CHAPTER V

DATA ANALYSIS AND INTERPRETATION

5.0 Introduction
The present chapter aims at the analysis and interpretation of the data collected to find out how far the stated objectives of the study have been realized. The information collected from various sources (presented in chapter IV) in two phases of the study has been analyzed in this chapter under two sections as given below:

5.1 Student teachers and learners participation in constructivist classroom on environmental themes
5.2 Student teachers and learners' perceptions about Constructivist Approach to Environmental Education

In section 5.1, data regarding student teachers and learners’ participation in the constructivist classroom on environmental themes has been presented in three subsections, 5.1.1, 5.1.2 and 5.1.3. In the subsection, 5.1.1 data regarding student teachers changing perspectives about environmental concepts has been analyzed and presented. In the subsection, 5.1.2 data regarding learners changing perspectives about environmental concepts has been analyzed and presented.

In order to present the real picture of the interaction, among student teachers and researcher in the teacher training class and among learners and student teachers in the school class room, for identify the misconception of the student teachers and learners exact verbatim have been used in Tamil and transcribed into English in this thesis without any editing and hence some sentences may appear grammatically incorrect.

In the subsection, 5.1.3 data regarding student teachers use of a constructivist approach to teach environmental concepts during practice teaching has been analyzed.

In section 5.2, data regarding student teachers and learners' perceptions about the use of constructivist approaches in learning environmental concepts has been analyzed.

5.1 Student teachers and learners’ participation in Constructivist classroom on Environmental themes
The data regarding student teachers and learners’ participation in the constructivist classroom on environmental themes has been presented in three subsections, 5.1.1, 5.1.2 and 5.1.3.

5.1.1 To study student teachers changing perspectives (conception) about
environmental concepts in the constructivist classroom.

5.1.2 To study learner changing perspectives (conception) about environmental concepts in the constructivist classroom.

5.1.3 To study the application of constructivist teaching methods and strategies by student teachers while teaching environmental concepts in their classroom during internship programme.

5.1.1 To study student teachers changing perspectives (conception) about environmental concepts in the constructivist classroom.

In the subsection, 5.1.1 (a) data regarding student teachers changing perspective about environmental concepts has been analyzed and presented. The data were collected by employing various methods and sources such as collaborative learning, enquiry learning and problem based learning (Appendix: A). The theme-wise analysis of the student teachers’ data is presented below.

5.1.1.1 Theme: House

Participants: First Year student teachers

Approach / Method: PBL

PBL problem:
In your village due to natural calamity 5 houses were completely destroyed. Consider that you are an expert in the field of construction work. The district administration requested you to give suggestions to make temporary shelter and later making permanent arrangement for affected people. Your suggestion is expected to include the following areas.

(a) Type of house
(b) What kind of basic facilities the house includes in it.
(c) What measures are to be done in constructing safe buildings
(d) Cost involved

Description of Classroom process:
The PBL problem is introduced in the classroom by providing photocopies of problem for all the groups. From few groups student teachers were asked to read the problem aloud and the researcher asked if any group has difficulty in comprehending the problem
it can be addressed. After this the student teacher groups started discussing the problem in their respective group.

During the group work the researcher visited each group and interacted with student teacher about the progress of group work. Each group worked with their own pace. Therefore, the content of researcher’s interaction with each group varied depending on the group’s progress. However, the researcher interacted with the individual groups during the progress of group work and whole class interaction at the end. Henceforth, researcher interaction with student teachers is presented after the group work.

**Group Work**
Different student teacher groups’ varied in their view on a solution for the problem. The amount for constructing a permanent house group varied from Rs. 10,000 to two lakh rupees. Similar type of house which need to be constructed for affected people varied from slanting roof houses with cement / iron sheet roof to concrete houses. Groups also suggested the need for natural calamity warning system and informing public about protecting themselves during calamities. However most of the group had a similar view to having basic facilities such as water, electricity, toilet facilities in the houses which is planned to be constructed. The synoptic view of group work (translated) is presented in the appendix A1.

**Researcher Interaction with student teacher groups**
The researcher interaction with the student teachers during group work centered on the similarity to the group work, except one group discussed about why houses in the hilly areas are not constructed very tall? The student teachers viewed that it is because, “hilly areas cold is a little bit more, if cold is heavy and house is little bit higher (taller) then it is difficult to stay there” and “During rainy seasons soil erosion (Land slide) happens”. During the discussion the student teacher’s initial expression shown equating the term soil erosion with landslide, but during further discussion another student teacher used the term landslide.
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Concept Maps:
While comparing pre and post concepts of student teachers, it is observed that there was a considerable change in their understanding of the concept House.

In pre-concept maps
Individual student teachers generally depicted one or many of the following concepts: types of houses, various ways in which different types of houses get affected / destroyed, things required to make various types of houses, general use of a house. There were other concepts such as electricity and water connection, use of bricks for brushing teeth, painting etc., were connected with house concept. However, some student teachers concept maps (Figure 5.1) lacked linkages between concepts.

In post-concept maps
Student teachers generally depicted few of the following concepts: types of houses, specific advantage and disadvantage of each type of houses, various natural calamities and types of houses which can sustain impact of specific calamites, things required for construction of different types of houses, different houses with economic value, life of different types of houses, types of houses in different geographical locations such as coastal area, plains and hilly areas, process of construction of different types of houses and measures to be take care for protecting different houses. In the post concept maps (Figure 5.1) the linkages between concepts were clear in many student teachers.

Self and Peer Assessment:
Only one group submitted the rubric of self and peer assessment. Out of five members in the group three were submitted their assessment rubric. All the three members rated low the fourth member’s performance against the specified statement. The group generally rated everyone engagement as good against each criteria. However one member engagement was indicated as fair and few aspects such as encouraging others, cooperation, making suggestion to group work rated as poor. One of the members was not participated in the group work, therefore not assessed. None of the members made use of rubric for self- assessment even though the researcher asked to do so.
Figure 5.1: Pre and post concept maps on the theme of house

Analysis
In this theme, even though replacing of new concept with the old concept (misconception) did not occur explicitly during researcher interaction with a student teacher, but the cognitive structure of the concept is widened. This can be observed from the student teachers’ pre and post concept maps. The student teacher interaction in groups helped them to widen the conceptual understanding. The improvement in linkages among the concepts in post concept maps also shows the rejection of some of the ideas attached to the concepts. One of the concept maps of a student teacher is presented above (See all the concept maps on various themes in the soft form (DVD) attached).

The pre-concept map depicts house as a major concept, the process of making a house and basic facilities are connected directly with the major concept. The post-concept map shows types of houses, various natural calamities and types of houses which can get affected by them. In the post-concept map the linkages between concepts are clearer than the pre-concept map. The synoptic view of group work (translated) is presented in the appendix A1.
5.1.1.2 Theme: Health and Hygiene

Participants: First Year student teachers

Approach / Method: PBL

PBL problem:
You have two articles with you regarding Anganwadis and Nutrition deficiency among Indian children.
Assuming you are a team of nutrition related experts, planning to give suggestions to the government. Your report is expected to address

(a) Nutrition requirement with respect to different age groups
(b) Which are the different nutrition available in different food items
(c) Amount of food requirement for children of different age groups

Your team is expected to keep in mind that different raw food material available in different seasons and economic aspects while preparing the report.

Description of Classroom process:
The PBL problem is introduced in the classroom by providing photocopies of problem for all the groups. From few groups student teachers were asked to read the problem aloud and the researcher asked if any group have any difficulty in comprehending the problem it can be addressed. After this the student teacher groups (Figure 5.2) started discussing the problem in their respective group. During the group work the researcher visited each group and interacted with student teacher about the progress of group work. Each group worked with their own pace. Hence, the content of researcher’s interaction with each group varied depending on the group’s progress. During the PBL problem on house, student teachers' group discussions (Figure 5.3) mainly relied on their own experiences, textbooks and what they read in newspapers etc. However, in this theme student teachers used their own experiences, textbooks, newspapers, IGNOU material on health and hygiene, hospital brochures on immunization schedule, growth record, development card of children etc.
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Figure 5.2: Photographs shows the Student teachers, first year, of group E are in discussion on health and hygiene.

Figure 5.3: Student teacher (first year) groups are in discussion on the issue of health and hygiene.
The student teacher took more time to complete this PBL problem. The student teachers discussed various aspects in their group and made their report.

**Group Work**

The structure of group work of some student teacher groups varied from PBL structure suggested as they accommodated more information. So the synoptic view of group work (**appendix A2**) also changed accordingly. Each group written work varied from 5 to 28 pages, the synoptic work only indicates the concept / title.

Most of the groups work indicated the daily nutritional requirement of different age group with the relevant food items, nutrition requirement (protein, vitamin, carbohydrate, fats and minerals) their functions and possible diseases on their deficiency and nutritional requirement of infants, children and pregnant women. Group works also includes growth and malnutrition, food habits, protection from mosquitoes, the importance of breast feeding, low-cost nutrition rich food items, seasonal foods and fruits, food chart with calorie value, preventive measures to deficiency diseases and plan of a balanced diet. However, some groups work indicated specific information on blood group, genes, functions of chromosomes, Ribonucleic acid (RNA), Body Mass Index (BMI) etc. The synoptic view of group work (translated) is presented in the **appendix A2**.

**Researcher Interaction with student teacher groups**

The researcher’s interaction with the student teachers during group work was centered on the similarity to the group work. However, at the end of group work, the researcher asked each group to make their presentation of their group work to the whole class. After each presentation student teachers from other groups, researcher raised questions / sought clarification from the presentation group. During this some of the perspective changes were observed. They were:

“For removing black colour of skin donkey milk is fed”

“Black dog blood also people feed it to babies .... for immunity power”

“If we take blood from monkey and inject into our body, we also become monkeys”

“acid rain ... is artificially made”

**Classroom Interaction on For removing black colour of skin donkey milk is fed and Black dog blood also people feed it to babies .... for immunity power**
The first two student teachers conceptions were based on the cultural practice and belief system. Even though the student teachers belief from cultural practice agrees feeding donkey milk to infants changes the skin colour, they accepted that it don’t have any scientific proof. This created disequilibrium in their conceptual understanding.

The researcher’s interactions with student teachers are given below.

**R:** What is the benefit of giving donkey’s milk to children?

**S.T1:** It has more immunity power sir.

(S.T2 wanted to say something, but S.T3 interrupted with loud voice)

**S.T3:** When we take the olden days there is a disease called karruputhavappu usually affected children. To cure it, donkey’s milk was given to children.

**R:** What disease?

**S.T3:** Kaurpputhavappu

**R:** Is it a disease?

**S.T3:** When child developing in the womb it is there. When a child is born when we see the child is looking little black. It is like; when poison is mixed with blood how body colour will go black, like that. For removing that black body colour donkey milk is fed. When we feed it the colour change little bit, little bit starts crying and or baby activities/behavioural change observed (during this time S.T4 beating S.T3, both were very close friends and they always make joke and laugh in the class silently) after birth and later child grown there is a good change.

**S.T5:** Black dog blood also people feed it to babies. They asked me to give it. They said it is useful for immunity power. Along with donkey milk, this also they asked to feed to babies. Cutting black dog’s ear and take the blood and give.

(Some of them showing annoyance by listening this)

(There was noice)

**Chorus:** There won’t be any scientific relevance.

**S.T6:** If the native doctor (Nattuvaithiyar) is there in our village we can consult him.

**R:** What do you think?

**S.T3:** We don’t think it has some scientific proof, but that is what people believe.

**S.T5:** People do that, now it is coming down, but it is a practice

**R:** No. Do you think, feeding of donkey’s milk will change the skin colour?

**S.T3:** I don’t know. But people believe it.

**S.T5:** Sir, Children skin colour slightly changes frequently when they are infants. I am not sure, whether it changes skin colour. But it is in practice.
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Classroom Interaction on acid rain … is artificially made

The second student teachers conceptions were based on the lack of conceptual understanding. The peer interaction in the whole class situation clarified the misconceptions.

S.T1: Rain also is sometime poured as acid rain, because chemical factories release \( \text{H}_2\text{SO}_4 \) (sulfuric acid) gas it mix with rain and becomes acid rain. When it fall on earth plants gets affected and if it rain at sea, living creatures in the sea also affected by this.

S.T2: She said about acid rain. It is artificially made. Naturally rain….

S.T1: (interrupts)

R: Wait, wait, wait… what do you think about acid rain?

S.T2: We are creating that. We can create rain. For that some chemical is there (he wanted to say chemical name but while uttering it sounds as reason) if we put that then we get rain. If we see in cinema there are rain situations; we can produce artificial rain.

Natural rain does not contain any pollutants. We can keep it clean and drink that water. We cannot get any effect from that. But the artificial rains there are so many effects.

S.T3: Artificial rain is different and acid rain is different.

S.T2: Then, what is the difference?

(S.T2 and S.T1 both wanted to say)

R: Wait a minute mam. (some student teachers laughing in the class)

S.T4: Say S.T3

S.T3: Artificial rain means on dry snow (ularpani when we spray) potassium iodide, we get it. Acid rain means…….

R: Wait a minute he wanted to say something.

S.T5: Sir, rain naturally pours. But when the poisonous gas in the air mixes with rain, the natural rain becomes acid rain.

R: Where from the poisonous gas comes?

S.T5: By burning gas

R: You wanted to say something. Say..

S.T1: That type of poisonous gas is present. From chemical factories more chemicals; more CFC from refrigerator comes, because of those ozone layer become a hole. These are all because of chemical reactions. The same way the factories which produces \( \text{H}_2\text{SO}_4 \) (sulfuric acid), the gas coming from the factory mixed with air and becomes \( \text{SO}_2 \) (sulfurdioxide) that becoming acid rain and pour into the earth and sea; plants and
aquatic plants and animals gets affected by this. When we see, due to ozone hole the sunrays fall into a human, because of that many skin diseases it makes.

R: What do you think?
ST2: Initially I thought both are same (acid rain and artificial rain)

Concept Maps:
While comparing pre and post concepts of student teachers it is observed that there was a considerable change in their understanding of the concept Health and Hygiene. However, the very minimum number of student teachers submitted both the concept maps, it is difficult to make conclusive inference for the whole class.

In pre-concept maps individual student teachers generally depicted one or many of the following concepts: various types of foodstuffs, nutrients and its importance, deficiency diseases, the impact of environmental pollution on health, different parts of the human body etc. However, some student teachers concept maps lacked linkages between concepts.

In post-concept maps student teachers generally depicted few of the following concepts: various types of foodstuffs, nutrients and its importance, impact on health by use of insecticides on food crops, balanced diet, health and exercises, nutrient rich food stuffs and organs of the human body. In the post concept maps the linkages between concepts are clearer than the pre-concept maps.

Self and Peer Assessment:
Out of nine groups six groups were submitted the rubric of self and peer assessment. Most of the student teachers from various groups rated their peers as good or excellent against different aspects indicated in the rubrics. Few teachers rated their peers as fair, good and excellent. However, within the group there is no internal consistency on low rating of any particular member. None of the members made use of rubric for self-assessment.

Analysis:
In this theme, replacing of new concept with the old concept (misconception) did occur explicitly during the whole class discussion between researcher and student teacher groups (refer researcher interaction with student teacher groups in the previous pages). The student teachers’ interactions show (i) the role of cultural practice and belief system in forming an individual conceptual understanding. The student teachers positioned
themselves the tension between the cultural practice / belief vs scientific truth, and conceptually inclined towards the scientific truth. (ii) The impact of lack of conceptual understanding of meaning making of other related concepts. The synoptic view of group work (translated) is presented in the appendix A2.

5.1.1.3 Theme: Soil

Participants: I Year Student Teachers

Approach / Method: Brain Storm, collaborative problem solving, Inquiry Learning

Context:
During the discussion on a previous theme on Nutrition requirement it was expressed that use of fertilizer in agriculture led soil to become infertile. As most of the student teachers are from village and agricultural background, the researcher felt that it is appropriate to discuss ‘soil’ as a theme. The researcher initiated the discussion by posing a question on what do they know / understand about soil.

Description of Classroom process:
The researchers’ question driven the class in a brainstorming mode and student teachers expressed their ideas on soil. Gradually the discussion moved on to student teachers critically looking into each other’s ideas and conceptualizing their understanding of soil. The discussion has also led to an inquiry activity on water holding capacity of various soils and their nature. The concepts discussed during the discussion were soil & earth; soil fertility; water holding capacity of various soils.

Student teachers’ interaction - Whole class Discussion:
During the whole class interaction student teachers expressed some of their misconceptions and it was addressed by the peers in a collaborative discussion. The misconceptions were:

“Soil is earth”

“Naturally it (soil) was made by god..... With full protection, God made this”

In both the cases other student teachers’ contradicted these ideas. Through discussion these misconceptions were addressed.

During the whole class discussion a student teacher raised a question that,

“If we take a rock and grind it into small-small minute pieces and make it as a soil, in that soil if we sow a plant, will it grow or not?”

“Why did rock soil have less water holding capacity?”
The classroom interaction for the first misconception is given below.

*Classroom discussion on – Do plant grow in rock soil:*

This led to further discussion and brought the understanding on nutrient present in the rocks.

**S.T1:** Sir, They are saying that soil came from rock. If we take a rock and grind it into small small minute pieces and make it as a soil in that soil if we sow a plant, will it grow or not?

(Few others talking with low voice)

**R:** Oh! Good question? Listen...

**S.T2:** Which question sir?

**R:** If we break rock into soil, will a plant grow or seed germinate in that soil?

**S.T3:** No it won’t grow.

**S.T2:** It will grow.

(Some discussion)

**S.T1:** They are saying that from rock, soil comes, and plants don't grow in that, then, how plants grow in that soil?

**R:** That is a question!

**S.T2:** It will grow... From rock also sometimes plant grows.

**S.T1:** *(interrupts)* we had an experience. When we put a bore, the soil (rock powder) came out. You know this soil came from a rock. We planted a plant in that soil, but the plant didn’t grow.

**S.T3:** It won’t grow sir.

**S.T4:** It will grow sir.

**S.T1:** It didn’t grow.

**S.T4:** It will grow.

**S.T1:** No.

**S.T4:** Because it is artificial.

**S.T3:** Whether soil comes from artificial or nature but it had come from the rock only.

**(S.T5 wanted to say something)**

**R:** Just a minute, I think he asked a nice question. Very good. Say mam,

**S.T5 & S.T6:** The soil come from rock had to decompose *(magganum)*.

(A big laugh in the class)

**R:** How it decomposes?

**S.T7:** With bacteria like living creature.
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S.T2: The things from water.
S.T6: Plant, tree or creepers after drying, it gets decomposed.
R: Do you say plant came before soil?
S.T6: No sir.
(RS – Recording stopped)
R: The plant did not grow in the soil (rock powder) that came while drilling borewell?
S.T7: Soil has to break. (Here he intended to say decompose, but he used the word break)
R: For decomposition what we need do?
S.T7: We don’t need to do anything. It naturally happens through decomposition by a living creature.
S.T1: From (He begins, meanwhile Shali interrupts)
S.T6: The soil comes from Rock, has that remained in the same place? No. it has not. During rain it floats from one place to another. When it mixes with the soil in that new place it receives nutrients. That is how plants grow.
R: Yes mam. So you are saying that the soil is already present?
S.T6: No sir, Plants might have been destroyed. Those nutrients mixed with the soil. So that is how plants grow.
R: For soil formation, do you want to say; already at that place plant might be present in dry and decomposed form?
S.T6: No sir, (laughing)
S.T2: She says how plants decompose that she explained.
S.T8: Sister, how plant decomposes?
S.T1: (says something in a low voice)
R: (with a smile and little laugh), another person want to say, let us listen,
S.T9: Sir, it was said that soil had come from Rock. The soil which came from Rock, if we plant a seed immediately will it grow? or has it grown? Does anybody know that?
R: Look, here he had an experience of his own. It didn’t grow.
S.T10: After soil formation, several thousand years later only living creature come into existence. If we see that way, the soil which just formed from rock, if you take that soil and we plant the plant, in that case no plant grow.
S.T1: We planted only after 10 months.
(There are a noise and discussion in the class)
S.T8: It requires several thousand years.
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S.T2: (laughing loudly) ha ha, ha…
S.T1: If rock breaks, whether plant grow or not?

(Again noise, everybody answering)

S.T2: Sir, you take land soil (Kollamannu) and rock soil (Paaraimannu). See which one
has more salt (she intended to say nutrients).

R: Raise your hand, if you want to say something (towards student teachers)

S.T1: Do the soil that we get from rock have high / low water holding capacity? When
you see it

(A word from class comes low – before he completes)

S.T5: Low

S.T2: Low.

S.T1: Why? You are saying that soil has more water holding capacity. Why did which
came from rock soil have less water holding capacity?

S.T8: The decomposed soil has more water holding capacity
(Padhapaduthapattamunnikkueerappathamaathigam)

S.T1: Why? What do you mean by decomposed soil?

S.T2: Yes. How many times it rains in the soil and how many living a creature
(jeevarasigal) dies that become fertilizer.

(Continues)

S.T2: Due to that minerals are obtained in the soil and by that plant grows.

S.T1: (interrupts)

R: It is a very good discussion. Good.

During the whole class discussion the researcher also discussed about finding
acidic and basic nature of the soil. But the elaborative discussion on this did not happen.
Similarly making a group drawing on student understanding of the concept “soil” was
done before and after the observation. Devising the plan of activity for water holding
capacity was not discussed on the same day. The activity was carried out in a
demonstration mode by student teacher in the class. (Due to some problem in cassette
recorder the classroom interaction was not recorded) However, through the researcher’s
field notes it was observed that the student teacher did not have any difficulty in devising
the activity plan during the classroom discussion. The researcher’s interaction with
student teachers in whole class discussion along with a synoptic view of group work is
given in appendix A3.
Student teacher groups conception of top soil:
The student teacher groups were asked to make a drawing of top soil based on their previous understanding. Later student teacher groups were asked to make the drawing by observing the top soil outside the classroom. Out of nine groups six groups made both the drawings is given in the table 5.1.

Table 5.1: Drawings of top soil by different groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Before observation</th>
<th>After observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td><img src="image" alt="Before B" /></td>
<td><img src="image" alt="After B" /></td>
</tr>
<tr>
<td></td>
<td>Stem, leaves, unripe &amp; ripen fruits, small stones, insects and worms were there.</td>
<td>Small pieces of grass, ants, and small stones were seen. The colour of the soil was brown and less amount of moisture observed.</td>
</tr>
<tr>
<td>D</td>
<td><img src="image" alt="Before D" /></td>
<td><img src="image" alt="After D" /></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Before D" /></td>
<td><img src="image" alt="After D" /></td>
</tr>
<tr>
<td>E</td>
<td><img src="image" alt="Before E" /></td>
<td><img src="image" alt="After E" /></td>
</tr>
<tr>
<td></td>
<td>Lime stones, leaves, feathers of hen, stone powder (norambu), small stones of different colour, small sticks etc.</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>Before observation</td>
<td>After observation</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------</td>
<td>------------------</td>
</tr>
<tr>
<td><strong>F</strong></td>
<td><img src="image1.png" alt="Image" /></td>
<td>In top soil ants, leaves, ant’s food, smaller sticks, plants, grass, stones were present.</td>
</tr>
<tr>
<td><strong>G</strong></td>
<td><img src="image2.png" alt="Image" /></td>
<td>Dried grass, small stones, insects, dried leaves, sticks, ant, cow dung and glass pieces. The soil was of brown in colour.</td>
</tr>
<tr>
<td><strong>H</strong></td>
<td><img src="image3.png" alt="Image" /></td>
<td>Small stones, earth worms, worms which are present in manure, ants etc. Dried grass, small stones, weeds, insects, ants, pieces of paper and dried leaves. The soil was of brown in colour.</td>
</tr>
<tr>
<td><strong>I</strong></td>
<td><img src="image4.png" alt="Image" /></td>
<td>Microbes, worms, plants, grass, earth worms, snake, frog, centipedes, small stones, wastes, small bricks and leaves. Ants, small plastic and iron pieces, broken bangles, coconut shells, seeds, leaves, small sticks, cow dung, small bricks, stones and paper pieces.</td>
</tr>
</tbody>
</table>
Student Teacher groups’ observation on soil nature, water holding capacity of coconut farm and dam area soils:

The student teacher groups’ experience of soil nature and water holding capacity of coconut farm (sandy soil) and dam area (alluvial soil) is drawn from their group work. Things used: Two transparent glasses, two similar coconut shells with equal size holes at the bottom, two pieces of the same cloth, dam and coconut farm soils and water.

Arrangement: Equal amount dam and coconut farm soil taken in the coconut shell covered with cloth. One glass of water poured into each of the soil. The student teacher groups observed in soil nature (texture, size) by touching it, and water holding capacity of the soils.

Soil Nature:
All the groups observed that coconut farm soil is of pieces of bricks, small stones and texture of the soil is hard and most of the group observed that the soil is of brown colour. On dam soil most of the group observed that soil is soft / smooth texture but having some small stones and more of finer particle. Most of the groups observed that soil is about coffee color and few groups observed that it is the red color.

Water holding capacity:
All the groups observed that coconut farm soil absorb the water quickly and at the same time drain it out quickly than dam soil. The water holding capacity of coconut farm soil is less than dam soil. The groups also observed that the drained water of coconut soil is more or less clear whereas, dam soil is of muddy water.

Concept Maps:
The researcher asked the student teacher to make the concept map on land in the beginning. For the present theme the pre and post concept map of the same is used. At instances, in post map few student teachers used soil / earth as a major concept. While comparing pre and post concepts of student teachers it is observed that there was a considerable change in their understanding of the concept soil - land.

In pre-concept maps individual student teachers generally depicted one or many of the following concepts: land, minerals, various geographical landscapes, water sources, soil, soil types, soil erosion, water, crops, air, industries, various pollution, earth, earth layers, planets and living things. However, student teachers concept maps lacked linkages
between concepts. They try to bring as many concepts but fail to connect related concepts in a logical manner.

**In post-concept maps** student teachers generally depicted few of the following concepts: Earth, various geographical landscapes, earth and moon rotation, earth resources (land, water, living), minerals, layers of earth, various types of soil, soil formation, soil erosion, various industries, mineral resources, fossil fuels, environment, bio-sphere, crops, life forms and various types of pollutions. In the post concept maps the linkages between concepts are clearer than the pre-concept maps. However, all the concepts were not logically connected.

**Self and Peer Assessment**
Out of nine groups six groups were submitted the rubric of self and peer assessment. Most of the student teachers from various groups rated their peers as good or excellent against different aspects indicated in the rubrics. Few student teachers rated their peers as poor, fair, good and excellent. However, within the group there is no internal consistency on low rating of any particular member. None of the members made use of rubric for self-assessment.

**Analysis:**
In this theme, the replacing of new concept with the old concept (misconception) did occur explicitly during researcher interaction with student teachers. The student teachers’ interactions showed the impact of lack of conceptual understanding of a particular concept on meaning making of other related concepts. It was also observed that student teacher’s posed question to others to get clarity on concepts. Further it is also observed that the student teachers’ cognitive structure of concept soil and land widened. This can be observed from researcher interaction with the student teachers and the student teachers’ pre and post concept maps. The student teacher interaction in groups helped them to widen the conceptual understanding.
5.1.1.4 Theme: Water

Participants: 1st Year Student Teachers

Approach / Method: PBL

PBL problem:

Recently Tamil Nadu Government decided to start a project through which it can bring water from Hogenakkal to Dharmapuri and Krishnagiri districts. The same way in our nearby places such as Vaniambadi and Ambur the water scarcity is a common phenomenon. What are the reasons for two situations? How to approach these situations and address the problem? Your team is expected to discuss these issues in detail and submit a report.

Description of Classroom process:

The PBL problem is introduced in the classroom by providing photocopies of problem for all the groups. From few groups student teachers were asked to read the problem aloud and the researcher asked if any group have any difficulty in comprehending the problem it can be addressed. After this the student teacher groups started discussing the problem in their respective group. During the group work the researcher visited each group and interacted with student teacher about the progress of group work. Each group worked with their own pace. Hence, the content of researcher’s interaction with each group varied depending on the group’s progress. During this PBL problem student teachers group discussions mainly relied on their own experiences. The student teachers discussed reasons for water scarcity and made their report.

Group Work

Most of the student groups could identify industrial effluents the major reason for the scarcity of water in one of the context i.e., water scarcity at Vaniambadi and Ambur. However, most of the groups failed to identify the major reason for the new water project for neighboring districts. There was a wide coverage of information in the past in newspapers about the fluoride presence in the ground water and increasing number of people get affected by thyroid related problem. The student teacher groups indicated other common reasons such as cutting of large number trees on road side during expansion of highways in the recent years, experiencing less rain fall over a period time, conversion of water bodies and rivers into cultivation area, excessive plastic use preventing rain water percolation into earth, rising average temperature, casual approach
of public on use of water, geographical location of Vaniambadi and Ambur falls leeward side of the mountain etc. A group made an observation that due to mixing of industrial effluent into river lead to reducing the fertility of nearby land thereby reducing yield. Hence, this acts as a push factor for people who were involved in agricultural activities switching to industrial (tannery) jobs for their livelihood without any choice, even by knowing they will get diseases by doing that.

Most of the group work indicates the solution for this problem could be rain water conservation and rain water harvesting by constructing new dams, lakes, ponds and rain water tanks. Groups also indicated that, preventing or treating industrial effluents before releasing it. Some of the groups indicated need to control sand mining from rivers, planting more number of trees, developing habit of judicious use of water, use of waste water for agricultural purposes, ground water irrigation, etc. It was also observed that one of the group linking of rivers as solutions. Some groups indicated the desalination and even family planning could be a solution. It was observed that most of the groups did not include their understanding of the problem in the post whole class discussion. The synoptic view of group work (translated) is presented in the appendix A4.

**Researcher Interaction with student teacher groups**

The researcher’s interaction with the student teachers during group work was centred on similar to the group work except few situations. One of the group expressed that constructing public places like bus stand on water bodies’ in towns lead to water scarcity. In another occasion a student teacher had an understanding that geographically proximal places have similar nature of water. The interaction is presented below.

**Classroom Interaction on - geographically proximal places have similar nature of water**

R: Yes S.T1, you want to say something.

S.T1: Is Hokenkkal water is salty?

S.T2: No. No. There the water is in good condition.

S.T1: If water is good and drinkable in Hokenkkal means it is also to be good in Dharmapuri.

R: Why?

S.T1: Because it is near to Dharmapuri.
S.T2: The water not yet brought to Dharmapuri. The people use the water which was already there. Hokenekkal water is good sir. Because it is river water and it comes from different places and it is ‘Mooligai’ (a water contains mooligai – *Ayurvedic content*) water, so it is good. If it is filtered and used, it will be good.

R: Hmm, I see. Do you think (S.T1), the ground water in Dharmapuri and river water are of similar nature?

S.T1: No sir. I got it.

R: mm.

After the group work the researcher engaged whole class discussion to develop a common understanding on the issue. During this the fluoride presence in ground water of Dharmapuri district is made explicitly known to all groups along with other aspects.

**Concept Maps:**

While comparing pre and post concepts of student teachers it is observed that there was a considerable change in their understanding of the concept Water.

However, the very minimum number of student teachers submitted both the concept maps, it is difficult to make conclusive inference for the whole class.

**In pre-concept maps** individual student teachers generally depicted one or many of the following concepts: various water bodies, the various purposes for which water is used, the importance of water for various life forms, pollution of water bodies, water borne diseases etc. However, student teachers concept maps lacked linkages between concepts.

**In post-concept maps** student teachers generally depicted few of the following concepts: Various water bodies, the various purposes for which water is used, water cycle, the importance of water for various life forms, pollution of water bodies, water borne diseases etc.. In the post concept maps the linkages between concepts are clearer than the pre-concept maps.

**Analysis:**

In this theme, even though replacing of new concept with the old concept (misconception) did not occur explicitly during researcher interaction with a student teacher, but the cognitive structure of the concept is widened. This can be observed from researcher interaction with the student teachers and the student teachers’ pre and post concept maps. The student teacher interaction in groups helped them to widen the
conceptual understanding. However, the group work indicates that the most of the groups worked on the problem at surface level than the deeper understanding. This was happening because the student teachers were getting ready for the practice teaching with preparation of lesson plans and getting it approved by subject teachers etc.

5.1.1.5 Theme: Energy Resources

Participants: II Year Student Teachers

Approach / Method: PBL

PBL problem:
Today, India as a developing economy needs more energy for sustaining the environment for economic development. At the same time some of the energy resources are depleting very fast in the world. We are living in a complex situation where on one side energy requirement is increasing and on the other side depleting energy resources.

Your group is expected to prepare a report on
a. What are our energy resources?
b. How do we get energy from our energy resources?
c. Which energy sources are at a risk of getting exhausted?
d. What are the other alternative energy resources?
e. Benefits and adverse effects of various types of energy resources

Description of Classroom process:
The PBL problem is introduced in the classroom by providing photocopies of problem for all the groups. From few groups student teachers were asked to read the problem aloud and the researcher asked if any group have difficulty in comprehending the problem it can be addressed. After this the student teacher groups started discussing the problem in their respective group.

During the group work the researcher visited each group and interacted with student teacher about the progress of group work. Each group worked with their own pace. Hence, the content of researcher’s interaction with each group varied depending on the group’s progress.

During this PBL problem student teachers group discussions mainly relied on textbooks, newspaper information and their own experiences.
Group Work
Most of the group works indicated that energy sources such as coal, petrol, and diesel are in a depleting condition. The groups work indicated solar energy could be a solution for the problem. Groups also suggested wind energy, mooligai petrol and bio-petrol from sugarcane were of alternative sources. The group works also indicated that locations in which hydroelectric, thermal and atomic power stations situated and how we make use of those energies, its advantage and adverse effects and how to avoid wasting of energies. Even though groups appear to have understood the problem (from first table ‘what you know ‘column of PBL format (Table 2.1)), two groups group work indicates on different types of energies instead energy sources. The student teachers of few groups had a misconception that, (i) in dam water flow from the above fall on the wires and due to the rotation of wires electricity generated (ii) depletion of energy sources due to irregular rains which affects growth of trees and affects the coal production. The synoptic view of group work (translated) along with GroupWise analysis is presented in the appendix A5.

Researcher Interaction with student teacher groups
The researcher’s interaction with the student teachers during group work some of the misconceptions were observed among few groups. They were:

“Space related experiments happening in Thermal & Atomic power stations”

“In dam, due to (turbine) rotation water becomes water vapour”

“The water comes from a height with speed and force, from that through rotation......... Water comes fast and when water comes with force the rotation speed of string will increase”

“Thermal power station means; if we heat gases in higher temperature, when we make that passes through machines and machine works”

“Hydroelectric power stations........ Where water falls down from the higher places it produces the high pressure. When it touches the machine, due to water and machine friction electricity is produced”

“Dirty water can be used to produce electricity. Through pure water we cannot get electricity”

“The gases come out from the coal burning through that electricity is produced”

To remove all these misconceptions researchers had a whole class discussion in post group work. The researcher’s interaction with the student teachers in the post group work is given below.
Whole Class Discussion

R: How electricity is generated from hydroelectric stations?

S.T1: Through turbine electricity is generated

R: How?

S.T2: When water falls from the tall place the spring kept at the bottom starts rotating due to water force.

R: Is it spring or turbine?

S.T3: Turbine sir

R: Someone said that using dirty water we can generate electricity?

S.T4: Yes sir. Due to salty water we can generate electricity.

R: Can’t we generate electricity through good water?

S.T4: Yes sir. We can’t

S.T5: No sir. Mettur hydroelectric power station is there. It is not salty water.

S.T4: It is not good water sir

Chorus: It is good water

R: Ok. Ok. Why do you say that from good water we can’t produce electricity?

S.T4: I read somewhere sir

S.T3: No sir. Pure water won’t conduct electricity. But we can produce electricity.

S.T4: Is it?

S.T3: Yes sir

R: Let us come back to the main question, how is electricity generated using water?

S.T5: The water from higher place fall on the turbine with force. Due to this force turbine starts to rotate; the turbine is connected with big motor through which electricity is generated.

R: How?

S.T5: We can run the motor through electricity or we can get electricity through by running the motor

R: Is it motor or generator?

S.T5: mm...

S.T3: sir probably it is generator

R: How do you say that?

S.T3: In cinema theatre when power cut happens they use a generator. That’s why only I said so.
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R: Yes it is generator. Ok. What is the difference between motor and generator?
(Silence)
R: Motor converts electrical energy into mechanical energy and generator converts mechanical energy into electrical energy. So what happens in the case of hydroelectric generation?
S.T5: The turbine is connected to a generator and the generator converts that mechanical energy into electrical energy.
R: What happens in thermal power stations?
S.T6: The gases coming out from coal burning is used to generate electricity
R: Is it?
S.T6: Yes sir
S.T5: Like rail engine, the water is boiled with burning coal and, from the water vapour electricity generated
R: Is it? How?
S.T7: The gases coming out of coal burning are passed to the machine, so machines works
R: Is it?
S.T7: Yes
R: Anyone else?
(Silence)
R: What he (S.T5) said is right. While burning coal the heat energy converts the water (in the water pipe) into vapour. When the water vapour with high pressure comes to contact with the turbine, makes the turbine to rotate. Then through the generator electricity is generated. Ok?!
S.T3: Sir is atomic energy also is generated same way?
R: Yes. Instead of coal, in atomic reactors Uranium is used. Through nuclear fission heat energy generated, this is again converted into mechanical energy through the turbine and electricity generated. What do you think about wind energy?
S.T3: It is simple sir. Through wind the blades rotate, so the mechanical energy converted into electrical energy using a generator.
R: Yes.


**CHAPTER V**

**Concept Maps:**

While comparing pre and post concepts of student teachers it is observed that there was a considerable change in their understanding of the concept Water.

**In pre-concept maps** individual student teachers generally depicted one or many of the following concepts: various energy sources (solar, water, wind, fossil), use of various energy sources, various forms of energy etc. However, student teachers concept maps lacked linkages between concepts. They try to bring as many concepts but fail to connect related concepts in a logical manner.

**In post-concept maps** student teachers generally depicted few of the following concepts: Various sources of energy, sources through which electricity generated, various forms of energy, uses of electricity, various uses of fossil fuels, electricity generation from sources and change in the forms of energy, process of electricity generation from various types of power stations, solar appliances, various types of power stations through which electricity generated from different sources of energy, excessive use of energy its impact on environment, renewable and non-renewable energy sources etc. In the post concept maps the linkages between concepts were clear than the pre-concept maps. However, all the concepts were not logically connected.

**Self and Peer Assessment**

Out of nine groups seven groups were submitted the rubric of self and peer assessment. Most of the student teachers from various groups rated their peers as good or excellent or fair against different aspects indicated in the rubrics. Few student teachers rated their peers as poor, fair, good and excellent. However, within the group there is no internal consistency on low rating of any particular member. In one of the group all the members rated 0 (1 – poor) for one of the member. During interaction with the student teachers it was found that the student teacher who was rated as 0 by peers was never been participating or engaging any of the activity in the group. The student teacher made use of rubric for self-assessment. Generally student teacher rated themselves as equal to others. However, in one case the student teacher rated very low (poor).

**Analysis:**

In this theme, replacing of new concept with the old concept (misconception) did occur explicitly during the whole class discussion between researcher and student teacher groups (refer researcher interaction with student teacher groups in the previous pages).
The researcher’s interactions with the student teachers’ show the impact of lack of conceptual understanding of meaning making of other related concepts. The change of conceptual understanding of energy generation lead to widening of cognitive structure is observed through post-concept maps where student teachers are able to connect the various concepts in a logical manner. During the pre-concept map some of the student teachers draw concept maps of individual energy sources and its uses separately. In the post-concept map, they could connect all these, and some of them could able to depict process of electricity generation, kinds of energy transformation occur during electricity generation from different energy sources etc.

5.1.1.6 Theme: Environmental Problem

Participants: II Year Student Teachers

Approach / Method: PBL

**PBL problem:**
In today’s urban life environmental pollution becoming an important problem. You are an expert team in the area of environmental issues. Your group is expected to analyze the reasons for environmental pollution in the town and provide suggestion for the Municipality- measures to be taken to face the problem. You are also expected to prepare reports for the public on their role in reducing the environmental pollution.

The learners worked in groups and interacted / discussed and prepared the report. During their group the researcher interacted with them and some of the excerpts of these are given below.

**Description of Classroom process:**
The PBL problem is introduced in the classroom by providing photocopies of problem for all the groups. From few groups student teachers were asked to read the problem aloud and the researcher asked if any group have difficulty in comprehending the problem it can be addressed. After this the student teacher groups started discussing the problem in their respective group.

During the group work the researcher visited each group and interacted with student teacher about the progress of group work. Each group worked with their own pace. Hence, the content of researcher’s interaction with each group varied depending on the group’s progress.
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During this PBL problem student teachers group discussions mainly relied on textbooks, newspaper information and their own experiences.

**Group Work**

Most of the group work of student teachers indicated that land pollution, water pollution, air pollution and noise pollutions were the major problem for people living in urban area. However, very few group contextualized the problem. The other specific problems observed by some of the groups were traffic congestion, adulteration of fuels, deforestation, water stagnation and contagious diseases. The group works also gives a detailed sketch of various pollutants, peoples practices and factors (like population growth) which lead to land, water, air and noise pollution, the impact of pollution on human health, agricultural productivity etc.

Groups made various suggestions to government bodies in terms of sewage line, industrial pollution control measures, waste management, reaching people through the mass media on various environment friendly practices and local bodies monitoring of people’s basic necessities. Groups also made various suggestions to common public on how to keep the environment clean by their practices. However, very few groups had made these suggestions to the target groups (government bodies and public) specifically. Most of the groups’ suggestions were general in nature. The synoptic view of group work (translated) along with group wise analysis is presented in the appendix A6.

**Researcher Interaction with student teacher groups**

The researcher’s interaction with the student teachers during group work some of the misconceptions were observed among few groups. They were:

“It (natural fertilizer) will give more yielding. Like the olden days (AdiKaalam), by using natural fertilizer we can cultivate”

“By keeping Pugaipokey (chimney) in higher height. There won’t be any air pollution”

When student teacher groups’ made a brief presentation on their group work the following misconception was observed.

“If the blood of AIDS, if it fell on us, due to that AIDS will come….. blood mixed with onion and those who ate panipoori all were got AIDS”

The first two misconceptions the researcher addressed it in the group itself. The last misconceptions researcher had a whole class discussion after the student presentations.

The researcher interaction with individual groups and whole class is presented below.
Classroom Interaction on - natural fertilizer will give more yielding

R: You have written that by using natural fertilizers, we can stop the land pollution. Is there any specific advantage of that?

S.T1: Yes. It will give more yielding. Like the olden days (AdiKaalam), by using natural fertilizer we can cultivate.

R: If it gives more yielding, then why do we use artificial fertilizers?

S.T1: Modern times, due to increase in Industries, everything…..

S.T2: People needs.

S.T3: Population explosion is continuously increasing so all people don’t get food. For that we have to produce more food items according to their needs.

S.T2: For quick growth of the crop and for good yielding.

R: But, you have written that natural fertilizers give more yielding.

S.T2: It is not like that sir. Olden days less number of people and large land area and people use to cultivate longer period crops. For example, in rice there are varieties which take 6 months time and there are varieties that take 3 and half month. These days we do not cultivate 6 month varieties much.

S.T3: Due to chemical fertilizers, soil quality reduces. Because of that food quality reduces. It is not like olden days food, the nutrition is reduced. Due to that human life span reduced.

R: What do you think S.T1?

S.T1: Yes sir, natural fertilizer provides quality food products.

Classroom Interaction on - By keeping Pugai pokey (chimney) in higher height. There won’t be any air pollution

R: Ok. You have written that by keeping the tall chimney (Pugai pokey), we can control air pollution. How?

S.T1: Effects

S.T2: (interrupts) Sir, if the place where no chimney (Pugai Pokey)

S.T3 (interrupts): Sir, Air density is more in lower area. When we go higher and higher the air density is very low. Because of that if we keep fire chimney (Pugai Pokey) very height, we are breathing air in lower height only. We are not breathing air from higher height. We breathe only lower O₂ only. Due to that they keep Pugai pokey (chimney) in higher height. There won’t be any air pollution.

R: Is it so?
S.T3: Yes sir.
R: Do you mean there won’t be any air pollution?
S.T3: Yes
R: Have you seen burning the wastes in the land after cutting the sugarcane?
Chorus: Yes
R: While burning if you are near to that place, how do you feel?
S.T2: Lot of smoke and hot. We feel suffocated
R: Fine. If you are a little distance away, how did you feel?
S.T2: Little better
R: Why?
S.T2: Because the smoke is not there
R: Why?
S.T3: No sir. Smoke is there, but when we go distant the smoke level reduces.
R: Why?
S.T3: Because it spreads and it becomes less concentrated
R: Yes. When the smoke spreads the concentration becomes less. When industries use taller chimneys the impact of air pollution get reduced. It is not completely gone.

**Whole Class Interaction on – AIDS**
The researcher was not sure on “Spreading of AIS through accidently having panipoori where the presence of blood drops of AIDS patient”. Therefore during this interaction the researcher did not make any clarification on the issue.
R: Someone said an interesting incident on AIDS. So I just wanted to know, what are reasons for getting HIV?
S.T1: Through Injection (with low voice) i.e. if the syringe is not in hygienic there is a possibility of getting.
S.T2: If the mother is affected by AIDS; then it will affect the child also.
R: mm.
S. T3&S.T4: improper sexual intercourse.
(There is a noise)
S.T5: By mosquito biting.
S.T6: It won’t spread by mosquito biting (laughing)
S.T4: It won’t come by mosquito da.
R: Listen
S.T4: Why sir? Will it spread through mosquito?
R: See here.
S.T7: Sir, if the blood of AIDS, if it fell on us, due to that AIDS will come.
R: mm.
S.T7: You know people sell panipoori. If they had AIDS (full laughing in the class) while they cutting onion it was in the newspaper. While cutting onion, their finger unknowingly cut by knife (here it means not completely cutting somewhere the knife scratched the finger) that blood mixed with onion and those who ate panipoori all were getting AIDS. When doing research on this, they finally reached the panipoori person and identified he had AIDS.
R: mm. So even HIV blood if it fell into food and if it enters to body we will get AIDS. She had said that even if HIV person blood unknowingly mixes with our food and we consume it we will get AIDS.
S.T6: AIDS is not a thothu disease
S.T8: It is a disease to spread through the blood.
R: mm…
S.T9: There is no chance at all to happen like that.
R: Do you want to say; is there no chance to happen like that at all?
S.T7: Like that already happened,
S.T3: It is already happened sir.
S.T7: Those two people.
S.T3: No four people.
S.T6: Sir, the blood which comes from hand due to cutting is mixed with onion; we know $O_2$ and gas present in blood, so it may be live 2 days.
S.T7: Those two brothers and sister had AIDS. But their parents don’t have AIDS. When doing research on how both these brother and sister got AIDS, two of them daily go to the beach for walking, during that time they buy and eat panipuri everyday. Because of the owner of that panipuri stall had AIDS, they got AIDS like that research report said.
(A lot of noise due to everyone discuss with others)
S.T10: It is said that, the virus come out from the blood that moment it will die, then how they might have been getting AIDS?
R: mm
S.T3: The virus dies when it comes out from blood.
R: The virus comes out from blood or body, the virus will die, like that he says… take this as a hypothesis and find the answer for it by reading books and other resources

S.T3: Why AIDS is not spreading through mosquito means, during mosquito bites when blood enters to mosquito stomach the virus dies so through mosquito it didn’t spread.

S.T7: When we see panipooori, they did not use onion for fry. They directly use it. So the viruses in the blood are alive. Up till blood gets dried the virus always alive.

R: mm

Researcher tried to get the answer to this question by consulting local primary health centre physician, internet sources, and informed the student teachers that the chances of getting affected by AIDS of this nature is practically rare. In a later stage, the researcher could get the news item (referred by the student teacher) from the internet about the issue. It is given in the box 5.1.

Concept Maps:
The researcher asked the student teacher to make the concept map on the environment in the beginning. For the present PBL problem the pre and post concept map of the same is used. While comparing pre and post concepts of student teachers it is observed that there was a considerable change in their understanding of the concept Environment.

In pre-concept maps individual student teachers generally depicted one or many of the following concepts: Living and non-living, classification of living things, environmental pollution (land, water, air and noise), pollution control, environmental protection, human activities which leads environmental pollution (industries, transportation, individual practices), importance of non-living things for living things and impact of environmental pollution on living things (human, animals and plants).

In post-concept maps student teachers generally depicted few of the following concepts: Biotic and abiotic factors, environmental pollution (land, water, air and noise), various ways environment getting polluted, its impact and the solution to the environmental problems, classification of animals based on what they eat, environmental protection, human activities which leads environmental pollution (industries, transportation, individual practices), importance of non-living things for living things and impact of environmental pollution on living things (human, animals and plants).
Box: 5.1

Can one get AIDS by consuming food contaminated with blood?

Tuesday, 04 July 2006
Answered by: Dr. L.M. Nath
Consultant, Community Medicine,
New Delhi

Q. I recently read a news citing a case in Mumbai. The news said that a 10-year old boy ate panipuri about 10 days ago and fell sick. Later when he got a health check up done, the doctors diagnosed that he had AIDS. His parents couldn't believe it. The entire family underwent a check up, but none of them were suffering from the same. The doctor then asked the boy, whether he had eaten out and the boy mentioned that he had panipuri one evening. The hospital team went there to check and found that the panipuri seller had received a cut on his finger while cutting onions and his blood had spread in the food. When the doctors checked his blood, they found that he too was suffering from AIDS but was not aware. Is it possible to have AIDS by eating food contaminated by blood of an AIDS patient? This news had spread panic among the people and created more stigma among the masses regarding AIDS. Please highlight the various modes of spreading of the virus.

A. It is extremely unlikely that HIV would be spread in the way you have described. Firstly the volume of blood ingested (even if it did occur) is likely to have been very small. Secondly while consuming HIV positive blood can theoretically give rise to HIV infection, it is not very likely. Thirdly, and most importantly, given if the child did get infected, in 10 days he would still be in the window period and the usual tests would not have picked up the infection. Please also note that single tests are quite likely to give wrong results due to false positive reports. Single tests do not have any diagnostic value and must always be confirmed by a second test.

Read more at: http://doctor.ndtv.com/faq/ndtv/fid/9204/Can_one_get_AIDS_by_consum ing_food_contaminated_with_blood.html?cp
In the post concept maps the linkages between concepts are clearer than the pre-concept maps. However, all the concepts were not logically connected.

**Self and Peer Assessment**

All the nine groups were submitted the rubric of self and peer assessment. Most of the student teachers from various groups rated their peers as good or excellent or fair against different aspects indicated in the rubrics. Few student teachers rated their peers as poor, fair, good and excellent. However, within the group there is no internal consistency on low rating of any particular member. In one of the group all the members rated 0 (1 – poor) for one of the member. This was observed in earlier problem too. The student teacher made use of rubric for self-assessment. Generally student teacher rated themselves as equal to others. However, in one case the student teacher rated very low (poor).

**Analysis:**

In this theme, the replacing of new concept with the old concept (misconception) did occur explicitly during researcher interaction with student teachers. The student teachers’ interactions show the impact of lack of conceptual understanding of a particular concept on meaning making of other related concepts. It is also observed that the student teachers’ cognitive structure of concept environment is widened. This can be observed from researcher interaction with the student teachers and the student teachers’ pre and post concept maps. The student teachers interaction in groups helped them to widen the conceptual understanding.

**5.1.1.7 Theme:** Imaginary Lines

**Participants:** II Year Student Teachers

**Approach / Method:** Brain Storm, collaborative problem solving

**Context:**

During the discussion on AIDS related topic, a student teacher raised a question that, “What is polar region? Is there any life exist?” The Researcher redirected the question to the whole class. The subsequent brainstorming session led the researcher to engage the student teachers to explore their understanding of the following questions:

- How latitude and longitude divide the earth? (Explain with diagram)
- Explain the impacts of earth’s movement (rotation and revolution)
CHAPTER V

- We can see only one side of the moon. Why?
- How does earth’s revolution around sun with 23\(^{1/2}\) degree inclined axis have an impact on seasons in the earth?
- Does sun rotates on its axis?
- How do eclipses occur?
- What are waxing and waning?
- Explain on heat and time zones
- Explain the temperature conditions at polar region and equatorial line area.
- Locating India in heat and time zones

**Description of Classroom process:**

The student teachers were engaged in group task to develop a write up to answer the above question. The following misconceptions were observed among the student teachers during researcher’s interaction with them.

“Moon’s one side only we can able to see….Because moon is not rotating. It is static”
“Sun won’t rotate by itself”
“When the earth rotates by itself….. season occur”
“From our earth to some length (distance- in atmosphere) temperature getting reduces (nammaboomilairundukonja length varikkumveppamkuraindhuthanirukkum) Why because due to gravitational force”

After the group work the researcher had the whole class discussion session to clarify these concepts. During whole class discussion these ideas were not explicitly expressed. This may be due to peer interaction among the student teachers from other groups as well as in the initial period researcher made some efforts to clarify these concepts by explaining them about longitude and latitude concept through blackboard as well as globe. Most of the student teacher groups had a view that due to moon non-rotation one could able to see only one side of the moon. This is observed by the researcher during the interaction with the groups as well as group works. The whole class discussion is presented below.

**Whole class discussion**

R: While interacting with you all, I could see varying responses on how seasons occur, why we could see only one side of the moon, does atmospheric temperature is depend on earth gravitation, eclipses and seasons. Let us sum up our ideas. I have just begun with a question, how day and night happens?
S.T1, S.T2 and S.T3: Earth rotation by itself makes day and night.
S.T2, S.T4: Sir, Sunlight fall only one side of the earth; that side day the other side is night.
S.T5: Earth rotates around the sun. But the sun is in the same place. (He explains with a ball) earth is rotating this side (A) it is day; when it moves to this side then it is night.

R: I have drawn what I understood from what you have said, According to you, when the earth is east side of the sun it is day and when it is moved to west it is night. Is it right?
S.T5: Correct sir.
R: What do you think? (Addressing class)
(Silence)
S.T6: Day and night happen due to its rotating by itself. Not sun. When it revolves around the sun it will take 365 days. Leap year means 366 days.
S.T2, S.T3: It will take a year to revolve the sun.
R: S.T5, What do you think?
S.T5: Yes.
R: Good. How does season occur?
S.T2: Due to earth revolution around the sun season occurs.
Chorus: Yes sir
R: Is it only due to revolution around the sun is reason for seasons?
Chorus: Yes sir
S.T7: No sir. Earth’s 23 ½ degree tilted axis is the reason.
R: Ok. Can you explain?
S.T7: Sir earth rotates in 23 ½ degree tilted axis and at the same time revolves around the sun. So one part of the earth gets more light than another part.
R: Which part?
S.T7: Sir, if it's upper side (northern hemisphere) gets more light it will be summer season there. But the lower side that time winter season will prevail.
R: Is it?
S.T7: Yes sir
R: Others, What do you think?
CHAPTER V

S.T2: Yes sir
S.T8: In the book also it is written the same.
R: Yes. Due to earth rotation with 23 ½ degree tilted axis, when it revolves around the sun its position changes at different point of time with respect sun rays. So some time sun rays fall straight to earth surfaces varies with 23 ½ degree Northern to 23 ½ degree Southern latitude. When sun rays fall straight in 23 ½ degree North, the day time in northern hemisphere more than the normal and experience summer. During that time the southern hemisphere experience winter. Ok.
S.T2, S.T8 and S.T7: Yes sir
S.T9: I understand it, but at the same time I am not getting
R: What is it you are not getting?
S.T9: I will read books and I will ask sir
R: Ok. We can see moon’s one side only. Why?
S.T10: Because the moon for its own rotation and revolving around the earth takes same time. It is 27.5 days
R: Yes, it takes 27.3 days. When does solar and lunar eclipse happen?
S.T11: When Moon is placed between Sun and Earth in a straight line solar eclipse occurs.
R: Is it?
S.T11: Yes Sir
S.T12: Sir, on that day it needs to be New Moon Day
R: Yes. Ok. What about the lunar eclipse?
S.T13: It is when Earth is placed between Sun and Moon in a straight line and full moon day, lunar eclipse occurs.
R: Good. I think we could understand all these.
S.T7: Certain extent sir.
R: That’s right. Once again go through the textbook and ask if you have any further difficulties.

But during a whole class discussion most of these misconception was not observed. During the whole class discussion student teacher accepted the fact that the season occurs due to earth revolves around the sun with its 23 ½ degree tilted axis. However, most of them could not comprehend the idea due to its complexity of visualization. This was expressed by some of them which can be seen in the whole class discussion. The
researcher’s interaction with student teachers during group work as well as a whole class discussion along with a synoptic view of group work is given in appendix A7.

**Concept Maps:**
As the theme emerged accidently the researcher could not have the concept map on this topic. However, the student teacher concept maps on earth included these concepts into it. For the present theme the pre and post concept maps of the same is used. While comparing pre and post concept maps of student teachers it is observed that there was a considerable change in their understanding of the concept earth (including concepts of this theme).

**In pre-concept maps** individual student teachers generally depicted one or many of the following concepts: earth, solar system, biosphere, hydrosphere, atmosphere, components of the biosphere, various seasons, soil, soil formation, earth rotation on its axis and revolution around the sun, the moon revolution around the earth and the water cycle. However, student teachers concept maps lacked linkages between concepts. They tried to bring as many concepts but fail to connect related concepts in a logical manner.

**In post-concept maps** student teachers generally depicted few of the following concepts: Imaginary lines, latitude and longitude, earth rotation on its axis and revolution around sun, seasons, biosphere (lithosphere, hydrosphere and atmosphere), biotic and abiotic factors, minerals, moon rotation on its axis and revolution, eclipses, solar system, layers of earth, full moon and new moon days, sources (fossil fuels and others), disasters, stars, renewable and non-renewable sources and water cycle. In the post concept maps the linkages between concepts are clear than the pre-concept maps. However, all the concepts were not logically connected.

**Self and Peer Assessment**
All the nine groups were submitted the rubric of self and peer assessment. Most of the student teachers from various groups rated their peers as good or excellent or fair against different aspects indicated in the rubrics. Few student teachers rated their peers as poor, fair, good and excellent. However, within the group there is no internal consistency on low rating of any particular member. In one of the group all the members rated 0 (1 – poor) for one of the member. This was observed in all the earlier problem too. The student teacher made use of rubric for self-assessment. Generally student teacher rated
themselves as equal to others. However, in one case the student teacher rated very low (poor).

**Analysis:**
In this theme, the replacing of new concept with the old concept (misconception) did occur during researcher interaction with student teachers. The student teachers’ interactions show the impact of lack of conceptual understanding of a particular concept on meaning making of other related concepts. It is also observed that the student teachers’ cognitive structure of concepts related to imaginary lines is widened. This can be observed from researcher interaction with the student teachers and the student teachers’ pre and post concept maps. The student teacher interaction in groups, resources helped them to widen the conceptual understanding.

**Major observations:**
During the group work the researcher visited the group and interacted with the group members. At occasions, the researcher observed some of the misconceptions / novice conceptions. Sometime the researcher addressed those misconceptions with the group interaction itself and at later stage during whole class discussion these were taken up to address if any other student teachers had similar misconceptions. However, the misconception which is observed during discussion when already recorded in the group journal by the student teachers. But they kept the group journal without corrections.

**5.1.2 To study learners changing perspectives (conception) about environmental concepts in the constructivist classroom.**
In the subsection, 5.1.1 (b) data regarding learners changing perspective about environmental concepts has been analyzed and presented. The data were collected by employing various methods and sources such as cooperative learning, problem based learning, enquiry learning and field visit (Appendix: B). The theme-wise analysis of the learners’ data is presented below.
5.1.2.1 Theme: Soil

Teacher: 1st Year Student Teachers

Participants: Learners of Grade IV in 3 different schools

Approach / Method: Inquiry Learning, cooperative learning

Theme Context:
The student teachers were trying to engage on a constructivist based classroom practices during their practice teaching program. During practice teaching four student teachers from three different schools were engaged in four activities on the concept soil through constructivist approach. The activities were:

(i) What is there in (top) soil? – This was done through children observation of top soil,
(ii) what comprises the top soil? – Bottle experiment
(iii) Water holding capacity of different types of soils
(iv) Between soil and water, which one absorbs and releases heat quickly?

Student teachers had carried out all these activities with Grade IV learners. The four activities were carried out in different schools. The fourth activity was carried out in three different schools. In total, 4 student teachers from 4 schools engaged in engaging learners of grade IV in soil related activities in a constructivist environment.

Activity 1: What is there in (top) soil? – Observation of top soil

Approach / Method: Inquiry

School: Panchayat Union Elementary School, Mel Achamangalam

Teacher: 1st Year Student Teacher (S.T)

Participants: Grade IV learners

Context:
In this activity, the student teacher wanted to know the learners’ idea (conception) on top soil.

Description of Classroom process:
The student teacher asked each group of learners to make the drawing of (top) soil (Figure 5.4) and indicate what may be present in it. The student teacher interacted with each learner group on their conception about top soil before they go for observation. Then student teacher asked the learner groups to observe the soil from outside the classroom where she marked in a particular area. After the observation she asked each
group to make the drawings of what they observed in the soil. She once again interacted with each learner group to know their observations. Learner group's drawings of top soil before and after the observation is presented below.

Figure 5.4: The photograph shows learners group engaged with top soil observation in Mel Achamangalam
Table 5.2: Learner group's drawings on top soil before and after observation

<table>
<thead>
<tr>
<th>Group</th>
<th>Before observation</th>
<th>After observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td><img src="image" alt="Image A Before" /></td>
<td><img src="image" alt="Image A After" /></td>
</tr>
<tr>
<td>B</td>
<td><img src="image" alt="Image B Before" /></td>
<td><img src="image" alt="Image B After" /></td>
</tr>
<tr>
<td>C</td>
<td><img src="image" alt="Image C Before" /></td>
<td><img src="image" alt="Image C After" /></td>
</tr>
</tbody>
</table>
The learner groups ‘drawings indicate that their initial conception of soil is of soil, stones, plants, trees, dusts, birds, house etc. The examples show their conceptions based on their experience of general observations. When they were asked to observe in a given area, they could observe other things or things which they did not think of (but they know) and the post observation drawings show new things such as small roots, sticks, dry leaves, bangles, paper pieces, fly, ant, etc. The pre-observation drawings show that there are variations among the group's conception about soil. There are indications that the learners understood the question that what are there on and above the soil “We thought whatever there on the soil like … Plants, trees”. The student teacher interaction with learners is given below.

**Whole class discussion**

**S.T:** What you have thought the things there in the soil, and what you have observed in the soil, are the same?
L1: Some are same and some are new
L2: We could think of thought whatever is there on the ground like
S.T: mm… means…
L2: Plants, trees, house like that
S.T: Ok… Is there anything which you did not think, but was present in the soil?
L2: mm
S.T: What is that?
L3: Fly
L4: Ant
S.T: You did not know these were there in the soil?
L2: No miss. We know it is there, but we did not think it would be there in the soil.
S.T: Ok.
S.T: What are the other things you did not think present in the soil, but, you observed it?
L5: Small roots
S.T: mm…
L6: Small sticks, stones
L7: Dry leaves
S.T: Ok.
The whole exercise indicates that developing observation skill among learners (through various activities) helped them widening their understanding of the concept soil. The student teacher interaction with learners during group work as well as a whole class discussion along with a synoptic view of group work is given in appendix B.

Activity 2: What comprises the top soil? – Bottle experiment
Approach / Method: Inquiry learning
School: Panchayat Union Elementary School, Mel Achamangalam
Teacher: 1st Year Student Teacher (S.T)
Participants: Grade IV learners
Context:
After completing “what is there in the soil?” The student teacher continued with another activity to make more clarity on “what comprises the top soil?” through the bottle experiment in the following week.
Description of Classroom process:
In this activity the student teacher asked learners “what could they see, when some soil is added into a bottle containing water, and shakes it and keep it for a while?”. The group wise learners’ responses were recorded. Then the student teacher took some top soil and added it to the bottle which contains water. The student teacher then shook the bottle well, so that the soil mixes with water well. She kept the bottle on a window. This was done during the last period of the morning session. After the lunch break, the learners observed the contents of bottle in groups (Figure 5.5). Each group was given around 5 minutes to observe and asked to make their notes after their observation. The student teacher assisted the groups in their observation. The learner groups made the drawings of their observation.

Figure 5.5: Learners of Grade IV observe the matters by using a magnifying glass at Mel Achamangalam
Before the activity for the question, what would they see if a handful of soil is put it in a bottle of water? The learner groups’ responses were: stone, paper, bangle, flower, bricks, soil, dust, small leaves, sand, eggshell, sticks, charcoal, ash, hair etc. After the activity the learner groups’ responses were: small stones, soil, root like thing, dirt, leave waste, clay etc. This variation is due to the learner’s idea before observation based on the previous activity and by engaging this activity they could able to get an idea of smaller things which generally they do not tend to see. During this activity student teacher made the learner realize that partially decomposed leaves (humus) and many things in the different weight presence in the soil through discussion. However, developing idea of student view on layers observed in the bottle was not enquired before the activity. The student teacher could have raised a question that, “Is there any possibility of different layers formed when soil is put in of a bottle and shacked well?” before the activity. The stage of making a student hypothesis by the learners was missed. The student teacher interaction with learners during group work as well as whole class discussion along with synoptic view of group work is given in appendix B1.
Activity 3: Soil – water holding capacity

Approach / Method: Inquiry

School: Panchayat Union Elementary School, Madavalam

Teacher: 1st Year Student Teacher (S.T)

Participants: Grade IV learners

Context:
The comparison of water holding capacity of three soils was done through the activity in the teacher education classroom while student teacher groups were engaged in soil related problem (Figures 5.6 and 5.7). As the activity was prescribed in the textbook of Grade IV, the student teacher had chosen this activity.

Description of Classroom process:
The student teacher planned to engage the learner groups in an inquiry mode. The student teacher requested the learners to bring a different type of soil in an earlier class. As the learners failed to bring the soil, the student teacher collected the soil from behind the school (appeared red), under the tree (appeared like garden soil) and from the playground soil (appeared sandy). These three sample soils were kept on the teacher’s table along with other things needed for an activity for learners observation.

The student teacher engaged the learner groups for this activity in five stages.

- Student teacher engaged the learner-groups to observe the soils and identify them with colour and make their hypothesis on soil’s water holding capacity
- Learner groups were engaged in group discussion to plan and devise a method to identify soil’s water absorbing capacity and rate of absorbing
- Whole class discussion on planning the activity (consolidation)
- Conducting the activity in demonstration mode
- Final observation and discussions
Figure 5.6: The student teacher was listening to the learner’s observation about the nature of the soil in the class (Grade IV) at Madavalam

Figure 5.7: Water holding capacity of different soil-after the activity in Grade IV at Madavalam
In the first two stages the student teacher called each learner group to the teacher’s table and interacted with them. The interaction is presented in a tabular form below. During these stages different soils were kept in the disposable transparent cup on the table. The transparent polythene cups, coconut shells, cloth pieces were also kept on the table during the individual group’s visit for observation.

Table 5.4: Activity on the theme of soil by various groups

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Groups</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Colour (Stage 1)</td>
<td>Soil 1</td>
<td>Reddish Beach</td>
<td>Red White Black</td>
<td>Red Light white</td>
<td>Red Black White</td>
<td>Red White</td>
</tr>
<tr>
<td></td>
<td>Soil 2</td>
<td>Beach Coconut</td>
<td>White Jiguna</td>
<td>White</td>
<td>Black White</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td>Soil 3</td>
<td>cover</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Soil Nature (Stage 1)</td>
<td>Soil 1</td>
<td>Nice</td>
<td>Little nice</td>
<td>Nice</td>
<td>Stony</td>
<td>Nice</td>
</tr>
<tr>
<td></td>
<td>Soil 2</td>
<td>Nice</td>
<td>Little rough</td>
<td>Stony</td>
<td>Stony</td>
<td>Little stony</td>
</tr>
<tr>
<td></td>
<td>Soil 3</td>
<td>Nice</td>
<td>Rough</td>
<td>Stony</td>
<td>Nice</td>
<td>More stony</td>
</tr>
<tr>
<td>Soil Name (Stage 1)</td>
<td>Soil 1</td>
<td>Red soil</td>
<td>Red soil</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td></td>
<td>Soil 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water absorbing capacity (order)</td>
<td>Soil 1</td>
<td>Third</td>
<td>Third (Third)*</td>
<td>Second (First)*</td>
<td>First</td>
<td>First (Third)*</td>
</tr>
<tr>
<td>(Stage 1)</td>
<td>Soil 2</td>
<td>Second</td>
<td>First</td>
<td>First (Third)*</td>
<td>Third (First)</td>
<td>Third (Second)*</td>
</tr>
<tr>
<td></td>
<td>Soil 3</td>
<td>First</td>
<td>First (Third)*</td>
<td>Second (Second)*</td>
<td>Third (Second)</td>
<td>Second (First)</td>
</tr>
<tr>
<td>Planning to find Water holding</td>
<td>Planning</td>
<td>Could not plan</td>
<td>Could not plan</td>
<td>Could not plan</td>
<td>Planning</td>
<td>Planning</td>
</tr>
<tr>
<td>capacity (Stage 2)</td>
<td>was done after</td>
<td>even after the</td>
<td>even after the</td>
<td>even after the</td>
<td>was done</td>
<td>was done</td>
</tr>
<tr>
<td></td>
<td>the discussion</td>
<td>discussion with</td>
<td>discussion with</td>
<td>discussion with</td>
<td>after the</td>
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<tr>
<td></td>
<td>with the</td>
<td>student teacher</td>
<td>student teacher</td>
<td>student teacher</td>
<td>the discussion</td>
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<tr>
<td></td>
<td>student teacher</td>
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<td>with the</td>
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<td>student</td>
<td>student</td>
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<td></td>
<td>teacher</td>
<td>teacher</td>
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</tbody>
</table>
Most of the learner groups’ could not plan the activity after the group’s discussion and so the student teacher organised whole class discussion to plan the activity. The groups could plan the activity during the student teacher interaction, actively participated in whole class discussion to devise the plan. The whole class discussion for planning the activity is given below.

Whole Class Discussion

S.T: Ok, Group B, are you ready with the plan?
(No response)
S.T: L6, can you say something about what your group discussed.
(No response)
S.T: Ok, what about Group C
L1: We will take soil in the coconut shell, I pour water into it, the excess water will go through the hole and we will collect it with glass and say which one absorbs more water.
L2: We have to place pieces of cloth coconut shell and we should put soil in it
S.T: Oh Yes. I forgot to say that
S.T: Will you take equal amount or different amount of soil to identify which one absorbs more water?
S.T: Different amount
L2: Then, how will you find which soil absorbs more water?
(No response)
S.T: Listen everyone, to find out which soil absorbs more water, do we have to take an equal amount of soil and equal amount of water or not? What do you think?
L2: If we are not taking an equal amount of each of the soil and equal amount of water, how can we find out which particular soil absorbs more water?
L2: Yes.
S.T: L1, what do you think? Other groups, what do you think?
L4: (from Group) we also initially thought different amounts because they are different soil, but later during discussion we understood that it should be the same amount.
S.T: Yes it should be the same amount.
S.T: Is the size of holes in the coconut cover are to be same or not?
L5: Same only, I observed when you were making holes with compass and nail, and threw away those coconut shells which has bigger hole.
S.T: Ok, it also needs to be same in size. So who will consolidate on what we are going to do?

L2: Sir, first we have to take three glasses and keep the coconut shell on each of it. Then placing pieces of cloth on each cover. Then we have to take the same amount of these three samples of soils and put it in different coconut shells. After that, we take equal amount of water and pour it on each of the soil. After some time, the excess water will drain out through the holes and we can see from which soil less water drains out.

S.T: Good. Can we do this on the table with one set up, as we have only three coconut covers and few cups?

Chorus: Ok sir.

After the whole class discussion the student teacher conducted the activity with the help of learners. After the activity it was found that the water holding capacity of different soils was almost same. It is because the soils were taken around the school premises. The student teacher realised that the soil was taken in and around the school from different locations. So the student teacher informed the learners that, this problem could have been avoided if the soils were taken from different places where soil is of varied nature. The student teacher interaction with learners during group work as well as a whole class discussion along with a synoptic view of group work is given in appendix B2

Activity 4: Which one absorbs/releases heat first: soil / water?

Approach / Method: Inquiry learning / cooperative group learning / whole class discussion

School: (1) Panchayat Union Elementary School, Mel Achamangalam
(2) Panchayat Union Middle School, Kalaroor
(3) Panchayat Union Middle School, Kurumbar Colony

Teacher: 1st Year Student Teachers (S.T)

Participants: Grade IV learners
Context:
This activity was prescribed in the textbook of Grade IV. In continuation with the other soil related activities, student teachers were interested in engaging this activity with their learners.

Description of Classroom process:
Even though the activity is same but all the three student teacher adopted different strategy to engage their class learners in the activity. The student teacher at Mel Achamangalam engaged whole class discussion with group wise activity, whereas, student teacher from Kalaroor engaged group wise activity and discussion after explaining the process of conducting the activity. In Kurumbar Colony the student teacher explained about how the activity to be carried out and demonstrated it. After the demonstration the student teacher tried to know the reasons from the learners.

Figure 5.8: The photograph shows an activity of “Which one first absorbs heat: Water or Soil?” Learners of Grade-IV engagement at Mel Achamangalam
Mel Achamangalam:
In Mel Achamangalam the student teacher engaged the whole class discussion to plan the activity and the activity done by learners, followed by the whole class discussion to consolidate the ideas. When the student teacher asked learners in the whole class discussion “among soil and water which one absorbs heat first?”, Some learners responded as soil and some other as water. Student teacher gave some clues to plan the activity in terms of the amount of soil and water. The student teacher engaged the learners in conducting the activity. Then learners accepted that soil absorbs heat first after conducting the activity. When the student teacher asked the learners to provide the reasons, the learners’ response was “soil gets heat first, because it gets heated and stays there and water gets evaporated and goes higher”. Later, the student teacher asked the learners “among soil and water which one loses / releases heat first?”, all the learners responded by saying water. The student teacher continued the discussion once again to plan an activity to examine which one releases heat first and engaged the learners in the activity. After the activity the learners accepted that soil releases heat first. The learners could not give the reasons for it. It is because the learners as whole, initially thought water will lose heat first. The result surprised them all.

Kalaroor:
In Kalaroor, the student teacher explained the process of conducting activities and engaged learner in conducting activity group-wise. After keeping the soil and water in the sunlight the student teacher interacted with individual learner groups to know the learners view about which one absorb and release heat first with the reasons. The learners had an understanding that soil gets heat first because it is generally there in the outside. The activity also strengthened their understanding of soil gets hot first. However, the second part of the activity except one group of learners, most of the groups arrived at wrong conclusion and stated water gets cool first. This is due to the student teacher did not visualise the need for keeping both soil and water outside to get warm. While conducting the activity learners brought back the soil and water plates when soil gets warm. As the water did not get warm in the first part of the activity, learners could not able to identify whether soil / water gets cool first. The student teacher engaged with interacting learner groups, failed to instruct / see whether water gets warm in the first part of the activity.
Kurumbar Colony:
In Kurumbar Colony the student teacher explained about how the activity to be carried out and demonstrated it. After the demonstration the student teacher tried to know the reasons from the learners. The student teacher asked the learner to provide reasons for why soil is getting hot before the water when kept in sunlight? Learner groups’ responses were “sunlight like a fire which makes soil to get hot” first than water, “water is previously cool”, “some soil from bottom moves to top and soil gets hot”, “due to its cool nature water does not get hot”, “It (soil) quickly works, But water will do slowly”. For the student teacher's question on “why soil gets cool first?” The learner group responded that “When air is blowing it loses its heat quickly. But water won’t lose its heat quickly”. Even though the activity focused on heat absorbing / releasing capacity of soil and waters, the main purpose of the activity was to bring the conceptual understanding on sea and land breeze.

In first two schools, learners had a misconception that water loses heat first. The activities conducted by learner groups gave clarity on the concept to the entire three situations. But lack of post group activity discussions and lack of organisation of activity by student teacher lead the ‘content’ less discussed and clarified. The student teacher interaction with learners during group work as well as a whole class discussion along with a synoptic view of group work is given in appendix B3

5.1.2.2 Theme: Water
Teacher: 1st Year Student Teachers
Participants: Learners of Grade I, II and Grade V in two different schools
Approach / Method: Inquiry Learning, cooperative learning, PBL
Theme Context:
Four students-teachers engaged with two different school learners on water related topics. The topics were:
(i) Water! Water!
(ii) Purification of muddy water
(iii) Rain Rain and
(iv) Improving the surrounding of the lily pond.
The first three themes were engaged in Kathirampatti school where as the last theme was held at Mel Achamangalam. The first two themes were engaged with Grade-I learners.
separately by two student teachers. The third theme was engaged with Grade-II learners. The fourth theme was engaged with learners Grade -V level.

**Topic 1:** Water! Water!

**Approach / Method:** Whole class discussion

**School:** Panchayat Union Elementary School, Kathirampatti

**Teacher:** 1st Year Student Teachers (S.T)

**Participants:** Grade I learners

**Context:**
This topic was presented in pictorial form in the Grade I EVS textbook prescribed by the Government of Tamil Nadu. The student teacher engaged the topic in a whole class discussion mode to enable children of Class I engage dialogue with the student teacher and peers.

**Description of Classroom process:**
The problem was introduced by the student teacher to *learners* in the following manner:

S.T: Babies (Kuttis) you see the pictures in the book (Showing the pictures from the book). Here, the young sparrow felt thirsty and her mother has taken her to different water bodies. The younger one did not drink water from all these (showing pictures) places and drink water from this place only. Why is it so? You have to carefully observe each picture and say what could be the reason?

Initially the student teacher tried to get the learners to recognise different water bodies. The children were able to name most of the water bodies. They could not differentiate some (like well and pond or lake and river). Wherever the children find difficulty in identifying by name, the student teacher introduced the vocabularies of that particular water body.

Once it was over, the student teacher asked children to observe carefully in each picture and tell the reason for which the younger sparrow refused to drink water. With slight initial difficulty children could identify the reasons from the picture and responded. It is also observed that few children just repeat the same answer for each water body and few children include the reasons to a particular water body by their observation. While asking the reasons for why the younger sparrow has refused to drink at well, the children said by showing well (in less distance) angaaadu, madukaluvuranga (goats and cows were given bath there – Researcher observation). They also included what they thought as the water
bodies based on their experience. For example they included the water tanker and the tap as water bodies, from where they get water.

The student teacher’s interactions with learners showing learner's imagination is presented below:

S.T: Is it so? From hand pump, how did young sparrow drink the water?
S6: That is, the mother sparrow pumps out water.

From the interaction we can observe that children could define what is good water based on their understanding. Children mixed their imagination, observation and textbook visual information to explain the reasons for why the younger sparrow did not drink water from various water resources. The belief system (existence of ghost) which they acquired from family, cultural background also played an important role in their imagination. They also interconnected the water and its importance within the existence of life.

Through their interaction among themselves along with the student teacher the children expressed themselves on their understanding on the need of clean water for life, and get to know the common ways in which water bodies get polluted. The literature also indicates that role and importance of Imagination in learning. Vygotsky stresses that imagination does not develop all at once, but very slowly and gradually. It evolves from more elementary and simpler forms into more complex ones. At each stage of development, it has its own expression; that is, each stage of childhood has its own characteristic form of creation. Furthermore, it does not occupy a separate place in human behaviour, but depends directly on the forms of human activity, especially the accrual of experience. The student teacher interaction with learners during whole class discussion is given in appendix C

*Topic / Activity 2:* Water purification  
*Approach / Method:* Whole class discussion  
*School:* Panchayat Union Elementary School, Kathirampatti  
*Teacher:* 1st Year Student Teachers (S.T)  
*Participants:* Grade I learners
Context:
In this activity the student teacher intended to make the learners to understand how water gets cleansed in a natural course.

Description of Classroom process:
The student teacher planned to keep the muddy water in a glass undisturbed for some time, so that the soil particle will go down and settle. Later the water above the soil could be separated and filtered to get clean water. To conduct this activity student teacher brought a bottle of muddy water and some transparent glasses to the class, and poured it into a glass and show to the learners. The student teacher intended to plan activities through whole class discussion. The student teacher initiated the discussion by asking the learner that, “How to purify this (muddy) water?”

The initial responses of the learners were to use a sieve to filter water. Sieve is used to filter many things, so student teacher asked for the situations where water like thing filtered through sieve. The learners gave examples of coffee filter. As the student teacher kept cloth pieces for the filtering, she filtered the muddy water through sieve. The water after filtering also had some fine soil in it. While student teacher pointing this, a student suggested the water to be thrown out and clean water is to be taken in the glass. In this context the student teacher suggested to keep the water idle for some time and the post discussion helped the learners to get the idea. The whole activity, the learners’ suggestion and discussion show that they were trying to suggest the solution from their own experience (observation of filtering of coffee at home), though the learners’ experience of their immediate environment (pond water), was not recalled by them. The student teacher interaction with learners during whole class discussion is given in appendix C1.

Topic / Activity 3:“Rain! Rain!”

Approach / Method: Whole class discussion
School: Panchayat Union Elementary School, Kathirampatti
Teacher: 1st First Year Student Teachers (S.T)
Participants: Grade II learners
Context:
The student teacher engaged the learner with the topic “Rain! Rain!”, from Grade II EVS textbook prescribed by the Government of Tamil Nadu. In textbook the topic is presented by explaining the sources from which we get water for our requirements, followed by a small story “Visit to friends” where cloud visits to its friends (water sources) and asks about their well-being. The friends expressed their difficulty of various types of water pollution.

Description of Classroom process:
The student teacher began the lesson by reciting a poem (not from a textbook) on water. In the poem she invited the rain to help to increase soil fertility; survival of plants / crops and all other life forms. After reciting the poem student teacher initiated whole-class discussion on various water sources and its uses. She had drawn learners’ attention on the way in which various water sources were getting polluted by the way we use it. Learners responded to these questions based on their experience and by observing visual contents of the textbook. During the whole-class discussion their responses showed their misconception on equating water sources and the locations water is stored and on the mode we get; their conception of sea pollution was mixed with imagination and what they heard. The learner’s imagination on sea pollution is given below.

S.T: Ok. How sea water gets polluted?
S3: Ship is going (By movement of ships)
S.T: mm
S5: In that they go and take a bath.
S.T: mm. They get bath in sea!!!, then,
S5&S3: They are fishing it & washing it, there only
S.T: What do they wash there?
S5: Fish
S.T: mm, then, what they do?
S5: We have to put a net for catching fish.
S7: Hey, we said it before
S5: The dirt on the net goes with it (the sea)
S.T: Is it?
S5: mm miss
The whole class discussion indicates the children of Grade II have an understanding of various water sources and used by human for various purposes. They could also recognise the water pollution related problems and its effects. Student teacher could engage the discussion on their misconception of water sources and the location where water is stored and the mode in which water is collected. Their conception of the sea and sea pollution is a mixture of what they learned from their teacher and their imagination and the understanding of water pollution they acquired in earlier classes. They could see water pollution leading to extinction of life forms in the sea. However they think pollution can harm only smaller life forms in the sea. The student teacher interaction with learners during whole class discussion is given in appendix C2.

**Topic 4:** Improving the surrounding of the lily pond  
**Approach / Method:** PBL  
**School:** Panchayat Union Elementary School, Mel Achamangalam  
**Teacher:** First Year Student Teachers (S.T)  
**Participants:** Grade V learners  

**Context:**

Before presenting the problem the learners were taken for a visit to observe the Lilly pond (AlliKulam) and its surroundings. It was felt by the student- teacher and the researcher that once learners are made aware of the situation of that place, they would be able to visualise the solution to the problem more contextually. After observing the lily pond the student teacher interacted with each group to know what they observed. Later the learner groups were asked to make a drawing of lily pond based on their observations (Figures 5.9 and 5.10). It was to make the learner recall what they observed and put their observation together, so that a collective visualisation of the situation be made as a basis. Through the student teacher’s interaction with learner groups the following aspects emerged.

- Things Observed inside the pond and around the pond by each group
- General perception of each group about the environment around the pond
Figure 5.9: Learners (Grade V) are taking a look at the lilly pond during the field visit at Mel Achamangalam

Figure 5.10: Learners (Grade V) groups are making a sketch on lilly pond at Mel Achamangalam
**PBL problem:**
You made a visit to observe the lily pond in Keel Achamangalam. The waste water of the village is connected to the lily pond, so it has become a store of drains (almost anything, including trees, cattle, etc.). Think that your group is asked to improve the prevailing condition of the pond. You will be given Rs. 50,000 to accomplish the task. How will your group use that money to improve the condition?

**Description of Classroom process:**
The PBL problem is introduced in the classroom by providing photocopies of problem for all the groups. From few groups learners were asked to read the problem aloud and the student teacher asked if any group has difficulty in comprehending the problem it can be addressed.

After this, the learner groups were asked to make their drawing on how the lily pond looks like after making it clean and improving it. The groups were allowed to work in for an hour. After an hour the student teacher interacted with each group about their group work.

**Group Work:**
The learners mixed the things they observed along with their imagination. For example, even though the learner groups did not see a fish or a snake in the pond, they mentioned that they were present. The researcher’s informal interaction with the learners shown that, they viewed the larva of a frog as fish. Somehow on this aspect the student teacher did not enquire with them. During the initial interaction with the student teachers the researcher had an idea that the lotus present in the pond (generally referred by lotus pond), but while visiting the pond the researcher and student teachers came to know that it is not a lotus pond, instead it is lily pond. But throughout the work, both lotus and lily ponds were interchangeably used by the learner.

One of the group work (Group A - drawings) is presented in figures 5.11 and 5.12.

**Things observed during the visit**
Lilly flower, sewage water, fishes, frogs, herbs, creeper, snakes, passi (algae), bamboo basket
General Perception on environment around the pond

Mixing of sewage water and dumping of wastes in around pond lead to pollution. These are the sources of diseases like skin diseases, malaria and other general illness.
**Student teacher interaction with learner groups:**

The student teacher interacted with the learner groups’ during the group work in progress. Some group had a view that, the trees grown around the pond will provide better air for the local people (“It will give good air to breathe madam”), keeping fishes in the pond one can’t drink water from it (“We can’t make it for drinking purposes, because, we leave fishes in the water”). The other group vowed that making a park and planting flower plant could be a good idea. There are misconceptions observed during the student teacher interaction with the learner groups. They were “Keep quiet. Why do we need frog?” To keep the pond clean, “It (algae) won’t have life”. The student teacher tried to address these misconceptions through questioning their thinking. Learners misconception of algae doesn’t have life related interaction is presented below.

S.T: Ok. Why do you want to put fish into the pond?

S2: To eat pasai (algae)

S.T: Why?

S3: Otherwise passi will grow and spread into whole pond.

S.T: Is it?

**Chorus:** Yes

S.T: Does passi have life?

S2: No miss, *It (algae) won’t have life.*

S.T: mm

S2: *No miss, it won’t have life. Miss, herb, human and living things have life but those don’t have a life like algae (Passi) etc...*

S.T: *Ok Dear. Then, why is it grown?*

S2: *Miss.... (Starts thinking)*

S.T: Ok, we put wood in water, will it grow after some time.

S2: No miss. It won’t.

S.T: Ok. If we take passi from pond and put it out for two three days in sunlight, what will happen?

S3: It gets dry.

S4: It dies miss

S.T: You all said that, it won’t have a life

S2: *Madam, It won’t grow. If it doesn’t have life it won’t grow.*

S.T: Ok, When you are seeing does algae grows or not?

S3: Grows miss.
S2: It won’t grow miss.

S1&S4: It grows miss.

S.T: Ok. One thing we will do. Everyone has some pot in your home. Is it not?

Chorus: Ok miss

S.T: *We put some algae in it with some water and see it after a week and tell me whether it grows or not.*

While observing all the group works it was observed that all the groups felt waste water collection in the pond to be stopped. Group A viewed that the pond can be recharged with rain water regularly. Whereas the other groups had a view that the drainage connection completely removed from pond and water may be poured or pumped into the pond. All the groups viewed that the dumping wastes around the pond to be stopped, group D viewed that waste tank may be kept near the pond and need to be cleaned regularly. All the groups had a view that around the pond flower plants to be planted, group A viewed those trees to be planted around the pond. Almost all the groups viewed that the ecosystem in the post cleaning of the pond consists of fish and lily plants. There is a clear evidence of lack of understanding of ecosystem and more of human centric view was observed. One of the learner groups explicitly expressed that keeping pond pollution free by removing frog, snakes and other living creatures from the ecosystem. The student teacher raised questions about this which made the learner to think. However, the student teacher did not carry forward this discussion with the learner group. The student teacher interaction with learners during the group work and whole class discussion is given in appendix C3.

5.1.2.3 Theme: Ecosystem

*Teacher:* 1st Year Student Teachers

*Participants:* Learners of Grade III, IV, V and VI in four different schools

*Approach / Method:* Inquiry Learning, cooperative learning, field visits

*Theme Context:*

The topics engaged under this theme were:

(i) Ecosystem

(ii) Bird house

(iii) Usefulness of animals

(iv) Living and nonliving things (biotic and abiotic; do plant has life)

(v) Difference between trees, plants and creepers
(vi) Do the leaves perspire?
(vii) Seed germination and
(viii) Seed dispersal.

Ten student teachers engaged the learners of various Grades from four different schools undertaken in these activities. Some of the themes were undertaken by topics engaged in more than one student teacher in different schools.

**Topic / Activity 1:** Ecosystem

**Approach / Method:** Cooperative Learning, Whole class discussion

**School:** Panchayat Union Elementary School, Kathirampatti

**Teacher:** 1st Student Teachers (S.T)

**Participants:** Grade V learners

**Context:**
The student teachers took Grade IIIrd and Vth learners (on the themes (i) and (v)) for a field visit to the neighbouring area, to observe their immediate environment. The learners were asked to note down whatever they observe in their immediate environment for a later discussion. The visit was organised during lunch break after the learners took their lunch. The student teachers took necessary permission from the Head Master for the first and second period of the post lunch-break for this purpose. The Grade V learners were asked to observe their ecosystem by the student teacher and the Grade III learners were asked to observe more on various plants and their nature. During their visit learners used magnifying glasses to observe very small things.
At the end of the visit Grade V learners (Figure 5.13) were asked to write/ draw what they have observed during their visit. The post visit work took almost 40 minutes by the learners. The student teacher interacted with the student groups during the group work. After that student teacher collected learner works. The class decided to discuss what they observed on their ecosystem in the next class (next day). The field visit and consolidating what they observed during field visit took the 2nd half of the school day. The student teachers interacted with their respective learners in whole class discussion in the following 4th period.

**Description of Classroom process:**
During the whole class discussion the student teacher tried to bring to everybody’s notice various kinds of living things in their environment from their observations. The discussion focused on the location(s) in which the living things were observed (lives), their nest and the way it was made (for ex. Formicary, Spider net), the method in which they get their food (prey), their predator and other habitats. During this interaction the student teacher clarified learner’s misconceptions such as “Spider eats leaves”, “Mosquito feeds water”. 

**Figure 5.13: Learners field visit at Kathirampatti**
“All mosquitoes suck blood”,
“Earthworm eats fertilizers”,
“Earthworms eat other small worms in the soil”,
“Butterfly gives silk”
“Snakes remove its skin in every 2-3 days”
“Python has bones in their stomach to break the prey”
“After swallowing human, it (python) winds on to a tree teacher, and then it breaks the bones of its food”
“Python does not remove its skin”

Learners differed in their view on acceptable conceptions like
“Spiders eat mosquitoes, housefly”,
“Earthworms eat plastic paper” and etc.

The learners were also curious to know the reasons when they came to know new information. For example while student teacher made clarification on “all mosquitoes suck blood”, she said only female mosquitos’ suck blood. This was new information to the learners and they wish to know the reasons for that. When the student teacher asked them to think about that and provide reasons, they responded that they do not know. The student teacher directed the learners to find the answer from other sources at first, if not the next day, she will respond to the query. The next day the learners approached the teacher to know the reason and the student teacher explained the need of blood for making mosquito eggs (this was not recorded by the researcher as on the next day the researcher visited some other school, but came to know from informal interaction with the student teacher). The student teacher interaction with the learners on mosquito is given below.

S.T: Then, you were writing about mosquito
S2: Mosquito is in drainage ditch, if it bites us, Chikenguniya will affect.
S.T: How mosquito breeds?
S2: On water.
S.T: Does it breed in water?
S2: In drainage.
S.T: Does it directly come as a mosquito or does it transforms?
S2: On water it lays eggs;
S.T: Does it lay eggs. mm?
S2: Those eggs after laid and become mosquito; and night times it bites.
S.T: mm
S2: If we keep mosquito coil we can kill them
S.T: What are their foods?
S2: Blood
S.T: It will come and take blood from us. What else it does?
S3: Mosquito drink water.
S.T: Does mosquito drink water?
S3: Yes
S2: No
S.T: Others, Does mosquito drink water?
(No response)
S.T: For drinking water does it go to plant?
S3: mhoom (No) towards plant side.
S4: On plants, flowers are there, so it goes.
S.T: Then, in flower what may be there?
S4: Honey
S.T: Honey, so mosquito goes and sucks honey.
S4: mm teacher.
S.T: Is it honey? Or a kind of sweet water?
S4: It is a kind of sweet water.
S.T: Yes mosquitoes feed that (nectar). It also takes plant juices. But they don’t drink water.
S3: Is it teacher!!
S.T: Yes. Do all mosquito’s sucks blood?
Chorus: Yes miss
S.T: Do everyone agrees with this?
S1: Miss, sometime mosquitoes on our land do not bite us like the once at home.
S.T: Is there any other view?
(No response)
S.T: Yes. It is true. Generally male mosquitoes’ do not bite human or any animals. Only female mosquitoes’ bite animals and sucks blood.
S2: Why Madam?
S.T: What do you think? Why is it so?
CHAPTER V

S2&S3: We don’t know madam
S.T: Try to find out from others, otherwise next class I will tell you.

When differed in their view on “earthworms eat plastic paper” the discussion lead to an understanding that earthworms don’t eat plastic paper, and how plastic pollutes the land. The learners suggested that we should avoid using plastic bags, instead using Manchalpai ("Yellow colour bags" – generally people get while purchasing clothes etc.) to be an environmental friendly. Learners also discussed on disposing of plastic wastes and the impact of burning plastics; they had a suggestion of reuse of plastics. The student teacher interaction with the learners on earthworm is given below.

S.T: Ok, You wrote that, you have seen worm, which worm have you seen?

Chorus: Earth worm

S.T: Earthworm, what did it eat?

S5&S4: It eats soil

S.T: What else it eats?

S3: Fertilizer

S.T: mm??!! Does it (earth worm) eat fertilizer?

S3: Yes

S1: No miss. It will die

Chorus: Yes miss, it will die.

S2: It will die miss.

S.T: What else do they eat?

S4: The things in the soil, it will take small worms in the soil

S.T: Is it? Earthworm eats small worms in the soil?

S1: No miss. It eats soil, not worms

S.T: Yes. Earthworms won’t eat other worms but it eats maggana ilia (humus) and other minute things

S3&S4: It keeps the land clean.

S2: Plastic paper.

S3: Those are all it eats.

S.T: mm!! Does it eat plastic paper?

S2&S3: Yes Miss

S4: No miss. Plastic, it cannot. Even big animals die after eating plastics. In Newspaper I have seen

S.T: Ok. What do you think? (Looking at S3&S4)
S3: He he....
S4: If we put a plastic cover in land earthworm will die.
S.T: What if we throw a plastic sheet on the ground?
S4: If we put it, when rain comes
S2: Water will stay (above), it won’t be absorbed by plants
S5: For roots water won’t go.
S.T: By putting plastic, the water won’t go to the roots. Why?
Chorus: Plastic covers the root.
S.T: Speak one at a time.
S5: Above plastic cover water is there.
S.T: mm
S5: Due to that water won’t go.
S.T: Ok. How does plastic go into the earth/soil?
S5: During ploughing?
S4: By carrying waste/manure (to put it on land)
S2: No teacher. We bring rice in plastic cover; later as a waste we dump that plastic cover in waste pit i.e. due to air/wind it fly and go and fall on the land, when rain comes that water goes to earth and goes to roots, at that time this plastic cover obstructs the roots of the plant; so water won’t go to the roots that plant becomes dry and die.
(All the learners want to say)
Chorus: We should not put wastes in sort. Due to that pollution happening.
S.T: One at time, not all at a time.
S3: We are also, when we for purchase, we should purchase things yellow (cotton) bag only, if we bring it in plastic cover it won’t be good.
S.T: So, what can we do with plastic bags and other things which already we are using it?
Chorus: We should not throw it on the ground.
S3: We should keep all this in a cover.
S5: We should burn it.
S3: Yes burn it.
Chorus: Yes
S.T: If we burn plastic, does air not get polluted?
S3: Pollution...
S.T: Does air get polluted or not?
**S1&S4: mhoom(no)**

**Chorus: No. It gets polluted**

**S.T:** For that, what can we do?

**S5:** How can we eliminate using plastic? We should not insert that anywhere. Whenever we bring plastic (intending plastic cover) we have to keep it in a bucket. We should not put in the waste bin. After closing it, we should not put it on land, but whenever we need we can reuse that (using many times).

The learners had confusion about the moth and butterflies. In one way it is due to the fact that the name of both butterfly and moth are quite similar in Tamil. The butterfly is called as “pattampoochu” and moth called as “pattupoochu”. The student teacher clarified the concept and explained the process in which silk is produced. After that, she raised a question to the learners as to why are the silk clothes purchased in marriages. The learners replied that silk sarees and silk dhotis are used in the marriages and we should avoid the practice of purchasing silk sarees’ and silk dhotis’ during marriages to avoid large scale killing of moth. The student teacher interaction with the learners on silk worm and other interaction can be seen in appendix D.

Learner’s observations also include plants. Learners discussed about trees and herbal plants and their use in the day to day life. Seed dispersal was discussed with examples. Their discussion also included Thulasi, neem tree, papaya, coconut, sunflower, honey comb, locust, goat, monkey, crow, cock and fish. Learners also shared their experience on how monkey, and crow snatching food / things from children. They also shared how hen hatches its egg, and how young chicks fall prey to other birds and animals. At the end, the student teachers tried to bring the ecosystem concept by explaining the interdependence of living things. But it was also observed that the fear of particular living thing etc. was still an obstacle in bringing any behavioural changes towards a better ecosystem.

**Topic / Activity 2: Bird House**

**Approach / Method:** Cooperative Learning, Whole class discussion

**School:** Panchayat Union Elementary School, Kathirampatti

**Teacher:** 1st Student Teachers (S.T)

**Participants:** Grade III learners
Context:
During the practice teaching the student teacher and the researcher observed that in a school birds’ nests were kept in a cupboard, where Teaching Learning Materials were kept. The student teacher expressed interest in creating learning situations around birds’ nests.

Description of Classroom process:
The student teachers initiated the conversation where the learners shared with various household animals / pets in their locality as well as on what they own or they rear. The common animals / pets were cow, dog, cat, sheep, and goat in their home. The uncommon animals were of parrot, rabbit etc. The discussion covered different types of plants and foods the animals eat. They also discussed about wild-animals, insects and other animals and their living place. The discussion moved to why learners go to the plot of land on mornings and evenings when they cultivate food crops. They responded that to drive away birds and animals that come to eat grains. Gradually the student teacher directed the learners focus towards where do the different birds stay and live. At the end the student teacher asked each group of learners to make the drawing of sparrows’ nest how it may look like.

The learner groups were given some time to draw the diagram. At the end the student teacher taken out the nests from the cupboard and given nest (Figure 5.14) to each group separately and asked them to draw the nest after seeing it. The student group's drawings on sparrows nest are given in figures 5.15, 5.16, and 5.17.
Figure 5.14: Bird nest examination by one of the learner groups

Figure 5.15: Group A drawing on sparrows nest

<table>
<thead>
<tr>
<th>Before seeing</th>
<th>After seeing</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Sparrow and crow nests</td>
<td></td>
</tr>
<tr>
<td>(ii) Sparrow nests</td>
<td></td>
</tr>
</tbody>
</table>
Figure 5.16: Group B drawing on sparrows nest

<table>
<thead>
<tr>
<th>Before seeing</th>
<th>After seeing</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Sparrow nest 1</td>
<td></td>
</tr>
<tr>
<td>(ii) Sparrow nest 2</td>
<td></td>
</tr>
</tbody>
</table>
Figure 5.17: Group C drawing on sparrows nest

<table>
<thead>
<tr>
<th>Before seeing</th>
<th>After seeing</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Sparrow nest 1</td>
<td>Drawing 1</td>
</tr>
<tr>
<td>(ii) Sparrow nest 2</td>
<td>Drawing 2</td>
</tr>
</tbody>
</table>

Later the student teacher interacted with the learners in a group and discussed whether any differences they observed. The student teacher asked how different birds make their nest and how cuckoos keep their eggs in crow nests for hatching. They also discussed about owl, bats and their nest and the way in which they catch their prey. The drawings made by each group on pre and post observation showed great difference. The student teacher interaction with learners during the group work and whole class discussion is given in appendix D1
CHAPTER V

Topic / Activity 3: Uses of Animals

Approach / Method: Cooperative Learning

School: Panchayat Union Elementary School, Mel Achamangalam

Teacher: 1st year Student Teachers (S.T)

Participants: Grade IV learners

Context:
The student teacher was interested to know learners understanding about various animals, their use in human activities and their importance.

Description of Classroom process:
The student teacher made a table in worksheets indicating animals name, whether (a) gives milk, (b) helps in transport of groups, (c) give skin for human use, (d) used as meat, (e) provides bio fertilizer (through its waster matter), (f) used as medicine, (g) food habit, (h) lay eggs or give birth to young ones, (i) habitat, and (j) used for any games?. The student teacher distributed this worksheet to each learner group and asked them to discuss and fill the table. Learners group was engaged in one period for preparing the list. In the next period the student teacher interacted with each group. During the student teacher interaction with learner groups, the student teacher clarified some of the learners’ misconceptions. Student teacher clarified when the group members disagreed with each other’s idea and on certain occasion whole group had misconceptions. The misconceptions were

“Elephant eats small camel”
“Rabbit is a bird”
“Tiger eats plants”
“Crocodile gives birth to younger ones”

The student teacher interaction with the learners group on what does tiger eat?, is given below.

S.T: What does tiger eat?
L1: Plants
Chorus: Plants
S.T: Which type of plant?
L1: Shrub (sedi)
L2: Shrub, creeper
S.T: What does lion eat?
S.T: What does a horse eat?
L3: Grass
S.T: Camel, What does it eat?
(No response)
L1: Camel?
S.T: Camel, What does it eat?
(No response)
S.T: Buffalo, what does it eat?
L4: Grass
S.T: Dog?
L1: Paper, Sooru?
Chorus: Sooru?
S.T: Did you see tiger eating grass?
L1: All animals eat grass.
S.T: Did you see?
L1 and L2: Cow, Ox, horse, buffalo, goat and all, we have seen.
L4: No miss. The tiger will eat other animals?!
S.T: How?
L4: My father said.
S.T: Yes. Tiger won’t eat grass. They eat animals. Similarly lions eat animals. But camels eat plants.

Even though the student teacher clarified the student’s misconception only at individual group level but the whole class discussion did not happen. The student teacher’s complete interaction with learners during the group work is given in appendix D2

**Topic / Activity 4: Living and Non-Living**

**Approach / Method:** Cooperative Learning, whole class discussion

**Schools:**
(i) Panchayat Union Elementary School, Mel Achamangalam (Grade III learners)
(ii) Panchayat Union Middle School, Kalaroor (Grade VI learners)
(iii) Panchayat Union Elementary School, Madavalam (Grade V learners)
**Teacher:** First and Second Year Student Teachers (S.T)

**Participants:** Grade III, V and VII Learners

**Context:**
The content of difference between plants and animals was prescribed in the textbook of Grade III. In Grade VI the topic our environment begins with ecology where the topic begins with the difference between living and non-living things as a pre-requisite knowledge. Due to learners lack of understanding of pre-requisite knowledge the topic become a learning aspect. After observing the Grade VI classroom experiences, the researcher asked the student teacher to engage the topic with Grade V learners.

**Description of Classroom process:**

**Mel Achamangalam:**
Initially learner groups were asked to make a list of things around them. After that they were asked to classify the things based on the common characteristics. (The idea was to classify the things into living and non-living). After some initial discussion the learner groups were asked to classify them into living and non-living things. Through discussion the learner groups classified the things into living and non-living things. Once the groups classified, the student teacher interacted with each group and observed their work and clarified some of their misconceptions / queries through discussion.

During the student teacher interaction with learner groups, the student teacher clarified some of the learners’ misconceptions and their queries. The queries raised by learners were:

“Is the paper a living thing?”
“Is Poosanikaisedi (herb) has a life?”

The misconceptions observed among learners were:

“Rat is non-living thing”
“Is cycle living?”
“Triangle is living”
“Soil is living thing”
“Ball is living thing, because it runs”
“Fish and bees are non-living things”

The learners’ group conception of “Soil is living thing” expressed during interaction between student teacher and learners group is given below.
L1: *Soil is living thing, miss*
S.T: *Is soil is living?*
L1: Living thing miss
S.T: mm
L1: Living thing
S.T: Is it living?!
L1: Yes, miss. It is living.
S.T: *Is it living? How do you say that it is living?*
L1: *That is, when rain comes, water comes.*
S.T: *How, when rain comes, from soil water comes?!!*
L1: *It is not living.*
S.T: *Ok. How do you say it is non-living?*
L1: It does not have arm and a leg.
S.T: mm
L1: *It is not having arm and leg. Someone when walking, when they kept on their leg on it, it dies miss (merichasethuduthu miss), and because if it does not food it dies (athukkusappaduillathamisssaguthu miss). It becomes dry, miss, and so it is not living.*
S.T: *If some place, where no one walked before, then in that place does soil lives?*
L1: mm...(thinking)... No miss. It is not living.
S.T: *Yes. Soil is not a living thing.*

Even though the student teacher clarified the student’s misconception at group level, it was not made known to the whole class. During this topic when student teacher was interacting with the one of the learners group the researcher was engaged in helping an injured child with first-aid related task. During the analysis the researcher while listening to the audio cassette came to know that the student teacher helped the learners in answering the questions. After asking questions, the student teacher gave the answer in a low voice the learners responded the same. This subtly indicates two possibilities, student teacher may feel that the time taken for content transaction is more than what it is supposed to be done, or student teacher believed that learners do not know the answer. The transcription of the related portion was not taken for analysis.

*Kalaroor:*

In VIth Std. Science textbook the topic our environment includes ecology (biotic, abiotic factors), different ecosystems, and the role of plants, animals and human in the
ecosystem. But the present discussion focused only on the first part i.e. ecology. The student teacher asked learner groups “what do they understand the term environment?”

The learner groups’ responses were:

“Things around us”,
“Trees, plants, sun, rain”
“Co-existence of biotic and abiotic components”
“Interrelationship between living and non-living things”
“A book”
“It is about physics, chemistry, zoology, botany all that comes i.e. living and non-living”
“Living things and surroundings”

The groups were asked to list down what are all they observed and observe in the environment. Through discussion (between student teacher and individual groups) the groups were engaged towards classifying their list into living and non-living things. All the learner groups had easily classified living and non-living things. One of the learners group had some misconceptions which led to the whole class discussion on what makes living and non-living things different? The student teacher interaction with the learners group is presented below.

S.T: What do you mean by living things?
S2: Stone, soil
S.T: Living thing (stress)!!?
S3: Hey, plants, animals, birds, water, robot (doubtful – slow voice)
S.T: Ok. What are non-living things?
S4: Stone, soil, trees, plants.
S.T: Is it so? What is the difference between living and non-living things?
S4: Living things sir, move from one place to another place.
Chorus: Non – living things are in the same place sir.
S.T: Ok, What else?
S4: Plants….. (Thinking)
S.T: Ok, Which are all non-living things?
S4: Non – living things are plant, creepers, and trees
S.T: Hey, those are all living things, vengayathaleiya (abusing student – by saying one who having an onion kind head)
S4: mm
S.T: Ok, what are all living things?
S4: Living things…. (Thinking -avoiding answering)
S.T: Ok, which are non-living things?
S3: Deer, goat, cow

(Researcher calls the student teacher and interacts with him personally and informs him that the need for patience and about potential of wrong responses to understand learners misconception. The next ten minutes were spent on planning to carry out the task in whole-class discussion)

During the whole class discussion many other concepts were discussed and some other misconceptions were clarified through discussion.

The Misconceptions clarified were:
“Robot is a living thing”
“Non – living things are plant, creepers, and trees”
“Living things can do reading and writing”
“Elephant, dog won’t take (eat) grass”
“Tiger is ottunni (parasite)”
“Ottunni (parasite) is the one which eats the same thing”
“Bear doesn’t eat grass”

The learners also raised the question to student teacher to clarify. The question was
“What is sarunni (Saprophyte)”?

A small part of student teacher interaction with learners during whole class discussion is given below.

S.T: Among living things, what difference do you see between plant and animal?
S5: Animals eat plants sir. But plants take water, air.
S.T: Do all animals eat plants?
S3&S5: No, sir.
S5: Even if it is hungry, tiger won’t eat grass (poolipasithalumpullaisappidathu i.e. A tiger won't eat grass no matter how hungry it is – a proverb from Tamil)
S.T: Ok. Tiger won’t take grass. What else won’t take grass?
S5: Lion, elephant, dog
S2: Dog won’t take grass, sir
S.T: mm…
S3: Elephant
S4&S5: Hey, it eats grass
S3: Does it eat grass?
S5: mm sir. The elephant will eat grass, sir.
S1: Goat eats grass sir.
Chorus: Tiger eats meat, sir
S.T: Human?
Chorus: Anaithunni (Omnivorous)
S.T: Tiger?
S1: Ottunni (parasite) (in low voice)
S.T: What is Ottunni?!!
S2: If it depends on something else.
S.T: Depending means, on what it depends?
(No response)
S.T: What is Ottunni?
S1: The one which eats same one.
S.T: What?!!
S1: The one which eats the same thing.
S.T: If it eats the same thing, then is it Ottunni?!!
S1: Yes sir
S.T: Is it so?
S3: I don’t know
S5: No sir, unnipoochi (Botfly) is aottunni sir.
S.T: Ok. What is Ottunni (Parasite)?
(No response)
S.T: Is paen (head lice) is ottunni?
S5: Yes sir
S.T: Then, now you say, lice and unnipoochi are parasite. What do you mean by parasite?
S5: It stays in our body and it lives by taking our blood
S.T: What else?
(No response)
S.T: Yes. Parasites are depending on their host. For example lice depend on us, unnipoochi depends on dog, cow etc. Even in our stomach some small worms live and are parasites.
The student teacher’s complete interaction with learners during the group work is given in appendix D3
Madavalam:
The student teacher intended to discuss on living and non-living things and the difference between them. He engaged the class by raising questions and getting learners’ responses. He neither facilitated learners’ discussion for their understanding of concepts nor explained about it. The learner disagreed on the concept plant has life. “Is plant a living?” the answer is “No”
The student teacher also did not make any effort to explain to strengthen learner conception of plant food preparation.
L4: “Plants prepare food using that (water, sunlight, air)”
S.T: How?
L1: Don’t Know
The student teacher’s interaction with learners during the group work is given in appendix D3

Topic / Activity 5: Differences among Trees, Plants and Creeper

Approach / Method: Cooperative Learning, whole class discussion, Field visit

School: (i) Panchayat Union Elementary School, Kathirampatti
(ii) Panchayat Union Elementary School, Mel Achamangalam
(iii) Panchayat Union Elementary School, Madavalam

Teacher: 1st Year Student Teachers (S.T)

Participants: Grade III learners

Context:
This topic was presented in the Grade III Environment Science textbook prescribed by the Government of Tamil Nadu. Three student teachers engaged the topic in three different schools. The procedure for engaging the Grade III learners was varied in different schools.

Description of Classroom process:
Kathirampatti:
Two students-teachers took Grade III Learner along with the Grade 5 learners for a field visit to the neighbouring area to observe their immediate environment. The Grade IIIrd learners were asked to note down whatever plants and trees they observe in their immediate environment for later discussion. The visit was organised during lunch break
after the learners took their lunch. The student teacher took permission from the Head Master for; the first and second period of the afternoon could also be used for this purpose. After the field visit the learners were asked to list down the plants they observed and classify them into trees, plants (smaller plants) and creeper. The learner’s groups took an hour to complete this task. The student teacher collected their work and on the next day the student teacher engaged in interacting with learner groups and with the whole class discussion (Figure 5.18).

![Image of students and teacher](image)

**Figure 5.18: The researcher, student teachers and learners of Grade III and V is seen in the photograph**

The student teacher clarified some of the learners’ misconceptions and their questions during the whole-class discussion. They were:

- *Trees life is of “2 months”*
- *Plant’s lives are of “1 month”*
- *Cotton plant live only “one month”*
- *Tamarind tree lives “4 years”*

During the interaction learners also expressed that tree life is just 10 to 12 years, because after that it will be cut down by people even though it can live 50 to 60 years. They also expressed that trees are very important for getting pure air and other benefits. On the question “what if, trees are not there” learners responded that, “we will die”.

The student teacher’s interaction with a learner during whole class discussion is given below.

**S.T:** (what about) Plants?

**L1:** *For plant may be .... 1 month*

**S.T:** Will it be one month?

**L1:** Yes (very confidently)

**S.T:** Ok, is cotton a plant or creeper?
L2: Plant
L1: Plant
S.T: How long it lives?
L2: 1 month
L1: 1 month
S.T: Cotton crop lives only a month?
L1: It will live 10 months
S.T: (about) Trees, how long it may be? How many years?
L1: It will live 3 or 4 year
S.T: About tamarind tree? When did it planted? Before your birth or later? Do you have any idea?
L1: It was before that (before birth)
S.T: How old are you?
L1: 8 years
S.T: How many years (tamarind) maybe?
L1: 10 years
S.T: Still how long it may live? What do you think how many years it will be there?
L1: Another 2 or 3 year it will be there
S.T: That much only? Beyond that…?
L1: People will cut it
S.T: They will cut it, if it is left as it is how long it may live?
L1: Fifteen years it will be there
S.T: Then…..?
L1: People will cut it
S.T: Ha… ha… Ok, if they do not cut it?
L1: If they don’t cut it means? (With surprise)
S.T: If they do not cut it, how many years it may be there?
L1: May be for 50 or 60 years it will be there
S.T: Beyond that…..?!
S.T: Ok, the tree which is supposed to live 50 to 60 years, if we cut it that is it a loss or gain for us?
L1: Loss
S.T: How?
L1: We won’t get good air. If trees are more on the road side, then, we get more air
S.T: From that, what we get? i.e. from tree
L1: From that we get more food
L1: Tamarind, mango
S.T: What if tresses are not there?
L1: More heat falls on us, we won’t get more enough air
L2: Air get polluted
S.T: mm (I see)
S.T: Then, what will happen?
L1: Then breath will stop.
S.T: Then?
L1: We will die.

The student teacher’s interaction with learners during the whole class discussion is given in appendix D4

Mel Achamangalam:
The learner groups were asked to list down the plants they know and then classify them into tree, plant and creeper. This task was completed easily by learner groups due to their day to day observations and experience. The student teacher moved around each group and interacted with them. At occasions learner groups kept a particular plant in two or all the three categories (trees, plants and creepers). While student teacher asked for these, the group responded correctly. Occasionally they had differences in their classification. The student teacher’s interaction with learner groups during group works and during whole-class discussion some of their novice conceptions, their disagreement on each other’s ideas, and their queries on a particular plant were clarified through discussion.

The learners had initial ideas like:
“Seetha (custard apple) is a plant”..... “Seetha is a tree”
“While it (Custard apple) is small, it is plant; when it became big, it is a tree miss”
“It (plant) is very small, and then it will become big”

During the discussion the learners moved from their idea of “Seetha (custard apple) is a plant”..... “Seetha apple is a tree” to “Seetha and madulam are small trees”. At this stage the student teacher introduced the term ‘shrub’.

A learner raised a question that “Miss, Is Annasi (Pineapple) tree or shrub?” when student teacher redirected the question to whole-class, the responses were
“Annasi (Pineapple) is a tree”
“Annasi (Pineapple) is a shrub”

Another student clarified their query by stating that, “Annasi (Pineapple) is a plant” as we planted on our land.

The student teacher posed a question “Is a banana a tree or shrub or herb?” the learners responded that

“We all call it as valaimaram” some other learner contradicted it by saying “we also call it as valaisedi”, “It is a shrub”.

When a student - teacher clarified that “Actually, banana is a large herb” the learners did not get convinced of the answer. The student teacher and the learners’ interactions are below.

S2, S4: “Herb?!! Miss, don’t confuse”

Priya: Ok. What confusion do you have?

S2: You are saying that it is neither a shrub, nor a plant and saying it is an herb. Then what is an herb?

S.T: Yes. Mooligai (herb) is a plant but does not have strong stem, so banana is a herb.

The student teacher’s interaction with learners during their group work and whole class discussion is given in appendix D4

Madavalam:

Two student teachers took Grade III learners for a field visit behind the school to observe their immediate environment. The visit organised just before the morning assembly. After the field visit the learners were asked to list down the plants they observed and classify them into trees, plants (smaller plants) and creeper. The learner groups took an hour to complete this task. After 30 minutes of group work the student teacher engaged in interacting with learner groups.

The student teachers made two crucial mistakes during the field visit. First, the chosen field area which is just behind the school has a lot of weeds and only few plants trees to observe and small way for some distance. This has limited the field experience. Second, it was organised in just 15 – 20 minutes before assembly and learners were not given adequate instruction on the observation and recording (noting down what they observed).

The student teacher interaction with the learner groups during group work was observed to be following novice conception.

“No difference between tree and herb”

“Banyan tree is big, but banana tree is in small size”
Student teacher did not make any clarification on “banana tree”. The student teacher asked each group to make drawing on what they observed. But, they did not make any discussion with the learners on that.

The student teacher’s interaction with learners during their group work is given in appendix D4.

**Activity 6:** Are the leaves perspiring (transpire)?

**Approach / Method:** Inquiry Learning, Cooperative Learning, Whole class discussion

**School:** Panchayat Union Elementary School, Madavalam

**Teacher:** 1st Year Student Teachers (S.T)

**Participants:** Grade IV learners

**Context:**
This activity was presented in the Grade IV Environment Science textbook prescribed by the Government of Tamil Nadu. The student teacher was interested in engaging the learner groups’ to do this activity.

**Description of Classroom process:**
The student teacher intended to teach transpiration concept through learner’s activity. The student teacher initiated the process with a question “Do leaves sweat (perspire?)”. After getting learners' responses, the student teacher asked the learners to plan an activity through which it could be proved. Once the learners got the idea of conducting an activity (both group and whole class discussion) they were asked to conduct the activity in groups. After the activity and observation, through whole class discussion, the content was summed up. The student teacher discussions with the learners at different stages are presented below.

The student teacher interaction with learner groups during group works and during whole-class discussion on some of their misconceptions / novice / tenacious conceptions, their disagreement with each other’s ideas were clarified through activity and discussion. Within the whole-class discussion the student teacher tried to get responses from individual groups. For the question “Do leaves on the plants and trees sweat (perspire)?” most of the student felt “No” or “We don’t know”. In one group some members said ‘yes’ and some said ‘no’. When a student teacher further probed, one of the learners who responded “yes” said “lower (side of the leaf) evaporation takes place, not on the leave’s (upper part), here (lower part) it evaporates, not in upper part”. Unfortunately the student
teacher could not understand what the learner intended, and the further discussion led the
student to say “No” (leaves won’t perspire).

Further the student teacher made an observation “You all think that plants won’t
sweat”, but “I think they sweat”. The student teacher continued by saying “I am going to
give a plastic cover and a thread to each group. By using this you have to identify
whether plant sweat or not. Take two minutes to discuss in your group”.
Student groups’ expressed the plans such as
“By putting mud on it (plastic cover) we can plant herbs in it, sir. Then we keep that
(thread) and see whether plant grows or not”
“A plant is there, we have to take a herb, we have to take a cover and fill it with soil. In
that the herb has to be planted. If we keep it in water, it will grow”
When a student teacher further probed, one student expressed his tenacious conception
on “leaves won’t perspire” and had a misconception that “during winter leaves may
sweat”.
This led the student teacher to ask a question, “When were water herbs and trees, where
does the water go?”
The novice ideas expressed by learners were:
“It goes to the leaves and in leaves it becomes bitterness is there like that”
“Water goes to the root, and then it goes to leaves then from leaves to stem”
At this stage, the student teacher stated that the “water gets evaporated i.e. water vapour
gets out from leaves”. But the learners did not agree with the idea by saying “No”, “It
won’t”.
Later the student teacher switched over to a whole class discussion and posed question
“What will happen if we cover a twig with this polythene bag and tie it with thread for
two hours?”
The learners’ responses were “Leaves will get little bit dry”, “Nothing will happen”.
Then the student teacher asked the learner groups to conduct the activity. After the
activity the learners agreed that leaves perspire in the whole-class discussion. The
student teacher introduced the term ‘transpiration’ while summing up the whole - class
discussion (Figure 5.19).
While observing the whole activity, it was observed that the student teachers believe that, “learners do not know the content” whereas “teachers know”. Instead of planning the activity through learners by engaging discussion the student teacher explain the processes of conducting activity. All these are work contrary to constructivist principle. Even though this activity indicated learner’s novice / tenacious misconceptions, the student teacher’s engagement with the learners showed the extent to which there was a need for teachers’ belief in constructivist principle necessary for engaging the constructivist based classrooms. The student teacher’s interaction with learners during their group work is given in appendix D5.

Activity 7: Essential Requirement (Factors) for seed germination?

Approach / Method: Inquiry Learning, Cooperative Learning, Whole class discussion

School: Panchayat Union Elementary School, Kathirampatti

Teacher: 1st Year Student Teachers (S.T)

Participants: Grade V learners
Context:
This activity was presented in the Grade V Environment Science textbook prescribed by the Government of Tamil Nadu. The student teacher was interested in engaging the learner groups’ to do this activity.

Description of Classroom process:
The student teacher intended to engage the learners to learn the content on seed germination through inquiry method. The student teacher began the class with a brainstorming session to identify the necessary things required for seed germination. After this, the student teacher asked the learners to devise an activity to prove that seed germination (Figures 5.20 and 5.21) is possible only when these necessary conditions are available present. The activity was planned in whole class discussion using inquiry learning and instead of group wise activity a single activity was conducted by the student teacher. This is because the activity needed six to seven days to see the result of that activity. In the following week, the student teacher engaged the interaction with learners groups’ to consolidate their understanding and record their observations.

Figure 5.20: Learners practicing the seed germination experiment
Figure 5.21: Seed germination experiment set up in the classroom at Kathirampatti

Through this discussion, the student teacher clarified some of their misconceptions/novice conceptions, their disagreement on each other’s ideas. The learners were aware that soil, water, air, sunlight is important for the seed germination. This shows their factual knowledge. But when they were asked “How will you prove that the seed won’t germinate if these are all not available?” they started explaining from their experience of plant growth. When the student teacher emphasised seed germination, they try to apply their understanding of plant growth on germination of seed. The question has triggered the discussion toward devising an activity to prove how these factors are important for seed germination. The learners could easily bring their experience of plant growth to devise the activity to prove that water is necessary for seed germination. But when they were asked to devise an activity to prove that air and sunlight (heat) are necessary for seed germination, the discussion brought their misconception/novice conceptions. They were:

“Keep it in the house by closing all the windows ensuring no air enter into it”

“One seed bag (seed sown in soil in the polythene bag) to be kept in a room which is completely closed where air should not enter even through a small gap”

When the student teacher asked the question “If we close the room completely, will air be present there in the room?” the learners disagreed on each other’s idea by saying “Yes” and “No”.
This helped the student teacher raise another question “If all the doors and windows of this room are closed, can we live here (inside) for 10 minutes?” the learners disagreed by saying “we can’t”. When a student teacher related the question with their life experience, by asking “In winter don’t you close windows and doors?” they could accept the presence of air.

Similarly the student teacher cited the learners’ life experience of pearl millet germination helped to devise the activity and to clarify the need of warmness (heat) for seed germination. One learner expressed a novice conception to avoid the heat is to keep the seed germination set up in the fridge! “We can keep it in that shop’s bridge (fridge)”. The student teacher asked “What will happen to soil in the glass where we poured water in it?” the learners responded “It (soil) will become tight” and the successive question of “Do we sow seed in tight soil?” learners responded “No” because seed won’t germinate. The post activity student teacher interaction with learner groups confirmed their understanding of the factors / conditions required for seed germination as well as on experimental procedures (procedural knowledge) on how to prove about each of the factors. The student teacher’s interaction with learners during their group work and whole class discussion is given in appendix D6

Theme / Activity 8: Seed Dispersal
Approach / Method: Cooperative Learning, Whole class discussion
School: Panchayat Union Elementary School, Madavalam
Teacher: 1st Year Student Teachers (S.T)
Participants: Grade IV learners
Context:
This activity was presented in the Grade IV Environment Science textbook prescribed by the Government of Tamil Nadu. The student teacher was interested in engaging the learners in understanding various modes of seed dispersion.

Description of Classroom process:
The student teacher interacted with learners through whole class discussion on seed dispersal. The student teacher began the discussion by asking the learners about various plants they see around the school, and preceded with the question “How it might have grown here?” learners responded that “somebody may have planted it”. The student
teacher further probed on which form plants are grown, and got the response “from seed, offshoots” from the learners. Later student teacher asked about thorn plant. The student responded by saying “That comes by its own”. Through further discussion and the student teacher made the learners to get an idea of different ways in which the seed dispersal happens (wind, water, human, birds and animal) based on different contextual questions. The student teacher raised appropriate questions which facilitated the discussion and to bring the understanding on different ways seed dispersal takes place. The student teacher’s interaction with learners during their group work and whole class discussion is given in appendix D7.

5.1.2.4 Theme: Energy Resources

Teacher: II Year Student Teachers

Participants: Learners of Grade VI, VII and VIII in two different schools

Approach / Method: PBL, cooperative learning

Theme Context:

Four student teachers and learners of the two schools have engaged in Energy Resources related topics. The topics were:

(i) Energy Resources
(ii) Energy Flow
(iii) Cloud Formation.

The first topic was engaged in Puthagaram Middle school whereas the last two topics were engaged in Kurumbar Colony Middle School. The first topic was engaged with Grade VIII by two students-teachers as a team. The Second topic was engaged with Grade VII. The Third topic was engaged with Grade VI and VII by a student teacher.

Topic / Activity 1: Energy Resources

Approach / Method: PBL, Cooperative Learning, Whole class discussion

School: Panchayat Union Middle School, Puthagaram

Teacher: Second Year Student Teachers (S.T)

Participants: Grade VIII learners

Context:

The student teachers were engaged in a PBL problem on Energy resources in the teacher education classroom. The student teachers were interested in engaging Grade VIII learners in similar PBL problem related to Energy Resources. Before presenting the
problem, the student teachers oriented the learners to PBL approach. The learner groups were made and the ice breaking session was done to make the group know each other’s strength and other aspects. After two sessions of making learners get into the group understanding, the theme was presented in the class. As the numbers of learners were more and it was Grade VIII, the student teachers were interested in engaging the problem with two member team.

**PBL problem:**
The electricity and fuel need / demand are increasing day by day. Consider yourself as an expert team in the area of energy and fuel, what kind of suggestions and solutions will you provide to the public and the government?

After presenting the problem, the student groups were asked to work in individual groups. The student teachers moved around the groups and clarified their initial queries. After an hour the student teachers interacted with each group for their group work.

**Description of Classroom process:**
The PBL problem was introduced in the classroom by providing photocopies of problem for all the groups. From few groups learners were asked to read the problem aloud and the student teacher asked if any group has difficulty in comprehending the problem it can be addressed. During the group work the student teacher visited each group and interacted with learners about the progress of group work. Each group worked with their own pace. Hence, the content of student teachers’ interaction with each group varied depending on the group’s progress.

During this PBL problem learners’ group discussions mainly relied on textbook information and their own experiences.

**Group Work:**
Most of the group works indicated that the location in which electricity generated from various types of power stations, uses of electricity, various fossil fuels and its formation, the purpose and use of various fuels, various energy sources, electricity conservation, uses of fuels and atmospheric pollution, precautions to be taken while using electrical appliances and alternate fuel sources (biogas etc.). Even though groups appear to have understood the problem (first table ‘what you know ‘column), most of the group work did not reflect the problem posed to them. This was because learners focused the
problem within the boundary of textbook content. The learners groups’ work indicates many misconceptions of the learners. Their list of misconceptions were:

“Electricity industries use the heat generated from thermal power station to generate electricity”.

“Petrol, diesel, kerosene, fire wood and gobar gas are used as a fuel in coal”.

“Due to use of vehicles, burning of papers and plastic materials ozone layer gets a hole and releases heat at 100 degree Celsius temperature”

“Energy is stored in Trees, coal, petrol, diesel and fuels in gaseous form. These energies we call it as chemical energy”.

“While burning firewood, kerosene and petrol heat energy is emitted. These properties we call it as fuels”.

“Michael Faraday invented electricity”

“Places from which we get fuel: Sathanur, Tuticorin, Dharmapuri, Kalpakkam and Chennai”.

“Electricity used in industries such as hydro power station and thermal power station”

“Fuel is formed from matchstick, firewood, petrol, diesel, bio gas and natural gas”

“Electricity generated from lamp”.

“Fuels are generated from water”

**Student teacher interaction with learner groups:**

The student teacher’s interaction with the learner-groups during the group work and during whole class discussion some of their misconceptions were identified through discussion.

The misconceptions expressed by learners during student teachers’ interaction with them were:

“Wind flow from tree”

“Wind flow from sun”

“Tree leaves fell down, then it became together, it goes to the soil, by become together and dry. It gets crushed and become black and coal taken from it”

“Due to smoke Ozone gets holed. Because of that air won’t come”.

“Electricity can be generated from underwater of sea”

“Underwater of seas wherever sunlight is there we can generate electricity”

“They make holes in the earth and insert the wire and pour water in it. Then we get earthing”
However the student teacher did not address the learners’ misconceptions expressed in the group works as well as during their interaction with the learner groups. The student teachers try to clarify the misconception which they had with the learners during whole class discussion and fail to notice the learners’ misconception in the group work. This may be due to lack of student teachers' own understanding of the content. The student teacher’s interaction with learners during their group work, whole class discussion and learners groups’ group work (translated) is given in appendix E.

**Topic / Activity 2: Energy Flow**

**Approach / Method:** Cooperative Learning, Whole Class Discussion

**School:** Panchayat Union Middle School, Kurumbar Colony

**Teacher:** II Year Student Teachers (S.T)

**Participants:** Grade VII learners

**Context:**

This topic was presented in the Grade VII Science textbook prescribed by the Government of Tamil Nadu. The student teacher was interested in knowing learners understanding on concepts energy flow and food chain. She raised a question, how solar energy flows in living things on earth? She asked the learners to work in groups. She moved around each group and interacted with the learners.

**Description of Classroom process:**

The student teacher’s interaction with student groups during group works and during whole class discussion on some of their misconceptions / novice conceptions, their disagreement with each other’s ideas were clarified through explanation and discussion. The novice / misconceptions expressed by learners group and contradiction of their own idea, student teacher scaffolding and student conceptual change is presented here:

**Misconception**

“Plants take solar energy through root”

“That root is absorbed (the solar energy in the form of heat), then it gives to stem”.

“The way it absorbs water like that it absorbs (heat) madam”.

**Learners’ contradiction on their own ideas and change in their conception**

S.T: Then, in plant, what do leaves do?

L1: The sunlight is required for the leaves of the plant for photosynthesis to occur.
S.T: What is mean by photosynthesis?
L1: Sun... i.e. energy comes.

(Student teachers scaffolding)
S.T: What is photosynthesis? anyone...
(No response)
S.T: Don’t know?
L1 and L2: mm..(yes)..
S.T: (Explains the photosynthesis process)

(Change in their idea)
S.T: If, a plant gets sunlight through leaves for energy, why is taking from the root? What does it do with it?
L1: We thought plant takes sunlight energy through the roots.

The novice / tenacious / misconceptions expressed by learners group and contradiction of their own idea, student teacher scaffolding and student conceptual change are presented here:

Misconceptions:

a) “That is (photosynthesis occurs) in the centre of the stem of its plant food; it plant prepares”.

b) “From that (sun) soil gets (heat energy), from soil plant gets”.
   “Miss, when we are planting miss that time we are pouring water, soil is absorbed that water. From soil water goes to plant miss, is it not? Along with water, it takes heat also miss”.

c) “$O_2$ is there in solar energy”

Learners’ tenacious conception and contradiction on their own ideas and change in their conception

a) S.T: “Which part of the plant gets that light?”
L1: “Through leaves and Kambu (tender leaves – leaf primordia)”.
S.T: What do leaves do with sunlight?
L2: Through photosynthesis it produces its food.

The student teacher at this stage raised the question on things required for photosynthesis, the responded that Sunlight, soil, water, air ($CO_2$).
S.T: Ok. Where Photosynthesis takes place?
L2: In centre of the stem,
CHAPTER V

S.T: Just you said photosynthesis happen at the leaves.
L2: Yes madam.
S.T: Where does the soil come for photosynthesis?
L1: It is already there.
S.T: Where?
L1: In the root.
S.T: But you were saying that photosynthesis happening at the centre of the stem. The soil is in the town. If all the four requires means how is it possible?
L3: The soil is there in the centre of the stem itself.
L2: How is it available in the centre of the stem?
S.T: In case, if you break the stem, in the centre, does soil will present there?
L1: No madam, it won’t be there, from the root the nutrition of the soil it will get sir.
S.T: Ok, for photosynthesis, whether the soil is required or not?
L1: Not required
S.T: Where does the plant take sunlight for photosynthesis?
Chorus: Leaves
S.T: Then how photosynthesis happens in the stem?
(Silence)
S.T: What do you think, where does photosynthesis happen?
Chorus: Leaves.

b) S.T: “Ok, in that case we keep the root part of the plant outside for solar energy and our place the plant inside the room, Will it grow?”
“It won’t grow miss. By getting solar energy only it (plant) will grow”.

c) S.T: “Is inside the room Oxygen is not there?
L1: It is there.
S.T: “Then, What is there in the sunlight?”
L1, L2 and L3: “Light”
The other learners’ group drawing did not reflect the energy flow idea clearly. But the student teacher’s discussion with a learners’ group didn’t reveal that as the discussion was very general. The synoptic view of group work (translated) is presented in the appendix E1.
**Topic / Activity 3:** Cloud Formation (Water Cycle)

**Approach / Method:** Cooperative Learning, Whole Class Discussion

**School:** Panchayat Union Middle School, Kurumbar Colony

**Teacher:** II Year Student Teachers (S.T)

**Participants:** Grade VI and VIII learners

**Context:**

This topic was presented in the Grade VI Science textbook prescribed by the Government of Tamil Nadu. When the researcher reached the school, the student teacher informed that there was a festival in the village, due to that many learners were absent and also few teachers were on leave. Therefore grade sixth and grade eighth learners were combined and classes were engaged.

The student teacher intended to engage the sixth grade learners with the theme water cycle. Student teacher was also interested in engaging the eighth grade learners with the same theme. The student teacher began the class with a whole - class discussion followed by the student group work on cloud formation.

**Description of Classroom process:**

The student teacher’s interaction with student groups during group works and during whole class discussion on some of their misconceptions, their disagreements with each other’s ideas were clarified through explanation and discussion.

The misconceptions expressed by learners were:

**(VI grade)**

For the question how cloud forms

“Miss, when we burn something those smokes goes out (up) miss that smoke will go”.

For the question how smoke goes to the cloud

“We are growing trees, when the wind blows; the smoke coming out of material burning that goes up”.

For the question how the rain comes?

“Miss, smoke goes up and cloud gets cool”.

“It (smoke) goes and hides miss; it won’t rain miss. When it opens like this rain comes miss”.

“Yes miss (Is smoke form cloud?)”

**(VIII grade)**
“If we burn wastes smoke will go up in skymiss. ....that smoke becomes cloud”.

“The water in the sea gets evaporated and goes up and becomes cloudy. For that another example also can be given, fire, which is what we make smoke, that also goes to up and becomes cloud”.

“Water, due to evaporation of water, cloud forms, also by burning wastes cloud forms”.

“The smoke which is burned goes up due to that cloud moves. Due to that smoke the sky becomes dark; that time the rain will come”

“The smoke of burning of materials goes to the cloud and due to its warmthness the cloud gets melted and rain pours”.

“When the smoke goes up, i.e. when petrol, diesel burns, smoke goes up and become cloud”

“Plants. When we cut it, it becomes dry, when we partially dry it, and become vapour and goes up. When we are burning wastes it becomes vapour”.

**Group work:**

Even though Group B’s (grade VI) group work showed cloud forming from sea water, the student teacher interaction with them reflect that they also accept the idea of smoke forming as a cloud. Group C’s (grade VI) group work did not show cloud forming from water. The student teacher interaction with them clearly reflects they think that cloud forms through evaporation. Group D and Group E’s (grade VI) group work shows they do not have any misconception. The drawing of Group A (grade VI) and Group B (grade VIII) shows the smoke which comes out while burning the waste, forming as the cloud. The drawings are presented in figure 5.22. The synoptic view of group work (translated) is presented in the appendix E2.
The student teacher’s interaction with learners during their group work, whole class discussion and learners groups’ group work (translated) is given in appendix F

5.1.2.5 Theme: Environmental Problems

Teacher: II Year Student Teachers

Participants: Learners of Grade VII and VIII in two different schools

Approach / Method: PBL, cooperative learning

Theme Context:
Four student teachers and learners of the two schools have engaged in Environmental problems related themes. The themes were:
(i) Improving Environmental Conditions of School Premises
(ii) Human-Elephant Conflict
(iii) Agricultural Problems
(iv) Wastes

The first three themes were engaged in Puthagaram Middle school where as the last theme was engaged in Kurumbar Colony Middle School. The first three themes were engaged with Grade VII learners by student teachers. The last theme was engaged with Grade VIII learners by a student teacher.

**Topic / Activity 1:** Improving Environmental Conditions of School Premises

**Approach / Method:** PBL, Cooperative Learning

**School:** Panchayat Union Middle School, Puthagaram

**Teacher:** II Year Student Teachers (S.T)

**Participants:** Grade VII learners

**Context:**

Whenever I (researcher) visited Puthagaram school we (me and student teachers) used to visit to the nearest mango farm during lunch time. We generally pass through behind the school and every time we observed that lot of waste spread over there. The school learners were throwing the wastes from the windows behind the school.

The school has classrooms in 5 different buildings and a single room. Out of this, four building are located on one side of the road and a building located on the other side. The first building comprises of two rooms out of which one is principal’s office cum staffroom and the other one is a store room meant for broken things and other unusable materials. The second building had two rooms with a damaged roof so it was not used. The third building had two rooms and a veranda where Grade I and II learners sit in one room, Grade III learners in another room and in veranda used to function as a Grade V learners’ class.

The fourth building had two rooms and a veranda where Grade VIII and VII learners sit in rooms and Grade IV learners sits in veranda. Along side of this building, a single room is there, where kitchen functions for midday meal preparation. The other building located on the other side of the road where two sections of Grade VI learners classroom.

The school premises had an unused toilet, 2 water storage tanks. One was used as dustbin and the other (syntax) without water. The learners rely on hand pump outside the
school for water. Even though the school had a well, the water was polluted due to waste dumping. The student teachers were sharing this information and one day during our discussion it was thought of why not we can take up this issue as a problem in PBL approach. While working out the problem, the student can become aware of their immediate problem. As a group we all liked this idea and we felt as two of our student teachers teaching in Grade VII this could fit well in that class.

**PBL problem:**
The Panjayat intended to provide Rs. 1 lakh to improve your school premises. In this regard your group is asked to make a detailed plan of expenditure to improve the condition of school premise. Before making a plan let your group visit the school premises and make a drawing depicting the present condition of the school. Work out your plan of expenditure and make a drawing depicting how the school will look like, once the money is spent on its improvement.

**Description of Classroom process**
The PBL problem is introduced in the classroom by providing photocopies of problem for all the groups. From few groups learners were asked to read the problem aloud and the student teacher asked if any group has difficulty in comprehending the problem it can be addressed. The learner groups made visits to school premises and noting down what they observe and during Group work where learners discussed (Figure 5.23) what they observed and made drawings of school premises then groups made a plan of expenditure. The Student teacher interacted with learner groups to facilitate the discussion and observed group progress. The student teacher could able to see interesting episodes (misconceptions, interesting views etc.) which become part of group work and generally the interaction began with what the group observed and their plan of expenditure and related discussions.
Figure 5.23: Learner groups (Grade VII) were seriously contemplating on school environmental problem at Puthagaram

Each group worked with their own pace. Hence, the content of student teachers’ interaction with each group varied depending on the group’s progress. During this PBL problem learners’ group discussions mainly relied on textbook information and their own observation and experiences.

**Group Work & Student teacher interaction with learner groups:**
The learner groups made a plan of expenditure and the visualized the school premises through drawings. During the discussion they discussed many other general problems beginning of the school context. One of the group's drawings about what they observed in school premises and after spending their visualization of how the school premises look like is presented below.

**Learners’ observation of school premises**
**Learners’ visualization of the school after renovation**
The student teacher’s interaction with student groups during group works most of their misconceptions, were clarified through peer disagreement on each other’s ideas, student teachers 'questions and some of their conceptual understanding widened through explanation and discussion.
The novice / tenacious / misconceptions expressed by learners were:

“Those who inhale it (smoke) gets affected by malaria”

“That’s only (to avoid mosquito breeding) sir, by constructing tank and leaving the water (industrial effluent) into it and close that tank”

“Trees and rains have no relation”

“Plants and trees evaporates won’t perspire”

“Insects eat plants, it eats plants and moves to root and it reaches the soil, then it eats soil so, soil gets polluted”

“Earthworm eats soil... due to that soil gets polluted”

“The bacteria’s in the soap mixed with water while washing. This water we use it for land. Due to those bacteria affects land (land gets affected)”

“Due to mosquito biting it (Cholera) spreads”

“Due to the burning of tyre, from that so much toxic gases comes out due to that many diseases (malaria) happens to us”

“If non-degradable things are not in the soil, then soil fertility increases ...... because it doesn’t stop water going into the soil (water percolation). So soil fertility increases”

“Making pit in the earth, and we should leave (industrial effluents) their”

“Due to that smoke.....AIDS comes”

One alternate conception was observed during the student teacher interaction with learners group “Papers are produced through palm leaves”.

The concepts widened through interactions were:

“Making Bore wells don’t have any adverse effects”

“for avoiding this scarcity we need make more bore-wells”

The student teacher facilitated the situation where learners could understand that making more bore-wells leads to lowering down the ground water level.

One of the group suggested making tar (used for road making) from plastic could be one of the solution to address plastic pollution. Learner group suggested this because they read this idea from a newspaper item. The student teacher’s interaction with learners during their group work and learners groups’ group work (translated) is given in appendix F.

**Topic / Activity 2:** Human – Elephant Conflict

**Approach / Method:** PBL, Cooperative Learning

**School:** Panchayat Union Middle School, Puthagaram
Teacher: II Year Student Teacher (S.T)

Participants: Grade VII learners

Context:
Student teacher brought a newspaper item on elephants coming to agricultural farms and the problem faced by the farmers. The student teachers were interested in engaging Grade VII learners in PBL problem related to Human Elephant Conflict. The researcher also shared a resource material on elephant in local language and had few more newspaper items for the student teacher to formulate the problem. With this background the student teacher framed this problem and provided all the learning materials to the learners in their PBL work.

PBL Problem:
You have two newspaper items and an article on the difficulties faced by farmers by elephants’ intrusion to their farm. Your group is expected to provide suggestions and solutions to reduce this human-elephant conflict through the report.

Description of Classroom process:
The PBL problem was introduced in the classroom by providing photocopies of problem for all the groups. From few groups learners were asked to read the problem aloud and the student teacher asked if any group has difficulty in comprehending the problem it can be addressed. During the group work the student teacher visited each group and interacted with learners about the progress of group work. Each group worked with their own pace. Hence, the content of student teachers’ interaction with each group varied depending on the group’s progress. During this PBL problem learners’ group discussions relied on newspaper articles, a resource book on elephant and their own experiences (what they heard, read etc.).

Group Work
Most of the learner groups’ work indicated that due to human encroachment in forest areas and cutting of trees from the forest were important reasons for elephants coming to cultivated areas. Elephants face food and water scarcity due to cutting of trees in the forest and low rainfall. Preparation of KallaCharayam (illicit liquor / DesiSharab) in the forest areas and by accidentally drinking of these by elephants has also become a major cause for elephants coming in border areas of forest and human settlement.
The learners groups’ suggested that planting more trees could be one of the solution. Enabling the water and food security in the forest for elephants was another suggestion. Some learners groups suggested by making a fence around the forests the conflict can be avoided. Avoiding farm related activities closer to forest areas also was suggested. It also suggested that elephants should to be protected from poachers. The learner groups work also indicates various things elephants eat, and other information like its average weight, its uses, different ways it was harmed by humans and their social group etc. Some of the learner groups also made elephants drawing. One such drawing is presented in appendix F2.

**Student teacher interaction with learner groups:**
The student teacher’s interaction with the learner-groups during the group work some of their misconceptions were identified and clarified through discussion. The misconceptions / novice conceptions and imaginations expressed by learners during student teachers’ interaction with them were:
“Elephants are, … human beings are putting baby elephants in inside cage. So it gets disturbed (feels bad) and enter into the village and attacks everybody”.
“If it's inside the forest, nobody puts food in it, so it comes out of the forest and eats humans”
“If we jail all the animals in sanctuaries, they will give food for them. For all animals they will give food”
“Yes sir. Even if it (elephants) present in the forest, it pollutes the nearby lands”
To a question on what are the advantages of having animals in the forests? The learners responded that the presence of animals makes people fear to go to the forest and cut the trees. This will help in getting more rain, pure air etc. The student teacher’s interaction with learners during their group work and learners groups’ group work (translated) is given in appendix F1.

**Topic / Activity 3:** Agricultural Problem

**Approach / Method:** PBL, Cooperative Learning

**School:** Panchayat Union Middle School, Puthagaram

**Teacher:** II Year Student Teachers (S.T)

**Participants:** Grade VII learners
Context:
The people around the village were engaged in agricultural farming, agricultural labourers, agro-business, agarbathi making etc. As most of the learners' family background is farming or related activity, the student teacher was very much interested in agriculture related problem. With this background this problem was framed. The student teachers were interested in engaging Grade VII learners in PBL problem related to Agricultural problems of the locality.

PBL Problem:
In our area, crop productivity is reducing over the years. The government has planned to avoid this situation and increase the productivity. Assuming you are a team of agriculture related experts to give suggestions to the government through your report.

Description of Classroom process:
The PBL problem was introduced in the classroom by providing photocopies of problem for all the groups. From few groups learners were asked to read the problem aloud and the student teacher asked if any group has difficulty in comprehending the problem it can be addressed. During the group work the student teacher visited each group and interacted with learners about the progress of group work. Each group worked with their own pace. Hence, the content of student teachers’ interaction with each group varied depending on the group’s progress. During this PBL problem learners’ group discussions relied on textbooks and their own experiences.

Group Work
Most of the learner groups’ works indicate that due to water scarcity, constructing houses in agricultural land, cutting trees and its impact on soil erosion, land pollution from industrial effluents, plastic materials, insecticides, rotten, floods, reduction in cultivation area were major reasons for reduction of crop productivity. Most of the learners groups’ suggested rain water harvesting (some learners groups were made drawing of rain water harvesting) and water conservation, non polluting water bodies, not burning wastes, use of bio-fertilizers and vermincompost as solution. Most of the learners groups’ work also indicates water cycle (Appendix F3).
Student teacher interaction with learner groups:
The student teacher’s interaction with the learner-groups during the group work few misconceptions were identified through discussion.

“Insecticides,…DD powder like insecticides (or artificial fertilizers)”
“Due to using artificial fertilizers….. Yielding getting reduced”

Alternate conception:
“For getting more yield, natural fertilizer should be use it”

However, the student teacher did not make an effort to address these misconceptions.

The student teacher’s interaction with learners during their group work and learners groups’ group work (translated) is given in **appendix F2**.

**Topic / Activity 4: Wastes**

**Approach / Method:** Cooperative Learning

**School:** Panchayat Union Middle School, Kurumbar Colony

**Teacher:** II Year Student Teacher (S.T)

**Participants:** Grade VIII learners

**Context:**
The student teacher was interested in knowing learners understanding on wastes. The student teacher began the topic by asking learners to observe what are the things they are throwing as a waste in their house and nearby places as a homework. The next day through initial discussion following questions / ideas emerged and the learners groups’ were asked to work in group to address the questions and ideas. They were:

- What are wastes?
- What are sewage wastes?
- What are the things at your home throw as a waste?
- Other than home, what are the other activities and places were wastes generated?
- Classification of wastes
- Adverse effects of wastes
- Waste management.

**Groups Works:**
Most of the learners groups’ work indicated that paper, plastic, grass, water can, and cardboard, rotten fruits, broken bulbs, pen, glass tumbler, onion, garlic skins etc are wastes. Most of the learners groups’ work indicated that waste water of various
household works, drainage water, and sewage water is of waste water. Learner groups also indicated that, Coconut cover, worn clothes, bags, slippers, cement bags, balls, papers, remaining food, rotten fruits, fire wood ashes are of household wastes. Plastic papers, chocolate papers, dried leaves, waste pipe were thrown at roads, school rooms, industrial areas, market, bus, lake, hospital and other areas. Most of the groups classified waste into two groups. They were degradable and non-degradable. Most of the group indicated that due to wastes there may be a possibility of getting a chickengunya Plague, Cholera, smoke, cancer, malaria, dysentery, typhoid, tomotogunia, throat infection, headache, eye pain, dengue, lung diseases, cough and cold. However some of the learners group also had a misconception that due to wastes there is a possibility of getting HIV, rabies, hepatitis, bird flu, leprosy, mumps, chicken pox, fever, leg pain etc.

Description of Classroom process:
Student teacher interaction with learner groups:
The student teacher’s interaction with learners groups’ during their group work and their misconceptions/tenacious conception were identified and clarified through discussion. They were:

“Breathing of waste water….. (Leads to) Cancer, vomiting and headache”
“Burning (of) wastes is good…..Otherwise it accumulates in front of the house as dirt”
“It (leather) won’t degrade”

One such interaction is presented below.
S.T: Is burning wastes good/bad?
L1: It is good.
S.T: How?
L1: Otherwise it accumulates in front of the house as dirt.
S.T: Ok. If we burn it, what will happen?
L1: Burning?
L2: It gets empty.
S.T: When it burns, what are all come out? (No response)
S.T: When we see burning, what are the things happening?
L1: Bad smell comes.
S.T: Then
L1: Gas is mixed with air.
S.T: Which gas?....Does smoke come?
L1: Yes smoke comes.
S.T: What happen, when smoke comes and mixes with air?
L1: Ozone layer will get affected.
S.T: Ozone layer gets a hole?
L1: I don’t know, but the air gets polluted.
S.T: Ok, if we take non-degradable waste, burning or burying, which one is the best option?
L1: Burning
S.T: Why?
L1: It quickly gets over. Burying we need space for dumping and takes so much time.
S.T: Ok. After sometime what happen to that waste?
L1: People use it for their land.
S.T: Is there any benefit of that?
L1: Yes. Crops yield will go up.
S.T: So, Which is the best option?
L1 & L2: mm... mm... he he... Burying.

The student teacher’s interaction with learners during their group work and learners groups’ group work (translated) is given in appendix F3.

Major observations:
During the group work in the student teacher visited the group and interacted with the group members. At occasions, the student teacher observed some of the misconceptions / novice conceptions. Sometime the student teacher addressed those misconceptions with the group interaction itself and at later stage during whole class discussion these were taken up to address if any other learners had similar misconceptions. However, often the misconception which is observed during discussion when already recorded in the group journal by the learners. But they kept the group journal without corrections.

5.1.3 To study the application of constructivist teaching methods and strategies with student teachers while teaching environmental concepts in their classroom during internship programme.
1. The student teachers use of constructivist teaching methods and strategies in their classroom for teaching environmental concepts fall on a continuum. Some student
teachers could use it well than the other. Similarly the same student teacher could use it well in a topic / activity than the other.

2. When more than one student teacher engaged the same topic, generally different student teachers engaged the learners in different methods. For example the topic, Which one absorbs/ releases heat first: soil / water?, the same activity three student teacher adopted different strategies (whole class discussion, cooperative learning, Inquiry Learning) to engage their learners in the activity. This variation indicates the student teacher's preference in learner autonomy in learning a topic. This was based on the student teachers' belief on constructivist approaches (see appendix D5).

3. Most of the student teachers allowed learners' responses to drive the topic when they were engaged in the dialogue with the learners. However, some student teachers could able to make use of the learners’ responses to change their (learners) perspective on environmental concepts by raising critical questions.

4. Some student teachers provided more constructivists based learning experiences to their learner than the others. It was also observed that those who felt more comfortable with constructivist approaches or thinking that they were using an innovative approach in their teaching to make constructivist based lessons.

5. There were instances where student teachers left some stages fully or partially of inquiry or the PBL process. This was due to various reasons such as lack of adequate planning, school environment, organization of learning resources, activities etc. In some of the topic / activity the intended learning occurred even after missing some stage. For example the topic, what comprises the top soil? The student teacher did not raise a question “Is there any possibility of different layers formed when soil is put in with a bottle and shaken well?” before the activity. The stage of making a student hypothesis by the learners was missed. However, the student teacher in the post activity during the whole class discussion asked about various things observed in various layers.

6. School environment and student teacher interest played a critical role in deciding field visits as a part of learning experience.

7. Student teacher interaction with their peers in the same school as well as other school helped them to plan out their activities. For example, listening differences among trees, plants and creepers one student teacher facilitated the other student teacher to plan seed dispersal activity in the other school.

8. Some student teacher carried their experience of engaging themselves in learning environmental concepts at a teacher education institution in the school classroom to plan
out similar activities and PBL problem for learners. For example, water percolation capacity and energy resources.

9. It was observed that at occasions student teacher ignored learner misconceptions during their interaction with their learner. It was also observed that at occasions student teachers did not address the learner misconceptions expressed in their portfolio (group work).

In general, it was a mixed experience with some success and some failures. However, by applying constructivist principles and methods in their teaching learning process most of the teachers began their journey to become constructivist teachers.

5.2 Student teachers and Learner perceptions about constructivist approaches to Environmental Education

The data regarding student teachers and learners’ perceptions about the use of constructivist approaches to Environmental Education presented in two subsections, 5.2.1 and 5.2.2

5.2.1 To study student teachers' perceptions about constructivist approaches to Environmental Education

5.2.2 To study Learner perceptions about constructivist approaches to Environmental Education

5.2.1 To study student teachers' perceptions about constructivist approaches to Environmental Education

The student teachers’ were interviewed to know their perception about the use of a constructivist approach to environmental education. The student teachers' perception is seen in the following aspects.

(1)How did learners react on constructivist way of learning?

Most of the student teachers’ said that learners were very actively participated with a lot of interest and enthusiasm. In fact, learners' participation in engaging the content through constructivist way was better than the student teacher themselves engaged.

The learners started to demand the student teachers to engage their lessons through constructivist approach. They started to raise new and those questions which they do not know. It was observed that, their participation was much better than the traditional classroom setup. It was also observed that their conceptual understanding was better when they were taught through constructivist approach.
However, some of the student teacher said, few learners find it difficult to participate, as they do not know how to participate.

(2) How student teacher did engage in their (practice teaching) classroom through constructivist approach?

The student teacher felt that the constructivist way of learning was very new to them. As they were new to this way of learning, they initially feared to adopt in their classrooms. However they observed that it helped them to see progress of individual student learning. They did not find it very difficult in adopting this in their classrooms. But student teachers felt that small size classrooms will be very suitable for this method. The student teacher observed that learners were very happy in learning through this approach as it allows them to ask questions to teacher which they do not know. The student teacher also felt that this keep them learning new things as they find it difficult to answer learners unexpected questions.

Some student teacher strongly advocated this approach in the classroom even though it takes more time than the traditional classes as they think “how much time we spent is not important but understanding was matters”

(3) What kind of school environment in which they adopted constructivist approach?

Most of the student teachers viewed that school environment was neither positive nor negative.

Most of the school teachers indifferent to the way student teacher engage themselves in their classroom. Neither they had any objection nor encouraged the student teacher. One school the student teachers said the school Head Master was encouraging the student teacher in engaging this approach.

(4) How did they view their engagement with content in a constructivist classroom and constructivist approach?

The student teacher alienated in their view on constructivism. Some of them felt they were very much interested in learning through this approach and make the learner to learn through this approach as a teacher. Some of them felt they were interested and actively participated but their peers did not do so. Some of the student teachers felt it was interested them for some time, but the interest could not sustain for a long time, because continuously having a particular type of approach (PBL) and working a long time for a problem became difficult and other curricular loads from the institution. Even though the approach appears to be very easy, but demands lots of thinking. Student teacher stated that they shared the responsibility, accepted each other’s view when it is found to be
appropriate. They also stated it provided an opportunity to express their views in the classroom.

Very few stated that they had different views during their group work, but they said they could accommodate each other’s ideas and accept appropriate answers. Few responded that their peers did not do well, and some of them said they themselves were not much involved.

(5) Student teachers view of change in environmental behaviour among themselves and their learner. The student teachers had a view that very little change occurred in terms of their environmental behaviour in their own as well as their learner. However, they agreed that a lot of change occurred in their understanding of environmental concepts and issues.

5.2.2 To study Learner perceptions about constructivist approaches to Environmental Education

The interview with the learners on their perception about the constructivist approach to environmental education revealed that, the learners liked to be taught by inquiry activities, Activity Based Learning (ABL), good handwriting and use of various learning resources (regular activities like padippum inikkum).

Most of the learners stated that they had a better conceptual understanding by learning environmental concepts through constructivist approaches.

Learners stated that they learn better if they can get access to many learning resources along with the textbook. While researcher specifically focused questions on their perceptions about inquiry learning they responded that they understand better by engaging themselves in inquiry learning. Their statements were:

“(We) like that Learning by doing activities”

“Through doing and seeing we understand better”

“We like learning through activities and understand. You cannot do activity on board”

However in most occasions learner explained the process of activity they engaged and stated that they like such learning.

Even though field visits made better conceptual understanding and many learners liked it, some learners from two schools did not like it. It is because one such visit the learner visited the place where path were muddy and sunny day. The other situation, the field visit was arranged in a post lunch session and learners need walk to one kilometer distance to see the lily pond. Since, some of the learners do not have their own sandal it
was very difficult for them to walk in a sunny time. One of the learners expressions on field visit was “seeing and studying in a group is better”

The learners were having a positive view of working in groups (cooperative groups) and addressing problems (PBL). Some of the learners’ expressions were

“Sitting in a group and learning is happiest one”

“If I do not know something, they (group members) will answer. If they do not know we will ask to teachers”

“If teacher teaches, whatever he/she teaches we understand little, but if the same thing we discuss in our group and learn ourselves, we can understand little bit better”

“If we have doubts it is very difficult to understand, if we are working in group someone clarify our doubts”

Some learners stated that “Teachers clarify only things in the books”. But when they do it in groups, they discuss the process in detail.

Most of the learner stated that by discussing the problem in their peer group they understand the content well. However few learners felt that doing activities and engaging ill defined problems are somewhat confusing. They stated that learning by themselves (through interaction with peers, resources) they enjoy it. However, whatever they do not know they wish to learn from the teacher.

There were dissenting voices also. Some such expressions were

“These people (peers) fight each other. Instead of that studying alone is better”

“Is it right (for learning) to go and see things?”

There were very few voices from learner giving positive responses to changes in their environmental behavior. One such expression was “By learning in a group, we decided not to put wastes in the school”. However, learners expressed they understood a lot of environmental concepts by learning those concepts through constructivist based learning.