applied Science)</td>
<td>Conduct a survey on food prices</td>
</tr>
<tr>
<td>(3) Light (Basic Science)</td>
<td>Finding transparency of different liquids</td>
<td>(3) The Science of Changes (Applied science)</td>
<td>Conduct a project to understand the condition under which rusting of iron takes place.</td>
</tr>
<tr>
<td>(4) Precious Soil (Agriculture)</td>
<td>Find the different types of soil in your area and identify which is the best soil for agricultureConduct a survey and find which is the main crop in your area</td>
<td>(4) Rearing Animals (Agriculture)</td>
<td>Conduct a survey on the cattle breeds in your locality</td>
</tr>
</tbody>
</table>
(5) Water: Sources that pollute water Sources of water wastage

(6) Food Health and Hygiene Is there a condition in your locality where mosquitoes are more? Causes of mosquito breeding in your locality

### Table 6.6: Units for which project were conducted in Grade VII and Grade VIII

<table>
<thead>
<tr>
<th>Unit name and category</th>
<th>Project name</th>
<th>Unit name and category</th>
<th>Project name</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Pollution of Earth (EVS)</td>
<td>Conduct a study on pollution and its sources that exist in your locality Put forward suggestion to make your school and locality pollution free</td>
<td>(1) Interdependence in the world (EVS)</td>
<td>Is there damage caused to the ecosystem in your locality due to indiscriminate human activity? Collect data and make suggestion to check the same</td>
</tr>
<tr>
<td>(2) Development through Agriculture (Agriculture)</td>
<td>Conduct a survey on the number of people involved in the cultivation of paddy in your area Conduct a survey on the paddy fields existing in your locality and those existed 10 years back Visit the fields near to your school to understand the methods used by farmers to control pest and disease of crops</td>
<td>(2) Speed in Chemical Reactions (formal/ fundamental science)</td>
<td>Select locally available vegetables and fruits. Examine which among these can produce electricity</td>
</tr>
<tr>
<td>(3) sound</td>
<td>Conduct a project to understand the shape, size and location of ears of different animals (not conducted in the class)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Units for which projects were not conducted or not mentioned in the textbook/teacher handbook that come under the category of fundamental/formal science

Table 6.7: Units from Grade V to Grade VIII for which there was no project

<table>
<thead>
<tr>
<th>Grade V</th>
<th>Grade VI</th>
<th>Grade VII</th>
<th>Grade VIII</th>
</tr>
</thead>
</table>
| 1. Properties of Substance  
2. The Living World  
3. Motion  
4. Human Body  
5. Consolation and Protection  
7. Sky Gazing | 1. omnipresent  
2. Force in Action  
3. Pure Substance & Mixtures  
4. Sources of Energy  
5. Plant and plant Kingdom  
6. Elements and Compounds  
7. From heart to Fingertip  
8. Light and Colors  
9. All are relatives | 1. Acids and Alkalis  
2. Sound  
3. Magnets  
4. The Cell: The unit of Life  
5. The language of Chemistry  
6. Simple Machines  
7. Liquid Pressure  
8. Food Habits in Plants  
9. Heat  
10. The Relation Between Chemical Change and Energy Change  
11. Spherical Mirrors  
12. Information Technology in Daily Life | 1. Structural Diversity in Organisms  
2. The Earth for our future  
3. Cell and Homeostasis  
4. Excretion  
5. The World of Chemistry  
6. A Peep into the Atom  
7. Compounds and Valence  
8. Water  
9. Solutions  
10. Acids and Bases  
11. Measurements and units  
12. Refraction of Light  
13. Lenses  
14. Motion  
15. Wave Motion and Sound  
16. Static Electricity  
17. Current Electricity  
18. Heat |

6.5.5 Conduction of Projects in the Classroom

The project was always conducted at the end of a unit. After completion of entire content of a particular unit, teacher announced the project topic and discussed methods of conducting project, main aspects of data collection, the format in which the project report has to be conducted and also date of submission of project report with the whole class. This sometimes took one whole period or half the time of a period afterwards children independently carried out the project. Children met the teacher in the staffroom if further assistance was required.

The conduction of the project comprised of:

1. Discussion of the project problem and format in the classroom and children making a note of the format
2. Data collection by children
3. Submission of the project report.

In the classroom teacher gave the project problem. Children conducted the project independently in discussion with their friends, science teacher, parents or elder siblings and submitted report written in the science diary to teacher for correction.

**Project 1**
**Grade V**
**Unit: World of plants (EVS)**

After finishing the entire content of unit the project on different types of roots was chosen and the question was given in the textbook and method of conduction of project was discussed in teacher handbook.

T: *You know classification of roots and you observed the roots of the plants. We can do a project on that…*

*Which are the plants that can be seen around near your home?*

Children one after the other telling out the names of various trees found around:

- plantain,
- jackfruit,
- mango tree,
- tulsi…..

*Teacher:* what you have to do is observe different plants found around your house and their roots and identify the type of roots.

…...So what is the problem of our project?

She continuing

……to find the type of roots for the plants that are found in our locality

……whether they has fibrous roots or taproots?

The teacher writing the format on the board

<table>
<thead>
<tr>
<th>Name of the plant</th>
<th>Tap root</th>
<th>Fibrous roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Examples of a Project

As noted in the note book of Ansalna, Grade V

1. Problem (prashnam): Whether plants found in our locality has fibrous roots or taproots?
2. Hypothesis: Fibrous roots
3. Data collection

<table>
<thead>
<tr>
<th>Name of the plant</th>
<th>Tap root</th>
<th>Fibrous roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Bamboo</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>2 Paddy</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>3 Grass</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>4 Rubber</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>5 Tulsi</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>6 Bitter gourd</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>7 Sugar Cane</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>8 Ginger</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>9 Turmeric</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>10 Yam</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>11 Butter Fruit</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>12 Exora</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>13 Lawsonia inermis</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>14 Teak</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>15 Coconut</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

4. Conclusion: Tap root plants are fibrous roots plants more among the trees found around my home

Example 2,

Grade VII, Topic-acid and alkalis

As noted in the note book of Nikhil Lal

1. Problem: which are the plants around us that can be used as indicators?
2. Introduction
Indicators are substances used to indicate the presence of acid/alakali. We can use hibiscus flower as an indicator. The aim of this project is to find the other plants that can be used as indicators.

3. Aim

Which are the plants and their parts that can be used as indicators?

4. Experiment

Take hibiscus flower, blue conch flower, turmeric, Beet root juice and spread it over a piece of paper. Dip the paper in lemon juice and lime and observe

5. Observation

<table>
<thead>
<tr>
<th>Plant</th>
<th>Colour in Lemon juice (Acid)</th>
<th>Colour in lime (Alkali)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hibiscus</td>
<td>Red</td>
<td>Blue</td>
</tr>
<tr>
<td>Blue Conch Flower</td>
<td>Red</td>
<td>Blue</td>
</tr>
<tr>
<td>Turmeric</td>
<td>Yellow</td>
<td>Red</td>
</tr>
<tr>
<td>Beet root Juice</td>
<td>Violet</td>
<td>Green</td>
</tr>
</tbody>
</table>

6. Conclusion: we can use hibiscus flower, blue conch flower, beet root juice and turmeric as indicators.

Observations:

The projects did engage children with investigations of their everyday life and this was a valuable source of connecting with the world around. However, as can be seen, the units in which there were such projects seemed to be limited to the topics that dealt with STS related units (health, agriculture, environment) and less with those which may be classified as ‘basic science’. None of the chapters on fundamental or basic science in middle school grades had any project. It is not only that project method was followed mainly for the chapters that were related to STS, but also teacher and method of teaching were also a bit passive towards the new method. In terms of classroom time only a maximum of 30 to 40 minutes was given for project and it was done independently by the children where the teacher only corrected the project book.

What is to be thought over is whether teaching of fundamental science through project method is difficult to achieve or what kind of preparedness it demands from the teacher, textbook and curriculum.
6.5.6 Seminar

According to the teacher handbooks of grade V, VI and VII seminar was a learning strategy that involves in-depth analysis of specific topic, preparation and presentation of a paper and it helps children to develop communication skills and overcome stage fright.

In practice in a classroom, teacher gave directions and chose the topic for the seminar that was mentioned in the textbook or teacher handbook. Children were grouped in the classroom, a seminar leader was selected and sub themes of the topics were assigned to each team. During recess, group members collected the information required for seminar, mainly from books, magazines, or newspaper available in the school library or from home. Teacher gave them guidance for the sources to be searched. There was a library in the school from where teacher kept various sources such as newspapers, magazines clippings separately for children’s reference to conduct the seminar/project. All the group members wrote the seminar report in “My Science Diary” and the seminar leader of each group read out the notes to the whole class. In the classroom the seminar was presented by one student who represented a group. After the presentation, there was a general discussion with whole class. The report was submitted to teacher for comments.

Following is an instance of a seminar that was presented by a grade VII student

**Seminar: Example1**

Unit: Development through agriculture

The whole class was divided into two groups by the teacher by taking numbers. All the children who called out “1” were assigned group 1 and 2, group2. It was a mixed group comprising of both girls and boys. The general topic for the seminar was “the problems caused by conversion of paddy fields”

Topic of Group1: “the problems caused to agricultural sector due to the conversion of paddy field”

Topic of Group2: “the problems caused to environment due to the conversion of paddy field”

The seminar notes for group 1 was read out by a boy and major points of his notes included the following

1. loss of employment for agricultural laborers
2. reduction in production of rice and its impact
3. the loss of agricultural tradition and the cultures associated with it
The seminar notes of Group 2 was read out by a boy who discussed the following
1. the species of animals and insects that will be destroyed by converting paddy fields
2. the obstruction it causes to the flow of water resulting in flood

**Seminar: Example 2**

Unit: Sources of Energy

Number of groups-5

Topics of each group
- Group1: Different forms of Energy and their sources
- Group2: Classification of energy sources
- Group3: Utilization of Energy
- Group4: The need to conserve energy
- Group5: The methods to conserve energy

The group leader for each group read out the notes to the class and afterwards, the teacher asked the whole class whether anyone has any question to ask. There were not any questions raised by children, nor clarification and no detailed discussion was observed during the session, but after each groups discussion the teacher reinforced the content read out by the child once more

T: *so what are categories of the energy sources that vivek discussed...*
C: *renewable and nonrenewable*
T: *what are examples of the renewable energy sources?*
C: *wind, solar energy, and tides*

After children finished the seminar, and teacher ensured that everyone in the class had grasped the content by repeating the content read by the child once more.

**Observations:** Seminar was one of the methods employed by the science classroom to reinforce the content of the units by relating it to an application or everyday phenomenon. What can be noted in the case of the seminar is, that it was also conducted for topics related to environment, health, and agriculture. There were few basic science topics for which seminar was conducted by children.
Following are the topics on which seminar was conducted by children

**Table 6.8: Topics on which seminar was conducted by children**

<table>
<thead>
<tr>
<th>Grade V</th>
<th>Grade VI</th>
<th>Grade VII</th>
</tr>
</thead>
</table>
| 1. The importance of giving first aid and methods  
2. Health and habits of healthy living  
3. Destruction caused to the nature due to human interference | 1. Energy sources  
2. Migrating Birds  
3. Domestic animals  
4. Global warming and climate change | 1. Sound recognizing mechanisms in animals and humans  
2. Pollution of earth and its impact on human health  
3. World Environment  
4. Conversion of paddy fields and the environmental issue cause by it  
5. The life style of early man  
6. Gardening methods: Budding, grafting, layering, Tissue culture  
7. Cash corps of Kothamangalam  
8. Ayurvedic plants found in house premises and its use  
9. Musical instruments: Drum, String Instruments, Flutes  
10. Sound Pollution |

<table>
<thead>
<tr>
<th>Grade VI</th>
<th>Grade VII</th>
</tr>
</thead>
</table>
| 1. Energy sources  
2. Migrating Birds  
3. Domestic animals  
4. Global warming and climate change | 1. Sound recognizing mechanisms in animals and humans  
2. Pollution of earth and its impact on human health  
3. World Environment  
4. Conversion of paddy fields and the environmental issue cause by it  
5. The life style of early man  
6. Gardening methods: Budding, grafting, layering, Tissue culture  
7. Cash corps of Kothamangalam  
8. Ayurvedic plants found in house premises and its use  
9. Musical instruments: Drum, String Instruments, Flutes  
10. Sound Pollution |

### 6.5.7 Club Activites

A science club for the school was also prescribed by the curriculum as part of the teaching and learning of science. The science teacher handbook directed teachers to organize various science club related activities, invite resource people from community such as local artisans, farmers, etc. for interacting with children as part of it. According to the middle school teacher handbooks conduction of various club activities is the one of the important pedagogic methods that can be employed to inculcate science process skills and attitudes in children. The handbooks directed the science teacher to be one of the organizers of the club along with a children's executive committee where children are the title holders. The club members must meet once in a week to plan, organize and implement various science related programs such as science corner, science bulletin in school, science exhibitions, science quiz, science seminars, designing small projects and creating science models, discussion of science articles and books, star watching, conducting science camps, eco-club, creating an aquarium etc.

During the tenure of the field work following are the club activities observed in the school

1. A science exhibition by high school and Vocational higher secondary school children
2. Celebrating farmers day
In the science exhibition that happened during the month of September the high school and VHSE students exhibited various projects, models and experiments. The projects included one on food preservation-in which children made different types of juices from locally available fruits and edible flowers, models on energy conservation, models of electricity production using various energy sources, producing electricity from vegetables, various items created from locally available materials, such as coconut shell, palm leaf, areca nut leaf etc. There were exhibits by individual children and also by group. One complete day was kept aside for the science exhibition where children of each grade visited the stalls during an allocated time.

During the farmers day that was celebrated during the month of August and that falls on the New Year day of the Malayalam Calendar the middle school organized a talk and interaction with a farmer. It was organized as a formal function where all children of primary and middle school assembled together to felicitate a farmer of the area, for his life time achievements in farming. The local panchayat representative, the principal and one of the middle school teachers congratulated him in their speeches. The children felicitated him by giving different types of vegetable in a vessel, adorning him with a ‘ponnada’ (a white cloth with golden lining) and a cap made of areca nut leaf. After the felicitation the farmer delivered a formal speech on farming methods, its importance, general aspects of farming-the seasons, types of crops he cultivates during each season and the methods he follows “that he is involved in farming for 62 years, started the occupation at the age 10 along with his father, agriculture was the traditional occupation of his family, he learned the techniques and skills from his father and grandfather; cultivates paddy, different types of vegetables such as long beans, cucumber, brinjal, bitter gourd, ladies finger, also tapioca, yam etc, followed by a elaboration on the season to start each crop, care needed, fertilizers used etc. He also elaborated upon the variety of paddy seeds available in the local market and the paddy seeds he chose to cultivate”

6.6 Socio Cultural Dimensions of the Classroom

The important factors that contributed to the socio-cultural dimension of the science classroom were the teacher student interaction, peer group interaction and gender interaction. This section look at two aspects of the classroom interaction i.e. teacher-student and gender interaction.
6.6.1 Teacher Student Interaction in the Middle School

Children in the classrooms observed were relaxed and participated in the classroom processes actively. Teacher maintained a positive relationship with students. During classroom sessions teachers paid attention to the whole class of students. All the discussions that happened in the classroom during the teaching and learning were between the teacher and the whole class of children; also it was teacher initiated and directed. There was no individual monitoring from the teacher during the classroom process to examine task done by the child or the learning difficulties faced by individual children. But at the end of every topic teacher corrected the science note book, science diary, seminar and project report of every child. The teacher interacted with individual children outside the classroom, whenever they wanted to be listened too, to talk about their problems, or share any interesting aspects with teachers. In all the classroom observation, the teacher guided and controlled the learning sequence and process.

What was observed in the classrooms was that all discussions that took place were initiated by the teacher. Generally children didn’t ask questions or initiated discussions, but contributed actively to the discussion which the teacher initiated. During the classroom session there were questions from teacher that were directed to the whole class and also to the individual child in the class. The nature of the questions asked by the teacher was either yes/no questions or cued questions. Few questions elicited naming examples or everyday instances. But very few of the questions were open ended or that tried to elicit children’s conceptions, ideas or experiences. Questions were also not directed at asking children to provide their own explanations or to speculate on reasons why. Examples provided by them were used to further the objectives of the lesson as decided. Teacher took in to account the responses from children and proceeded with the discussion focusing on the content of the textbook or the content she wanted to teach. Thus the teacher had a particular curricular objective in mind to be achieved for every classroom session; all the activities and discussion of the classroom was structured to achieve this objective.

6.6.2 Gender Interaction

Gender segregation existed in the classroom processes of all grades between girls and boys with respect to the seating arrangement of the classroom which governed who the children interacted or worked with in the classroom. During
classroom observation in the middle school it was also noted that teacher paid more attention towards the boys; as they continuously sought her attention/help, through out the discussion and classroom activities; also discussion in the classroom happened between the boys and the teacher. In every class there were a few boys who were very active, also considered to be better at doing physical tasks and who got chances to assist the teacher for conducting experiments; bringing the equipments from the lab etc. Boys were also seen to dominate verbal exchanges that happened between the teacher and children in the classroom. The boys, who were active in the class shouted the answers, raised their hands for a chance, waited impatiently by continuously calling the teacher and insisted on a chance to share their ideas. It was also noted that there were few girls in every class who also attempted to shout the answers to the teacher, though the teacher took in to account their ideas for the discussion, the boys seemed to be competitive and whenever she spoke they seemed to deviate the teacher’s attention towards themselves.

6.7 Discussion

The efforts and teaching learning process of the above science classrooms have shed some light on the challenges and opportunities of building constructivist and project-based science curricula and classroom that accommodate everyday world of the child, and support inquiry-based teaching and learning in schools. The range of pedagogic strategies which were a part of the curriculum and pedagogy was impressive in terms of the range of experiences it provided for children and the opportunities it gave to bring in the relationship with everyday life experience.

One of the major constraints noted towards the implementation of the new mode of pedagogy was the strict time tabling of the school time in to 45 minutes sessions which had to be strictly followed by teachers. This constrained science teaching according to an inquiry or new mode that required grouping children, distributing materials or taking children out of the classroom, conducting discussions, etc. Every inquiry or exploratory mode of learning requires its own time depending on the nature of the activity.

What was noted in terms of the physical setting of the classrooms were that though the curriculum emphasized on a classroom with seating arrangement that must facilitate active and democratic participation of the child where children
and teacher can work in groups, use of various concrete materials etc. the present science classrooms were not configured according to these requirements of a constructivist classroom. The classroom didn’t have ample space or logistics required to conduct activities, or the classroom wasn’t suited for a constructivist classroom where children and the teacher could work in a format that makes better interaction possible.

The manner in which the state of Kerala implemented the new curriculum through a systematic, rigorous and compulsory in-service teacher training program is noteworthy. The process of implementation of the curriculum to the classroom, coordinating with various bodies from the state level to the individual school level can be considered as a remarkable achievement. Teacher training helped the teacher to plan the classroom teaching and processes; also plan each unit of the textbook prior to teaching. This eventually helped teachers to implement the curriculum objectives in a systematic manner; also structure the classroom activities in discussion with their colleagues and sharing ideas or classroom experiences with each other. The sessions trained teachers on every aspect of pedagogy, also to teach science in the classroom keeping strict adherence to the processes suggested in the teacher’s sourcebook and contents of the textbook. The training sessions demonstrated to the teachers how to conduct science classes through activities and experiments and they acquired a prior understanding of materials required, method of setting up an experiment and how to introduce content in the classroom through activities and experiments. Thus it contributed towards preparing the teachers for the classroom teaching, to implement the new curriculum and to use the handbook. Teacher training programs also attempted to enhance teacher’s understanding of the new constructivist and student centered pedagogy. It also helped in transforming their attitudes towards children.

What can be noted is that when the teacher handbook scripted the classroom processes for the teacher, the teacher training session trained the teacher regarding the manner in which the script to be followed. Thus every aspect of the classroom process was controlled and predetermined by the curriculum designers and implemented systematically through a teacher handbook and a rigorous and compulsory teacher training processes. This in a way constrained teacher’s own independent approach or thinking towards the science teaching in the classroom which put the agency and role of the teacher in question.

What can also be noted in the case of Kerala model of curriculum development is that, curriculum was devised at the state head quarters by team
of experts and disseminated to schools via directives, guidelines, and teacher handbooks and enforced through resource people visiting and monitoring the classroom processes, checking children’s science diaries, seminars reports, projects, answer sheets, evaluation sheets etc. The curriculum developers specified the knowledge and skills required to implement the new curriculum and imparted them in teachers through rigorous in-service teacher training programs that were made compulsory for every teacher. The curriculum was spelt out in remarkable detail in the teachers handbook that provided lesson by lesson directions, manner of conducting every activities, experiments, projects, seminars and manner of evaluation, in an effort to render curriculum ‘teacher proof’ (Hodson & Barnett, 2004). This made the role of the teacher to that of a ‘performer’, who job was to perform according to the script, teach in a way prescribed by others and asses students learning in a way that is designated by others. This approach has been called as the “Engineering model of change” (Elliot, 1994 in Hodson & Barnett, 2004) which Hodson’s paper illustrates as the tradition and model that existed during the 1970’s “The Engineer designs a system which will fulfill certain precise function or goals, and then supervises its implementation. The plan enables the engineer to control the process of development by communicating his/her requirements to the workforce, and providing criteria for monitoring and supervising progress” (Elliot, 1994)

Observations of the science classroom and discussions with the two middle school science teachers suggested that both of them were in consonance with the spirit of the new curriculum and pedagogic methods.

What was observed in the middles school science classrooms as evident from the classroom episodes, for each class the teacher had a fairly clear lesson objective. The structure, content and process of the science classrooms and discussion adhered to content, examples and structuring of content of the textbook and directions of the teacher handbook. The classes were structured to introduce the topic, conduct a demonstration to introduce concepts and then move on to discussion with children about the important concepts. As was seen in the episodes children’s contributions were invited to close ended answers that related closely to the objectives of the lesson and the phases of the lesson. Other observations of children were not engaged with. The teacher came in to the classroom with the materials required for conducting the experiment and she had a predetermined plan regarding the concepts that needs to be introduced during the session. Hence whole of the classroom activity was structured and
sequenced towards achieving this plan of the teacher. The answers from children are taken as prompts to continue/enrich the discussion that was within the content of the lesson. Also involving all the children of the class didn’t appear as essential. The discussion of the classroom happened mostly between the boys and the teacher. Girls were almost quiet during the whole of the session. The answers came from boys and these were children who were active in almost all the sessions observed in the grade.

Of all the instructional strategies that were recommended, the ones that the middle school teacher was found to employ were four: —demonstration, discussion, projects and seminars. In the classroom process, even those focusing on activity/demonstration primacy was given to teaching the content, and the activity was treated as a method for making the content realistic and interesting. The practical activities were done in the classroom to note down observations, make phenomena more real, interesting and connected to the everyday world-materials and instances, and reinforce content of what is to be taught. Teacher initiated, controlled and directed the discussions that happened in the classroom, and discussions were structured around the content. The children responded to the teacher initiated discussions. Teacher tends to begin the class by asking questions to the whole class and then move on to teaching through demonstration or explanations. Given the emphasis and orientation of connecting everyday life to the content of science, the teacher invoked everyday world examples while teaching the topic. The textbook flow was designed to begin by drawing familiar example from children’s everyday life which the classroom and teacher also followed. The materials that were employed for the experiments and activities were familiar materials chosen from the child’s everyday world. Towards the end teachers emphasized the important conclusions that the children need to remember from the experiments. Also while activities were being conducted by the teacher, children knew what they were expected to write in textbook tabular column or notebook, which was a general format followed for all lessons. Hence it was not explicit in teacher’s instruction about when the children should make notes in the tabular columns of the textbook or write in the notebook. The process was understood by children from the previous lesson. In all classroom episodes, we noticed several references to everyday experiences of children being invoked by the teacher.

In the science classroom teaching and learning was structured around the textbook and teacher handbook, it mainly focused on transaction of the content
of the textbook in a manner as described by the teacher handbook. Though activity based teaching was accepted as a method for science teaching and learning and was dealt in a significant manner in the textbook, it has not been translated in to a meaningful or authentic manner in the classroom practice. The science classroom treated the activity as having a particular outcome and conclusion and the activities were done as a simple proof to establish the facts. Activities were used as a way of verifying the ideas or principle given in the textbook rather than as a means for open ended investigation. Students learning happened through watching demonstration. In the science classroom experiments were initiated and demonstrated by the teacher and textbook, the students mostly observed the demonstration. Even if they were doing independently they followed the instruction provided by the teacher and textbook that directed children which particular observations to focus on and the inference was also told to them.

The activities chose materials that were familiar for children or those were from everyday world. The use of familiar everyday concrete materials or examples gave contextual meaning to the science experiments and content. Teacher described and explained the experimental procedure in great detail while demonstrating. The tabular column provided in the textbook gave all details that had to be observed. Thus while doing a demonstration the content of the textbook was translated in to a set of physical activities by the teacher. In doing all this, the teacher was following a script or recipe while doing science classroom activities. Textbook decided the content to be taught and hand book decided mode of transaction. There was little autonomy for teacher. Every activity conducted in the classroom and examples used by the teacher were the ones given in the textbook and the handbook scripted the conduction of classroom processes for the teacher. Thus we can say that science classroom processes were heavily scripted and the invoking of everyday was predetermined by the handbook and textbook. The teacher followed the scripts of the handbook.

In the science classroom episodes what we noticed was the use of everyday materials to introduce the concepts that were exclusive to the domain of science i.e. materials such as sugar, water etc was invoked and used in the context of a science classroom to introduce concepts such as ‘elements’ or ‘liquid pressure’. Thus everyday familiar world of the child was recontextualised in the context of a science classroom. What can also be noted is the translation of classroom activities, experimental procedure, conclusions and discussions in to a written format in a notebook which was
the manner through which children were integrated and trained to the technical language and vocabulary of science. Moreover while converting these to a written format everyday example, concepts and language was being ‘recontextualised’ to that of language and procedures of science.

The project and seminar were methods employed by the science classroom to reinforce the content of the units by relating it to an application or everyday phenomenon. The projects did engage children with investigations of their everyday life and this was a valuable source of connecting with the world around. However, the units in which there were such projects seemed to be limited to the topics that dealt with STS related units (health, agriculture, environment) and less with those which may be classified as ‘basic science’. None of the chapter on fundamental or basic science in middle school grades had project. What can be noted in the case of the seminar was that it was also conducted for topics related to environment, health, and agriculture. What is to be thought over is whether teaching of fundamental science through project method is difficult to achieve or what kind of preparedness it demands from the teacher, textbook and curriculum.

In science classrooms there seemed to be many opportunities for teachers to draw upon children’s everyday experiences through her questions. This was seen in demonstrations, even lectures and in project mode etc. The range of activities in the science classroom was impressive and the seriousness with which they were conducted by the teacher was also commendable. But at the same time it must be noted that the examples were used to further the objectives of the lesson and thus used in more circumscribed ways. Children were not invited to speculate on theories and reasons very much.

One of the aspects that need to be reexamined in the present science classroom is that of engaging learners in meaningful/authentic scientific inquiry that will also introduce children to the fundamental concepts of science by relating it to the everyday world of the child. The investigatory approaches were employed more in environmental related, socially relevant topics that can be generally categorized under STS. The topics tend to prepare children who are aware of the environmental problems, who also know ways to find solutions for the problems.

In classroom observations, there was no attempt made to accommodating instruction to an individual child—accommodation that takes into accounts the experiences and knowledge of the individual child. Another aspect that was noted
was appropriating students’ knowledge as an integral part of instruction was missing. Also invoking children’s prior knowledge was totally absent in any of the classroom observation which is the marked characteristic of science learning as advocated by constructivist science curriculum.

While it was noted that the classroom environment was on the whole supportive, the gendering of the classroom is also an important aspect that must be noted.

This chapter provided an overview of the classroom processes and showed how the objectives of the lessons in basic science provided an overarching constraining framework within which teachers had to negotiate the invocation of the everyday. In the next chapter I will be presenting children’s understanding of matter based on the tasks that were provided to them and the interviews that were conducted.