

## CHAPTER-V

### ANALYSIS AND INTERPRETATION

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#### 5.0 Introduction

**Qualitative research** is conducted through an intense contact with a field situation in order to get 'holistic' information of the context under study. The researcher attempted to collect data on the social skill behavior of student teachers through PBL process. The analysis was an on going process with data collection. The data collection activities typically were carried out in close proximity through audio\video recorder. Such data were transcribed, edited, typed and corrected. After processing the words were assembled, clustered and found patterns upon them. Analysis was consisting of three concurrent flows of activity: *data reduction, data display, conclusion drawing and verification*

#### 5.1 Data

The researcher collected information in the form of handwritten field notes as well as audio\video recordings of events. Field notes were focusing on words in which the data were found. The information was scribbled when it was recorded in the reflective diary. Some queries in the form of question were left on the sheet during and after observation. Some key words on the left side of the sheet of paragraph were outlined. These were comments what the researcher saw and heard. Notes made afterward were haphazard. Some missing contents were added as soon as possible after completion of each activity. After thorough recall the remembered things were included in the notes. Such addition was part of processing data. Direct tape-recordings of field-events were also included in the data. Thus, field note and audio-visual recordings were two ways in accumulating data.

##### I. Editing and Coding

As soon as the field note and transcription of video tapes were finished, the information was edited. Selective information was seen after editing. The research questions were guidelines to defense against unnecessary and overloaded information. The 'words' were the main to make sense. Some codes were used to the descriptive or inferential information compiled during the transcription.

## 5.2 Transcribing Video-Tapes

A part of analysis was done during transcription of video-tapes. For analyzing, the following steps were followed

1. **Preparing the data in transcript form-** The raw data were analyzed through transcribing the recordings and writing the transcriptions
2. **Formatting the transcript for analysis-** The transcript was formatted by leaving a wide space in the left hand margin in order to facilitate reading it and to write comments next to the transcriptions.
3. **Identifying meaningful data unit-**The general themes and issues in each session were identified keeping the research questions in mind.
4. **Organizing the relevant categories under the research questions-** Relevant categories to the dimensions of the each session were organized under research questions 1, 2, 3, and their sub-questions.
5. **Interpretation of the data-** The data obtained through the PBL process were reported and interpreted.

## 5.3 Social Skill Components

Identification of social components can be accomplished after assessing the socialization of teacher trainees within their group. In order to ascertain the socialized behaviours the two groups of teacher trainees were engaged in the solution of problem. The functioning of PBL groups of teacher trainees were activated through social actions and interactions. Teacher trainees' behavior with one another in finding possible solutions led them to be sociable. As it has been discussed in the methodology two problems have been formatted to identify the social skill behavior; the analysis of the different types of behaviours exhibited by the teacher trainees during the solution of problems, the researcher has identified the components of social skill behavior to infer the socialization. Analysis pertaining to this has been presented below:

**Note:** The abbreviations TT<sub>1</sub>, TT<sub>2</sub> represents teacher trainees of group 1 and group 2, respectively.

### 5.3.1. How Teacher Trainees Learnt To Socialize?

#### Problem scenario-1

*“You are resource person with the environment protection organization. A call came once to you.*

*The world is growing up thermostatically, put by a carbon's new mathematics number. This number is equated to a global average temperature of about 57<sup>0</sup>Fahrenheit. The increase in temperature may be due to factors of construction of cities in all places, production of crops, air and water supplies being used and even the changes of the seasons at higher latitudes get across our psychological calendars.*

- *You estimate the components of carbon which meets the climate challenge.*
- *Find solutions to check in case it actually record rise in atmospheric carbon dioxide (CO<sub>2</sub>) level*
- *Investigate if there seems difficult to get greener always.*
- *You must give warning(s) that could be affected by this challenge”.*

#### Evidence 1

#### Group TT<sub>1</sub>

The teacher trainees looked at one another as they saw the hard copy of problem scenario-1. It was something to explain green house effect to disagree to population growth and might be to find problems due to pollution!

So much was this so that **Jalpa** raised the question asking the meaning of ‘thermostat’ and then started conflicting herself by saying that “due to rise in temperature, it causes a change in carbon number, it is always flexible. Carbon dioxide is produced.....”

**Mridula** was slow and comfortable to speak her guessing about the carbon number.

At that time, **Deepthi** was silently looking at Mridula, putting her palm under the check.

**Neelam** was disagreeing to the points of jalpa. She thought in a different way and requested to repeat in order to understand better.

**Saket** answered to Neelam explaining “how it occurs”. He showed the information to the group.

**Mamata** asked pin-pointedly to search for the meaning of carbon number.

After such conversation, **Mridula** took up the responsibility to make loud reading of the statement of problem scenario.

### **Group TT<sub>2</sub>**

**Geetanjali** all on sudden started reading the problem scenario.

**Palak** started asking what Carbon number is?

At that time, **Nikita** was looking at Palak and answered that carbon number is due to pollution.

**Darshana** said yes! yes! and she queried how?

**Anita** answered the same and informed about the data of rise in temperature.

**Palak** was not agreeing with Anita. She was rubbing her eyes. She tried to ask to the group about the cause of rise in temperature.

All on sudden, **Palak** told the group to list out ‘Known data’ and took such responsibility in the group.

### **Observation 1**

The fact that there was a time when a teacher trainee could not understand that others had feelings like his\her own. All were asking question to one and another. All were looking for its answering. As a matter of fact, the teacher trainees could not understand even for a minute that they themselves were separate individual people, capable of independent feeling and action. The *awareness about self*, of being somebody came gradually.

## **Evidence 2**

### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Mridula** pointed out that pollution causes rise in temperature.

**Saket** informed a 'case-study' to explain the evidence of pollution.

**Deepti** said yes! I understood the real cause of rise in temperature. Smiled and said thanks to Saket.

**Neelam** questioned to Saket about the composition of carbon.

**Mamata** tried to answer her.

**Saket** further explained her answer with a diagram

**Mridula** was writing the points said by Saket.

### **Group TT<sub>2</sub>**

**Anita** started loud reading of her collected material and convinced all how the carbon number has increased.

**Nikita** said yes, yes emphatically.

**Geeta** repeated the word 'yes' again and again and indicated one of causes of pollution.

**Komal** was listening to; both her hands were crossed over the chest.

**Palak** and **Darshana** were putting their views on the issue of pollution.

**Anita** answered with examples which caused pollution. She was speaking with a high-pitched voice and in an erect posture to explain the matter.

**Others** were looking eagerly; supporting the query.

**Geeta** noted the clarifications made by Nikita.

## Observation 2

This narration revealed a fact that when the members in a group came across with doubt, every body thought in their own way. While some one queried another was putting his\her clarifications. But, one was to lead to reach at conclusion and that was done by Saket and Anita in the respective groups. The leading behaviors of both were seen within. It was a demonstration of *co-operation and agreement* of all in finding a point. It was seen that the teacher trainees *go hand-in-hand* in the group.

### 5.3.2. Feelings and Know –How?

While the group was working, it was necessary to be aware of three things about teacher trainees' social development

- A teacher trainee's attitude toward affection, love, trust, hate, suspicion etc.
- The strength of his \her feelings (deep, casual, indifferent)
- What kind of know-how he\she had in getting along (one gets the data by asking for it, stealing it or grabbing it?)

## Evidence 3

### Group TT<sub>1</sub>

#### Problem Scenario-1

The teacher trainees were divided as per the steps of PBL. All were looking at each other, opened their reflection diaries to record.

**Mridula** and **Deepthi** were suggesting Jalpa what was to record on the column "need to know".

**Jalpa** all on sudden said to write the points under 'what is given'. All agreed on Jalpa's statement.

When **Jalpa, Deepti** were interacting with Saket, **Neelam** was listening to an explanation with her eye focused towards Saket. She was straight on her seating position and her palms were placed on the table. She was quick to receive their conversation. Then, she prompted to make clear the meaning of things to be true about cause and effect of CO<sub>2</sub>. She was explaining clearly and correctly with firm eye-movement, kept her hands/palms open, nodding her head. Others were gratifying in listening her.

**Deepti** added a new concept. It was eagerness to all in listening and writing her information. Even **Mridula** and **Jalpa** added some expressions of words to her main part of information. They were attentive. They uttered 'yeah' during the time of their work.

**Neelam** was clapping with her hands to appreciate Saket's view.

#### **Group TT<sub>2</sub>**

**Geetanjali** attempted to ask her doubt to Anita about the word 'thermostat'

**Palak** explained about the industrial pollution due to carbon dioxide.

**Komal** agreed on Palak's point.

**Anita** raised the issue of forest firing. She explained this issue as the cause of global warming.

**Geetanjali** gave data about the increase of carbon dioxide.

**Nikita** followed her points.

**Darshana** was listening to Nikita's sayings and asked a question to get clear.

**Anita** smiled and answered to Darshana.

**Darshana** was looking at Anita, listening with ease. She thanked Anita.

### Observation 3

This prompts to accept *positive way of behaving* towards each other within the group. Thus, *Feelings of love, affection, responsibility, care and firm belief* in the strength of teacher trainees were understood. These were the hallmarks of social development. Their feelings of *unity and togetherness* gradually deepened sharply which was recognized through their voice and clappings. It sparked many 'learning issues' to be faced by the group.

#### 5.3.3. A Teacher Trainee Became Aware of 'Self'

PBL was small group learning of teacher trainees. In a group, at first instance one teacher trainee was not known by other trainees in relation to their backgrounds. They were all aware of their resemblance about their background in relation to their B.Ed course which was quite natural. It was however, in due course of PBL process, the future relationship with one another was developed. It was the base how the group learning facilitated towards one to one relationship among teacher trainees.

### Evidence 4

#### Group TT<sub>1</sub>

#### Problem Scenario-1

**Saket** informed the drastic condition of environment. He informed the dangerous effect of pollution

**Deepti** recognized the learning issues.

**Jalpa** was doubtful about the solution and learning issues of the problem. She was asking repeatedly to Saket.

**Mamata** was listening and all on sudden asked for writing the list of known data. She had eye contact towards Saket.

**Jalpa** nodding her head, said yes!

Then all distributed the work of PBL activity as per its steps.



## Group TT<sub>2</sub>

There was difficulty in finding out the learning issue. So, the researcher facilitated to search the main learning issue and then asked to link ideas to find out sub-headings of learning issues. **Darshana** and **Palak** re-read silently the scenario and recorded the points.

**Anita** clarified about carbonate and bi-carbonate to the group.

**Darshana** put a question ‘what’ and ‘why’ of bi-carbonate effect towards pollution to the group. At that time **Anita** was serious about the present situation while giving the reasons for the effects of carbonate and bi-carbonate towards pollution. Her eyes were bold and voice was thrilling. She was excited to give information about the impact of increase of 1 degree celsius temperature in the glacier. This caused great *anxiety* among the teacher trainees.

**Nikita** supported Anita and was careful towards the view points of Anita. She convinced the same to Geeta. She was comfortable to explain within the group.

**Komal** found out global warming as one of the learning issues in course of Anita’s clarification. **Geeta** added economic issues towards global warming. She was shocked about the severe issues of global warming.

## Observation 4

Through such discussion, the *responsibility* of taking a task for each member was refined. The distribution of work was done under five headings: Known data, Needs to know, Learning issues, possible solutions and the solutions. That was ‘*division of work*’. It was clearly recognized through group responsibility.

### 5.3.4. Teacher Trainees were Different from One Another

Analysis of group interaction revealed that initially all teacher trainees were comfortable in mixing with each other, present and well mannered. They were quite graceful in exhibiting their behavior in front of their colleagues. However, there were two teacher trainees whose behavior indicated some deviance in their group behavior. Thus, differences between one another were marked in the PBL group.

## **Evidence 5**

### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Mridula** was listening to Saket. She kept her hands under the chin; stroking chin sometimes. How did you find it? **Jalpa** asked. She understood some points selected from the collected material. She took some points told by Saket. It was supporting to the view point of Saket.

‘Good’ **Mridula** said.

‘This might be a possible solution to our problem’ said **Deepti**.

“Look here” **Jalpa** said, “The diagram was drawn to show the multiple uses of electronics which affects the pollution”.

“Very good illustration” appreciated **Mamata** and **Neelam**.

**Mamata** joined in conversation with Jalpa and others.

They were leaning towards the table.

**Neelam** did not like to answer. She had written only lines. She was looking at other.

### **Group TT<sub>2</sub>**

**Geetanjali** raised the issue of ‘Chipko Movement’. She explained contribution of this movement towards Green-house effect. She was loud in her explanation. She was straight and leaned forward. Her eye was focused towards the centre of the group.

**Palak** raised solar issues.

**Nikita** gave examples on the effects of smoke and fog in winter in Kutch district of Gujarat state.

**Komal** appreciated! Said very true! We all are experiencing.

**Anita** summarised all instances and confirmed that pollution is acute.

**Darshan** was only writing something. But she was saying nothing.

## Observation 5

The reactions to one another with regard to number of things were *well-behaved and humble*. Saket, Jalpa, Mamta, Deepti and Mridula were *participated well* but, Neelam was not participating. She was *isolated*. However, irritating towards other teacher trainee was not seen. Successful *inter-personal adjustment* was lacking within Neelam.

Anita, Komal, Palak, Nikita and Geetanjali all of them contributed towards explaining the issue of pollution But, Darshana was silent and was not participating. It means that her ability to adjustment towards others was not healthy.

### 5.3.5 How Did One Do What She\He Did?

As one teacher trainee approached another she\he might be casual, relaxed and at ease. She\he might be friendly or hostile, confident or afraid. She\he may have the right words or still be relying on body movements. The quality of one's approach to another was seen by the quality of his\her voice, the rhythm, fluency and tempo of his\her speech, facial expression and gestures and postures. These were all in one integrated response. Therefore, it was more important to see when teacher trainees did something and working out their social relationships during exploring the materials.

#### 5.3.5.1 Body Position and Movement

Body expression is apart of personality expression. A person's body is himself. He uses it, as he feels. The tilt of the head, the use of the hands, body stances, amount of body activity even, body contacts all are means of communicating. Trust & Fear, Confidence & Inadequacy, all found expression in body posture. So the body movement gave an indication about some sort of social skill behavior.

## Evidence 6

### Group TT<sub>1</sub>

#### Problem scenario-2

**Bacteria are bad or right?**

**Not always**

**Yes, they can cause illness. But some of them are actually good for you.**

**In short, while harmful bacteria hate your guts, good bacteria love your guts.**

- ❖ **Devise a safe plan and programme for this possible good or bad bugs.**

Discussion on effect of micro-organism was going on. **Jalpa** gave some tips. **Mridula** added fascinated facts related to health matter. **Saket** explained different situations. At that time, **Jalpa** was nodding her head.

**Mridula** was saying ‘yes’, ‘yes’.

**Mamata** was blinking her eyes slowly.

**Jalpa, Mridula** and **Deepti** were sitting close to each other. Their hands were flat and down and palms were open. Their chest and head were inclined forward.

**Neelam** was pointing her fingers of right hand towards **Deepti** and **Mridula** to indicate some points.

**Mridula** was listening to her.

**Neelam** had firmly eye contact towards her.

### Group TT<sub>2</sub>

**Geetanjali** asked what useful bacteria for food are?

**Anita** was prompt to answer the name of bacteria which were beneficial to a human being.

**Geetanjali** stressed her question again. She had eye contact towards **Anita**. She was sitting straight. Her hands were open and kept her palms flat on the table.

**Nikita** queried about bio-degradeable, another point of useful bacteria.

**Palak** tried to answer relating with toxic agent. She had eye contact towards Nikita while answering.

**Darshana** was listening to both conversations. All on sudden she identified some points as learning issues and told to note in the list.

### **Observation 6**

All teacher trainees were *responsive* towards each others' ideas. Spontaneous link to continue the *discussion* was found. The discussion was common to all. *Firm trust, willingness to receive, encouraging and alertness* in finding common agreement were implicitly shown by the teacher trainees. It was shown within one and all.

#### **5.3.5.2 Quality of Voice**

This was an integral part of communication. As and when an individual speaks, his/her emotional state is revealed.

### **Evidence 7**

#### **Group TT<sub>1</sub>**

##### **Problem Scenario-1**

**Saket** was informing global situation. His tone of voice was loud; his accent was used to draw some judgments. His concern was about population growth. He was very much excited to convey a case-study on population growth. He was speaking with a high-pitched voice; his chest was outward with an erect posture of sitting near to Mridula.

**Jalpa** raised her voice about Tsunami and its effect towards global warming. Her voice was increasing with loudness. She was posing her question to the group. She had eye contact within the whole group. She reacted to the situation of global warming.

**Neelam** and other had focused eye contact towards her.

All were raising their voice. It was noisy at that time.

## **Group TT<sub>2</sub>**

Various points were raised about causes of environment pollution. **Geetanjali** informed the effect of ultra-violet light towards different species in the world. She was fluent in her speaking. Her pitch of voice was raised.

**Anita and Nikita** added some points with a picture presentation.

**Palak** told 'we should live and allow living others'

**Geetanjali, Anita and Nikita** told the same. They complimented Palak. They shook hands with each other.

## **Observation 7**

The situation was *stimulating* for good articulation on the part of Jalpa and Saket in their views.

### **5.3.5.3 Facial Expression**

This was related to communication. This accompanied 'quality' in speech.

## **Evidence 8**

## **Group TT<sub>1</sub>**

### **Problem Scenario-1**

**Mridula** was noting the points. She read out loudly what she had written on her diary. She had written the points which were agreed by others.

**Saket** was smiling towards her activity.

**Anita** was inclined forward. Her head was forward and towards the centre of the group.

**Jalpa** was nodding her head. She was listening to what Mridula was loudly reading

**Deepti** was looking at Mridula. Her hands were flat and kept on the table.

## Group TT<sub>2</sub>

**Anita** informed carbon and Oxygen were main components in any pollutant.

**Geeta, Komal** and **Darshana** were also suggesting the same elements.

**Komal** was insisting Geeta to write something. She was easy to look her notebook; her eyes were calm and straight forward towards Geeta.

**Anita** was emotional to the situation. Her eyes were bold and thrilling in her voice.

**Komal** convinced her views to Darshana. There was face to face eye contact between them. She spoke with high pitched, modulated voice with ease while explaining to Darshana.

**Komal's** gesture and posture was right towards Darshana.

## Observation 8

Komal was objective and intelligently *communicating* her ideas to Darshana and others within the group. Mridula was taking approval of others and hence, communicating the issues clearly. Others were agreed upon those written points as it was understood from their non-verbal gesture and posture during listening to Mridula's points. Their *face to face eye contact, feelings while explaining, thrilling expression in the voice and modulations with ease* were the ways of communication.

### 5.3.5.4 What Did the Teacher Trainee say? And How Did the other Respond?

Speech did not reveal everything. But, it talked a good deal. The actual dialogue and conversation between the teacher trainees could describe the response and their behavior patterns in group setting.

## Evidence 9

## Group TT<sub>1</sub>

### Problem Scenario-1

The conversation between teacher trainees is shown

**Saket:** New carbon number is the effect of increase of carbon dioxide (CO<sub>2</sub>) in the atmosphere.

**Deepti:**It is the phenomenon of thermostat.

**Mridula:** How is it fixed carbon number?

**Neelam:** ‘OK’. This may be true!

**Jalpa:**It is carbon’s new mathematics number

**Saket:**Carbon number is always changing

**Mamata:** Due to environment pollution

**Neelam:** Carbon number will never be constant!

**Jalpa:** (nodding her head) Carbon’s new mathematics number will always change

**Deepti:**“Hey!” (High pitched voice) It is the problem of environment pollution

**Neelam:** (Head tilted forward) Now what is the value of carbon number?

**Mridula:** No answer, looking towards Neelam.

**Mridula** to **Deepti:** Rise in temperature creates problem to the environment

**Jalpa:** (Silent and Grave) now it is serious

**Mamata:**Global pollution!

**Saket** joined his finger tips of both hands together, and explained one instance of pollution.

**Jalpa, Mridula** and **Deepti** had eye contact toward **Saket** during his clarification.

### **Group TT<sub>2</sub>**

**Geetanjali:** Migration causes global warming.

**Darshana:** I am not able to understand and please clarify again (with cordiality)

**Nikita:** Said plant migration may be one of reason

**Komal:** (Astonished) how could it be? Can you please repeat the sentence?



**Anita:** displayed a PPT presentation on global warming.

**Komal:** (Loudly) read the points on normal migration

**Geetanjali:** This is bio-diversity phenomena. Then, she related bio-diversity with cause of global warming

**Komal:**(Maintaining an erect posture) Yes, Yes, Very true!

**Palak:**(Clapped her hands) Good PPT!

### **Observation 9**

This quoted a dialogue, approaching to *apart of relationship*. It was an act of social behavior of teacher trainees. What did the other trainee do and say? Such record was an easily understood illustration of how behavior was affected by other trainee's responses.

### **5.3.5.5 What Happened Next in Relationship?**

Approaching each other was a meaningful relationship. After it was made, then what the teacher trainees did? Did the trainees carry on conversation?

Whether the contact/ approach blossomed into a new and additional consideration? To what extent it worked out the problems both of intellectual comprehension and of emotional complexity? The characteristic way in which one member was likely to respond with other members emerged the pattern of behavior.

### **Evidence 10**

#### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Saket** questioned "if carbon dioxide (CO<sub>2</sub>) will increase, what will be the situation of the earth?"

**Mridula:** Looking with wide opened eyes towards Saket.

**Mamata:** (Impatiently) "No, No"

**Deepti:** Listening to him, kept her hands under the chin.

**Jalpa:** (Loudly) put questions to Saket.

**Saket:** Demanded for facts from Jalpa

**Mridula:** Introduced the Copenhagen Summit's result.

**Deepti:** (cheerful) India is leading nation to take major steps towards environment pollution!

**Neelam:** Good news!

**Saket:** OK! (Appreciating the news)

### **Group TT<sub>2</sub>**

**Geeta** started conversation on global warming at ease with Nikita.

**Nikita** was recording to the writings. She invited Geeta to read out the written material.

When Geeta was reading; **Nikita** was close to her seat. She was along with Geeta's statements. She tried to make understand within two to three lines. Some mechanism of carbon in the environment was explained by her.

**Geeta:** How it occurred in the environment?

**Nikita:** To search out 'cause and effect' relationship. She made eye contact towards Geeta.

**Geeta** was come near with Nikita's points.

### **Observation 10**

It was way of exploring one to one approach making *inter-personal relationship* and developing *friendship* between Geeta & Nikita. Saket gave authentic and more important material. Approaching towards one another with scientific outlook was a *part of relationship*. After that, the other trainee's response determined further action. It revealed *orderliness* among the teacher trainees.

#### **5.3.5.6 Emotional Association**

A teacher trainee in the group played the role in relation to his/her feeling and attitude towards others. How he/she acted out the respects of filling and how he/she thought others fill toward each other were recorded.

## **Evidence 11**

### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Jalpa** was explaining her views. She called other trainees. Listen my dear! (Softly) and told that 'Global warming is danger to our future'

**Saket:** "All right"

**Mridula:** Silently looking to Jalpa

**Deepti** was silently looking towards Jalpa and nodding her head. Her seating posture was straight. Her fingers were touched her cheek. She was ready with a pen to write something.

**Neelam** put her hands under the chin with pen in between fingers. She was looking towards Jalpa. **Jalpa** looked serious in her facial expression; stroking her chin; palms were crossed and closed and put below the chin.

**Saket** with an eye contact towards Jalpa initiated discussion on the points one by one. He forwarded a case-study experimented in western country to convey the future shock happened due to global warming.

**Jalpa** saying 'Yaah', 'Yaah' (Pointing her fingers to the table)

**Saket** continued to say about global situations. His tone of voice was loud; his explanation gave a clue to draw some judgment.

**Jalpa** made sincere thanks to him.

**Deepti, Mridula and all** clapped for him.

It also caused thrilling among **other teacher trainees**.

### **Group TT<sub>2</sub>**

**Anita** explored the general doubt on R<sub>22</sub>, CFC. She explained about its use and application.

**Geetanjali, Nikita and Palak** requested Anita to explain further.

**Anita** searched in the internet and informed about R<sub>11</sub>, R<sub>21</sub>, etc.

**Palak, Nikita and Others** were prompted to write in their diary.

**Komal** approached the screen and loudly read out the details which were displayed on the screen.

Slowly, all moved near to the screen and recorded the informations about R<sub>21</sub>, R<sub>22</sub>.

Lastly, all thanked Anita and made clappings.

### **Observation 11**

One tried to clear the doubts through explanation and then further by using internet materials. It motivated to approach each other while they were clarifying the doubts. Thus, the way of behaving was consistent in the group learning. It was seen that attitude changed their role in indifferent contexts. The evidence demonstrated certain behaviors like *carefulness, curiosity, conflicting own self* through brain storming among the teacher trainees of particular PBL group.

#### **5.3.6 Pattern of Behavior**

The characteristic way in which the trainees responded in their relations with other trainee emerged a pattern of behavior. The changing pattern of behavior towards socialization indicated the success of PBL in group fashion. The pattern of social skill behaviors were organized by clustering the items around such categories as the following:

##### **5.3.6 .1 Evidence of Interest among Teacher Trainees**

Direct evidence was the number of trainees approached with each other or positive approaches in-between the trainees. Looking to one, listening to others, imitating and recording the points were indirect evidences of interest within teacher trainees.

##### **5.3.6 .2 How were Contacts Made?**

The way, the teacher trainees moved toward others (Initially or always) and how one move were studied. The movement was both appealing to some trainees and sometimes uncertain and unassuming. The trainees responded to the behavior of others through appreciating their ideas and giving suggestions with consent of others. The

trainees were questioning and excited to discuss different components of problem scenario. They were interested to collect data to find out possible solutions. There was interaction through talk, conversation, dialogue and demonstration of ideas. The correspondence was also made when one was calling to seek informations through internet search. In this way, the contacts among one and all was made.

### **5.3.6.3 How Did One Behave with Other Teacher Trainees?**

#### **Evidence 12**

#### **Group TT<sub>1</sub>**

##### **Problem scenario-1**

**Saket** put another issue of plasma research to explain nuclear fusion and fission. He was stroking his chin. He informed its dangerous effect to the group.

**Jalpa** was listening and had kept an eye contact towards Saket.

**Deepti and Mamata** both asked a question. Their heads were inclined forward.

**Saket** was sitting erect and answered the questions. He explained the dangerous impacts of global warmings.

**Neelam** was listening to their questions and answers.

#### **Group TT<sub>2</sub>**

**Anita** in the group put her ideas on causes of pollution. She was very much eager to narrate some issues relevant to pollution. She was encouraged by others also. Her contribution in giving ideas and suggestions on pollution was accepted by all.

**Palak and Darshana** at that time, made some clarifications.

Sometimes, **Komal** was repeating her explanations.

**Anita** was amicable. She had clear tone and high pitched voice during her conversation.

**Nikita** was listening to her.

**Geeta** was recording key points.

## Observation 12

In order to understand one, the recording of one's behavior was analyzed to know to what extent one was *aware of other's right*. To what extent one was able to *help others*? Did one contribute ideas and suggestions? And, to what extent? How was one able to *share materials*? What was general *tone* at group work? Anita's suggestion were consistent with other trainee's ideas. Hence, it was accepted by all. Thus, One's *wishes, desires and annoyances* etc., were understood during group learning.

### 5.3.6.4 What seemed to be one's Feelings About other Trainees?

The feelings of likes and dislikes were the nature of inter relationship. Even the paired work was demonstrated which was kind of special friendship.

## Evidence 13

### Group TT<sub>1</sub>

#### Problem scenario-1

**Mridula** started conversation with ease on circumstances of carbon number. She had direct eye contact towards Deepti. She was listening attentively.

At that time **others** looked at her.

**Deepti** shared her point with Mridula. She was bent right way towards Mridula. She was pointing her right hand fingers towards Mridula to indicate main points.

**Mridula** was listening to her. During that period, she invited Mridula to read out the point which was included in the material.

**Deepti** was saying the things within 2-3 lines to make understandable. Different forms of carbon and some chemical compounds were clarified by each and everybody.

### Group TT<sub>2</sub>

**Nikita** presented a cartoon picture drawn by her. It was about the effect of pollution.

**Geetanjali** suggested making sun cry in that picture.

**Anita** supported her suggestion and drew the same in that picture. she stuck a pen in her mouth.

**Nikita** told Waahh!

**Darshana** put another idea of solar cooker effect.

**Komal** was sitting with her arms crossed over the chest. She was asking reason about solar cooker.

**Palak** said o.k, o.k, its pollution free!

### **Observation13**

Mridula with Deepti and Geetanjali with Nikita were approachable to each other while discussing. One was inclined to others to discuss unanswered questions and made clarification in an amicable way. The approach towards each other developed their *inter relationship*.

#### **5.3.6.5 What Position Did One Take in Relation to Other?**

The seating arrangement of all teacher trainees was circular. But none of the trainee's position was fixed. However, the pair of trainees in relation to certain personality or inter personal relationship were understood from their positions. Most of the time, in first group, **Saket-Jalpa**, **Mridula-Deepti** and **Mamata-Neelam** positions were maintained in pair. Similarly, **Anita-Nikita**, **Geeta-Komal** and **Palak-Darshana** were paired that was developed in the second group.

#### **5.3.7 Evidence of Growth**

Comparing the first day and later days' behavior of teacher trainees, their performance became mature. Summing up the generalizations in the light of the pattern of emerged behaviors, the study brought into focus an image of how group learning was effective in the solution of real life problems to construct social skill behaviors.

Thus, it was understood that socialization took place in the group during PBL. The pattern of behaviours exhibited by the participants during socialization were analysed below.

## 5.4 Case Analysis:

In order to identify the social skill behavior, the activities and interactions observed during PBL activities have been analysed. It may be mentioned here that not all interactions have indicated the social skill behaviours and therefore, only those interactions which have demonstrated the exhibition of social skill behaviours have been presented.

### Illustration-I

#### Group TT<sub>2</sub>

#### Problem Scenario-1

*“You are resource person with the environment protection organization. A call came once to you.*

*The world is growing up thermostatically, put by a carbon's new mathematics number. This number is equated to a global average temperature of about 57<sup>0</sup>Fahrenheit. The increase in temperature may be due to factors of construction of cities in all places, production of crops, air and water supplies being used and even the changes of the seasons at higher latitudes get across our psychological calendars.*

- *You estimate the components of carbon which meets the climate challenge.*
- *Find solutions to check in case it actually record rise in atmospheric carbon dioxide (CO<sub>2</sub>) level*
- *Investigate if there seems difficult to get greener always.*
- *You must give warning(s) that could be affected by this challenge”.*

**Anita** explained “due to increase in carbon dioxide (CO<sub>2</sub>), temperature increases. Temperature of land air and upper surface of the sea level increases. It also affects cultivation and rate of food productivity. The situation becomes so dangerous that water moves upward; minerals go upward affecting the geography of life on earth”. She was in an erect posture while explaining an example relating to the



cause of pollution. She was looking bold in her eyes. She was straight forward in telling these facts. Her pitch of voice was high. There was complete pin drop silence in the room. Others were listening silently. She answered the questions of others quickly. She proved the carbon's new number in front of all teacher trainees.

**Geeta** gave an account of rise in temperature. She was saying that "It was due to green house effect which brought changes in carbon number. The change in carbon number would be the new mathematics number of carbon."

Further, **Nikita** drew attention of all trainees to indicate green house effect as the main reason. This caused to bring about carbon's new number.

**Darshana** raised question related to thermostat.

**Geeta** told yes, yes, .she remarked that was to be emphasized!

**Anita** told, "That's true."

**Komal** repeated the same question to know the meaning of thermostat.

For a while, the group was silent and the discussion came into a halt. All of them were engaged in serious thinking.

### **Observation-I**

The teacher trainees were engaged in finding the carbon's mathematics number in a group. They were keen towards the calculation of mathematics number. They were desirous to see the logic of this calculation. So, it is understood that teacher trainees were deeply thinking. It inferred their development of socially accepted behaviours like *eagerness, interest, stimulation of action, excitement and empathy*. Similarly, boldness, fearlessness, answering the fact quickly were other type of behaviors tends to prove *confidence* among teacher trainees.

### **Illustration-II**

#### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Mamata** read out the written series of points. She narrated the list of "known data" of the problem scenario. She showed the following sequence of given data located in the problem scenario.

- 1) The civilization is growing up in the world.
- 2) Thermostat- A constant temperature
- 3) Causes of new carbon are
  - a. Our modern cities
  - b. we eat Crops that made of pesticides
  - c. Air & water used
  - d. Passage of season
  - e. Global average temperature of about 57<sup>0</sup>F.
  - f. Psychological calendar according to 3 seasons.

The detailed points under “known data” were agreed by other trainees.

**Jalpa** approved the list of data on ‘what is given’. Other teacher trainees read out the statements again and again and approved her list. She then found another step of problem solving. She informed the group to find the list of ‘Need to know’.

**Deepti** found certain issues during learning and made a list of learning issues. All were easy, comfortable, looking towards each other, smiling, opening reflective diary for recording their information.

**Mridula** and **Deepti** both were helping Jalpa about what is to be recorded under the column ‘Need to know’.

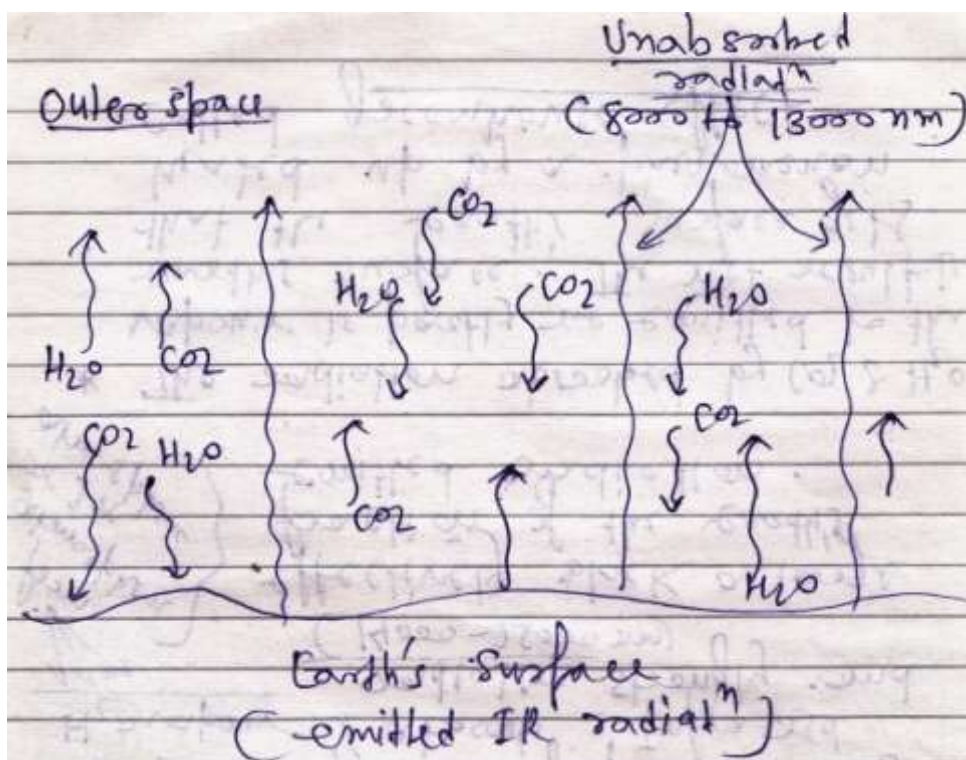
During those times, **Neelam** and **Mamata** were silent & grave. They were engaged to write those things on their diaries.

**Jalpa** pleaded two points for ‘need to know’. (1) Accumulation of Water (H<sub>2</sub>O) droplets (2) Formation of glaciers.

**Saket** was excited to make clear the meanings of the green house effect through diagram. He produced a picture by making arrow marks and straight lines (**learning log 5.1**).

## Learning Log 5.1:

### Figure of green house effect



The figure was appreciated with open clappings by all teacher trainees. **Saket** again tried to clarify the effect of increase of CO<sub>2</sub> towards atmosphere. **Jalpa** and **Deepti** were exchanging their view points with Saket. **Neelam** was open to talk with Saket. She reasoned out the cause and effect of CO<sub>2</sub>. She received the answers of the effects of CO<sub>2</sub> from Saket. She had firm eye movement at Saket. Her palms of both the hands were open during her argument to claim the cause of CO<sub>2</sub> towards situations of atmosphere. She was nodding her head when collecting the responses from Saket and other teacher trainees. The teacher trainees were silent during their conversation. They accepted their points. They recognized the key points from their discourse. While the discussion of Green House Effect was on, a significant point was raised by Saket i.e. sinking of carbon dioxide. He has presented the idea in the following figure (**Learning log 5.2**).

**Deepti** clapped being happy with this figure.

**Mridula** marked the figure as correct.

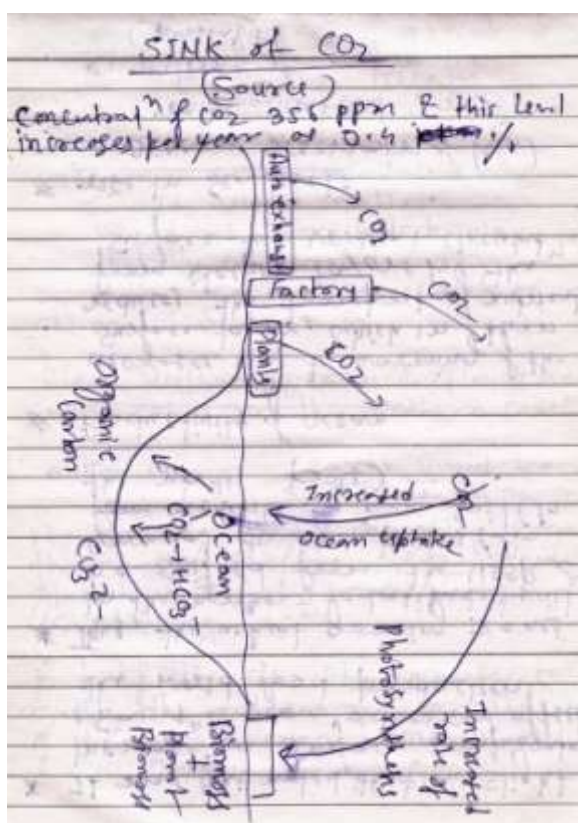
**Mamata** and **Neelam** understood the central idea of the figure. All were looking to this figure.

**Deepti** recognized the concept of the figure as new one.

**Mridula** had eye contact towards Saket while Deepti was saying.

## Learning Log 5.2:

### Figure of Sink of carbon dioxide



### Observation-II

The teacher trainees in the group had a particular task during learning. The task was distributed as per the steps of PBL process. The steps were clearly identified as 'Known Data', 'Needs to know', 'Learning Issues', 'Possible solutions' etc. When one was preparing 'known data', other two listed out 'need to know' and another trainee collected the issues to make ready of list of 'learning issue'. This implied a clear distribution of work in the group. Thus, 'division of work' principle was adopted which proved the group is making as a "community". Also there was spontaneity of participation among teacher trainees during discussion, dialogue and conversation on

related issues and drawing of figures. They took responsibility of their distributed work and shared in their exchange of views. They also worked in pairs. They worked together during the course of conversation and drawing of figures. So, it is concluded that *sharing, co-operation and collaboration* were the social skill behaviours which developed in group work. Further, one trainee led the group to learn new concept. It developed *trust* on others. This demonstrated *confidence* of the trainee. Thus, learning results *autonomy* in doing, *satisfaction* and overall *enjoyable* to them. *Pleasure and gratitude* were another distinct component of social skill behaviours found in the group.

### Illustration-III

#### Group TT<sub>1</sub>

#### Problem scenario-2

**Bacteria are bad or right?**

**Not always**

**Yes, they can cause illness. But some of them are actually good for you.**

**In short, while harmful bacteria hate your guts, good bacteria love your guts.**

❖ **Devise a safe plan and programme for this possible good or bad bugs.**

**Mridula** read out the statement of the problem scenario. She was showing her fingers of right hand while talking the sentence that ‘bacteria causes illnesses. Her eye contact was on the right towards Jalpa. She was repeating the sentence with normal voice.

**Mamta** started asking what are Bacteria? .Her eye contact was towards Mridula.

**Mridula** was stating (85-90) % of Bacteria are harmful to human body.

**Mamta** queried ‘what is the percentage of harmful effect of bacteria?’ She then asked to list under ‘needs to know’. She said ‘I am preparing the list’. All on sudden she started reading the list of ‘known data’.

**Mridula** generalized Bacteria means diseases.

**Neelam** guaranteed 85% of bacteria are harmful. She had eye contact towards Mridula. Her notebook was open and she was beating to the written page with her pen. She was slow in her voice.

**Jalpa** was engaged in opening a page on the computer screen to display diagram of bacteria.

**Mamata** was continuing to read the points noted under 'needs to know'. She told bacteria are good for alimentary canal.

**Jalpa** informed to the group that some bacteria are virus and protozoa. She was slowly repeating the terms.

**Mamta** was repeating the names along with Jalpa.

**Saket** was sitting with his arms closed and looking at his own diary.

**Neelam** informed Pro-Biotic as the nature of bacteria

**Saket** Hanh! , Haah! Thia is pro-biotic.

**Jalpa** displayed a picture during the announcement

**Mamata** appreciated Jalpa for her effort to show the diagram. She then explained that she could not collect the diagram from the internet.

**Neelam and Mridula** both read loudly the labels of diagram.

**Neelam** showed her fingers towards the screen and she asked Saket what is duct?

**Saket** said endocrine gland is the place where duct is secreted. He explained further. His eye was focused towards Neelam and Mridula. He was nodding his head.

**Neelam** was repeating some words said by saket

**Mridula** leaned forward and kept eye contact towards Saket.

**Mamta** was looking at Saket. Her hands were on the table. She was smiling. Sometimes her lips were up and down. It appeared her promptness to say something. She was trying to repeat some of words told by Saket.

All were focused towards the discussion about the diagram and agreed that digestive system is important part of human body where, bacteria are found.

### Observation-III

One initiated reading the statement of the problem loudly, another found 'known data' during reading. When it is asked to list out, it was communicated in the group suddenly. This showed that all were **active participants** through reading, listening and writing the matter. When the term 'bacteria' came into play another displayed the diagram of digestive system to show alimentary canal of human body. The discussion was centered on the places where bacteria are found. All were participating. One after another, they were entering into the dialogue and discussion. It was the way how all got involved in the process of **discussion**.

### Illustration-IV

#### Group TT<sub>1</sub>

#### Problem Scenario-2

**Mridula** raised a doubt on guts and asked to the group. She hadan eyecontact towards Mamta.

**Mamata**asked the position of bacteria in our body

**Mridula** referringto her notes told the name of system of our human body.

**Mamata** reviewed the previous days' work and read out those to recall the point. She accepted the answer of Mridula.

**Jalpa** said "Bacteria are found in digestive system and alimentary canal. Oseophagous and pancrease are seen in the digestive system". She asked on which body part the bacteria can be found?

Neelam said there are about 300 to 400 bacteria found in digestive system.

Mridula read some lines from the material collected from the internet. She could not understand and sought help from the group.

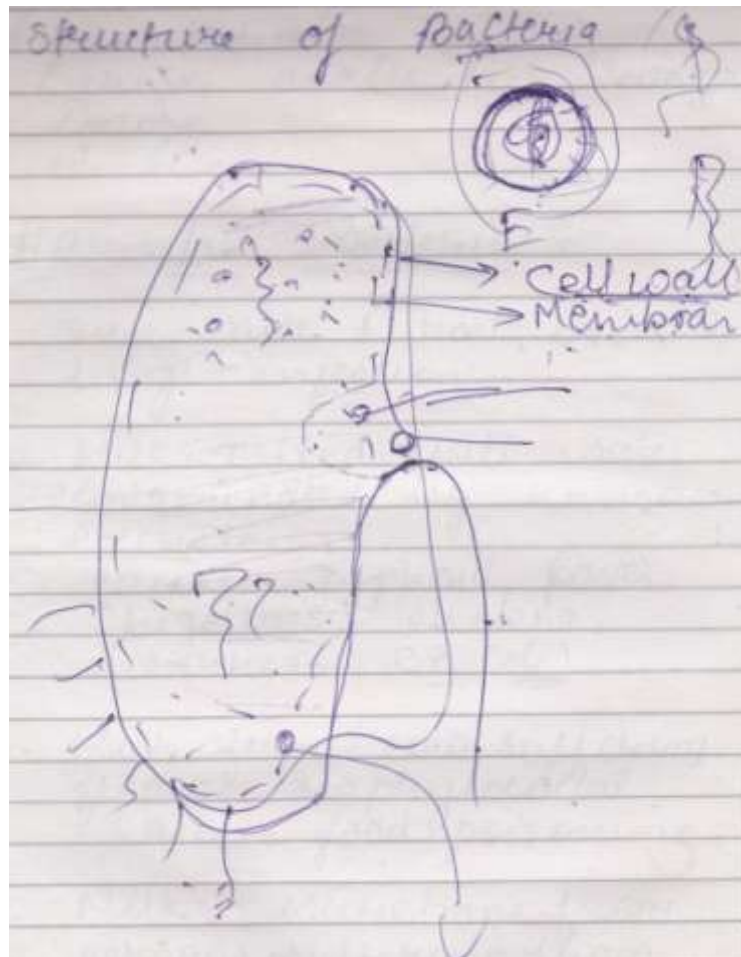
Mamta was very eager to look at the paper.

Neelam was silently looking towards the paper which was placed infront of her.

Jalpa was prompted to take that paper from Mridula.All on sudden she drew a picture to explain the structure of bacteria (**Learning log 5.3**).

### Learning log 5.3:

#### Structure of Bacteria



**Mridula** informed about two types of bacteria. Her face was towards Saket and Jalpa. Her hands were open. she slowly and clearly told the name of bacteria.

**Mamata and Neelam** were looking towards her.

**Saket** explained further the structure of bacteria.

**Jalpa** showing the diagram drew some dots and lines to explain the movement of bacteria. She was drawing dotted lines while fluently narrating the same.

**Mridula** was focusing her eyes towards the diagram.

**Neelam** was drawing that diagram on her own notebook.

**Saket** questioned to Jalpa in order to explain further. others were listening to him



Jalpa was sitting straight. Her left hand supported to the table and she was writing by her right hand on the paper. She used her pencil frequently on the paper to explain the structure of bacteria. Her paper was placed in the centre of table. All were focusing towards the diagram. She was saying all key parts of bacteria. She was also answering the questions raised by Saket and Mamata during her explanation.

When jalpa was busy in explaining to Mamata and others **Saket** was helping to Mridula to make understandable about how Bacteria makes movement in the human body. He was even adding some points towards the explanation of Jalpa.

#### **Observation-IV**

It was seen that when one was putting question during some explanation, others were listening silently and another was answering. There was complete **discipline** found among the group. All were agreed upon one idea. It illustrated the common agreement between one and another. All were focused to understand the structure of bacteria through diagram. It was led by one and followed by others. Inquiry through question-answer was developed. This proved **confident behavior** of teacher trainees during the completion of a particular task in the group.

#### **Illustration-V**

##### **Group TT<sub>2</sub>**

##### **Problem Scenario-1**

**Anita** informed about the impact of rise of 1 degree Celsius temperature in the glacier. She had eye contact towards Darshana. She summarized the situation in her own language and words;

‘It is noted that a slight increase in surface temperature, say 1°c can adversely affect the world food production’.

**Geeta** and **Nikita** extended their view points to initiate discussion.

**Nikita** became serious to understand this situation. **Geeta** and **Komal** excited to know the hazardous situation of environment and expressed loudly Oh! Yah!

**Geeta’s** voice was thrilled and loud.

**Komal** was surprised to know the danger of the situation. She was reactive. Her face was pale coloured. She was not normal. She was emotional.

**Darshana & Palak** too joined in this noise. After a while, the group became silent and came into halt for few seconds.

**Komal** noticed this scenario as an alarming situation. She perceived 'global warming' as one of the learning issues. Her gesture and posture of hands were pointing towards the group. Her chin was upward and chest was projected outwards. Her Palms of both the hand were openly kept over the table. Her arms were vertically placed on the table while she was speaking to her friends in the group.

**Darshana and Palak** were recording and verifying the points with the sayings of Komal while recording.

**Anita, Geeta & Nikita** were silently listening to her.

**Komal** requested Darshana to read out the list of 'Needs to know'. The list was ensured by Komal.

**Darshana** was also ready to read out the list of 'Needs to know'. Her eye contact to each and every teacher trainees was moderate. She was speaking in a fast pace voice. She was rubbing her hair while announcing the points.

### **Observation-V**

Awareness about 'environmental change and its negative impact towards society' was made when one gave a clear generalization on environmental pollution. It was felt 'future shock'. Some teacher trainees were sensitive and saying Oh! Yah! Another trainee was narrating this as alarming situation. During this time trainees were also in *tense* which is inferred from their gesture and posture and body movements. That means the teacher trainees were sensitive towards the problem of environment. *Being sensitive towards social problem* is an indicator of social skill. Thus, characteristic feature of *good citizenship* was demonstrated by the teacher trainees. Further, two trainees *worked in pair* and took responsibility to ensure the list of 'needs to know'. They were verifying the points again and again before recording. This shows *autonomy* in their learning and *leading behavior* in the group.

## Illustration-VI

### Group TT<sub>1</sub>

#### Problem Scenario-1

**Mridula** picked up a sentence from the text. She read that sentence and explained to other trainees. She had an eye contact towards Deepti. She emphasised the fact that “rise in temperature creates imbalance to the environment”.

**Saket** repeated that statement to put further importance.

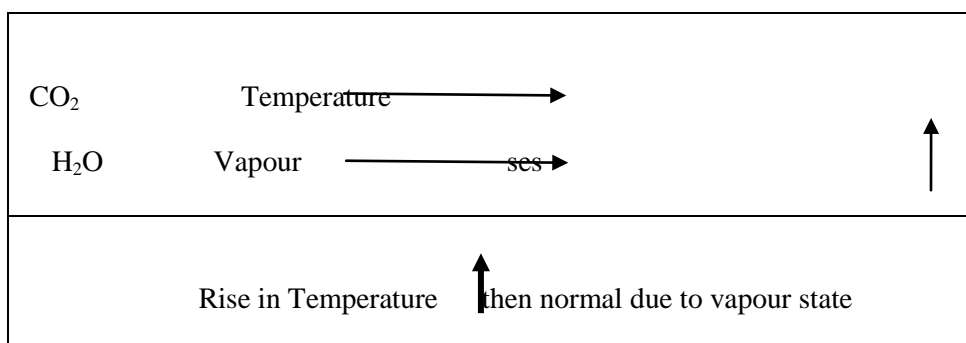
**Mamata** was nodding her head while listening to that statement.

**Deepti** was justifying that statement while reading. She made analysis on the given concepts to find as true.

**Saket** mentioned that “the temperature affects to the position of CO<sub>2</sub> and H<sub>2</sub>O. The combined effect of these elements cause global climate to a long range”. He further explained by drawing a figure instantly (**Learning log 5.4**).

#### Learning log 5.4:

##### Figure on Effect of temperature to Carbon dioxide



**Saket** calculated to show the increase of carbon dioxide which effect 3° C rise in temperature.

**Deepti, Jalpa** and **Mridula** were eager to see the steps of the calculation. They understood the result of mathematical calculation. this result shocked to them. They were frightened to think about the existence of earth to maintain one's life. They were grave and silent to ponder over the situation.

**Mamata** kept her palms open on the table. She was pointing her fingers to accept her stated points. She wrote and read the paragraph to clarify further. She highlighted two important lines of the paragraph: “The radiation absorbed by CO<sub>2</sub> and H<sub>2</sub>O is partly remitted to earth’s surface. The net effect on earth’s surface is getting heated which is called global warming”.

She was confident about the statement which was accepted by others. She tried to alarm the danger within the group.

**Jalpa** was listening to Mamata. Her eyes were focused towards her.

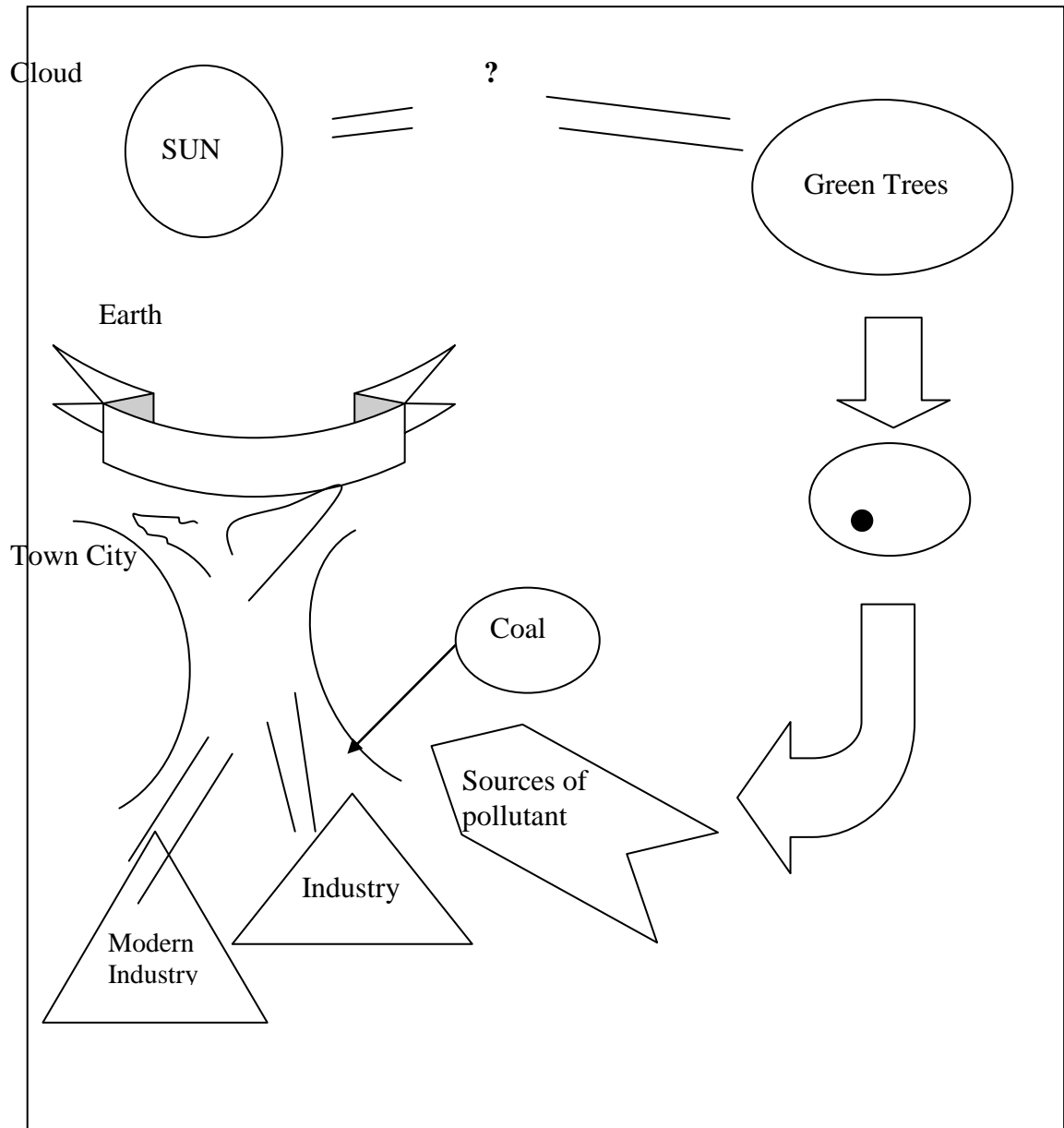
**Neelam** repeatedly say that “the increase in temperature of atmosphere is global warming”. It highlighted the sayings of Mridula, Mamata and Saket.

**Deepti** was nodding her head. She had an eye contact towards Mridula.

**Jalpa** was seated closely near to Mridula. She was looking her diary at a distance. She learnt a fact from the material of Saket. She was astonished to know about the 2% increase of carbon on earth. She tried to add and explain another point with the points argued by Saket. She was very prompt. Her eyes were open towards all. She had an erect posture and proper gesture of hands to convey her view serially. She had put forward a diagram to explain her view point (**Learning log 5.5**). The diagram was illustrating the cause of pollution due to multiple uses of electronics. While explaining she was posing questions to Saket. She tried to find facts.

### Learning log 5.5:

#### Figureon Imbalance of environment



#### Observation-VI

One teacher trainee illustrated the effect of temperature rise due to carbon dioxide through a figure. He tried to show  $3^{\circ}\text{C}$  rise in temperature through a calculation. Similarly another trainee pointed out a fact on imbalance of environment due to increase of 2% carbon on earth. The two illustrations were scientific. These illustrations portraided the evidence of *analytical thinking behavior* of teacher

trainees. While one teacher trainee was explaining, second trainee was listening to her, other trainees tried to analyse the text told by first one. They reasoned out the cause of rise in temperature. All teacher trainees accepted the conversation of others. This demonstrated *clarifying further and sharing* which led to reach them in a *common agreement* to the points.

## **Illustration-VII**

### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Saket** informed ‘vegetation is increased due to global warming’. All of a sudden **Deepti, Mamata and Mridula** raised the question how? They were desirous to know about vegetation.

Then **Deepti** argued that “vegetation is supported by carbon dioxide”. She argued differently. She then explained through data base related to this: “Around 2.7 billion years ago, the temperature due to carbon dioxide was 70°C. But Bacteria and other viruses slowly turned carbon dioxide into oxygen and the concentration of carbon dioxide in atmosphere dropped to just 0.038 °C temperatures”.

Similarly, **Mamata** informed “In 1880, carbon content was 283 PPM and at present it is 356 PPM”. She looked for interpretation of data to the effect of the rise in carbon. Then, she wondered to ask to what extent of carbon, human being can survive?

**Deepti** informed another fact that ‘Carbon dioxide is synthesized to photosynthesis’.

**Mridula** supported to her statement.

**Deepti** further explained that utilization of plant for release of carbon dioxide is needed.

**Saket** added the mechanism of metabolism process occurred during photosynthesis.

**Mridula** documented the data about vegetation.

**Saket** added “forest growth is the cause affecting vegetation”.

**Mridula** argued that “vegetation do not support global warming’. There was disagreement to the statement made by Mridula. All were in doubt about the meaning of vegetation. All were unclear to refine the concept of vegetation.

**Mamata** and **Neelam** were not satisfied with the view point of Mridula. They demanded for further clarification. They asked Saket to clarify the doubt. They had eye contact towards Saket. They were trying to find the data to elucidate on vegetation.

**Deepti** added how carbon dioxide helps in vegetation.

**Mamata and Deepti** disagree to such evidence. They inquired whether it was true or not?

**Saket** further presented another dimension of vegetation. He argued ‘pollution increases vegetation’. He was bold and determined with this statement. He repeated the same information to convey all.

**Mamata, Mridula, Jalpa and Deepti** agreed to what Saket said. They summarized the main points and tried to give remark towards accepting these points.

**Mridula** clapped. She was easy and comfortable to take part in summarization. Her facial expression was pleasant. She thought it may be possible! All remained silent. After some time one after another, believed the fact to be true. All accepted his views with clappings.

## **Observation-VII**

The illustration showed *one-to-one dialogue* on vegetation at first, then mobilizing towards group discussion among the trainees. Discussion was going on deeply; different views one after another were placed for argument. One was accepting when another was opposing the fact on vegetation. There was conflict on the theme of vegetation. After thorough analysis with evidences, it got simplified and synthesized to reach at a common point. When doubt on vegetation was formed, there was disagreement on different views. They contradicted to each other and then reached at common point. This was the way of *resolving the conflict*. After getting resolved, each contributed points were complimented by other teacher trainees.

## Illustration-VIII

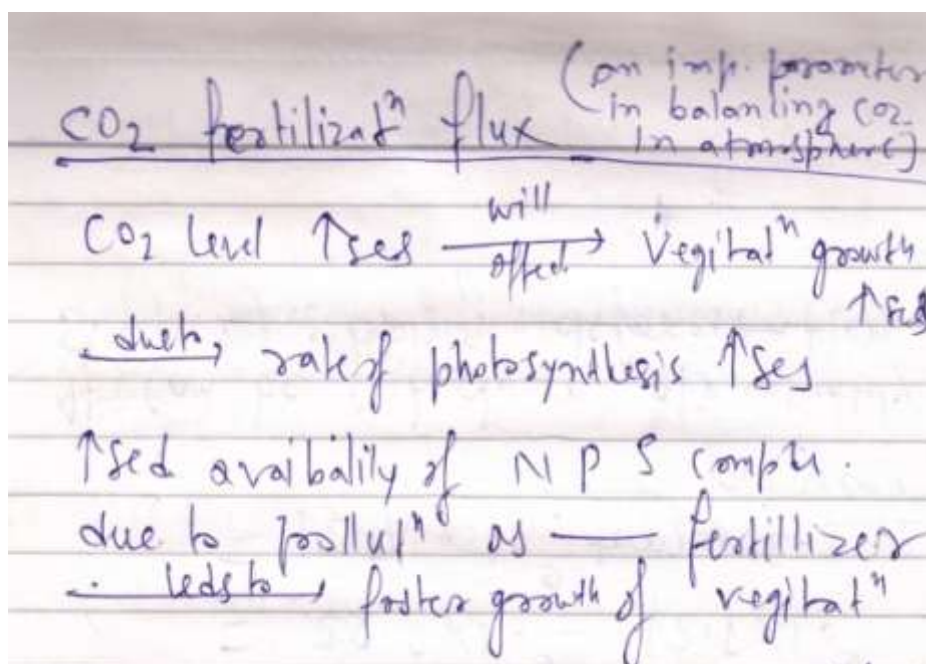
### Group TT<sub>1</sub>

#### Problem Scenario-1

**Saket** informed about the fertilizers of NPK, NPS which were used in plenty in vegetation. He analyzed the 'carbondioxide fertilizer flux'to illustrate an example. This explanation was done by Saket again through figure marker(**Learning log 5.6**).

#### Learning log 5.6:

#### Figure of carbon dioxide fertilizer flux



He convinced flux as a continuous change (a bodily discharge). He opined that “concentration of nitrates, phosphates and sulphates lead to enhanced growth of micro organisms leading to larger uptake of carbon dioxide by that water”. Such explanation was followed by a case study and also with an example which was describing the cause of environmental pollution. Other trainees were nodding their heads while listening to him. Facial expression was smiling. Eye contact was directed towards Saket. All said yes! and ok!

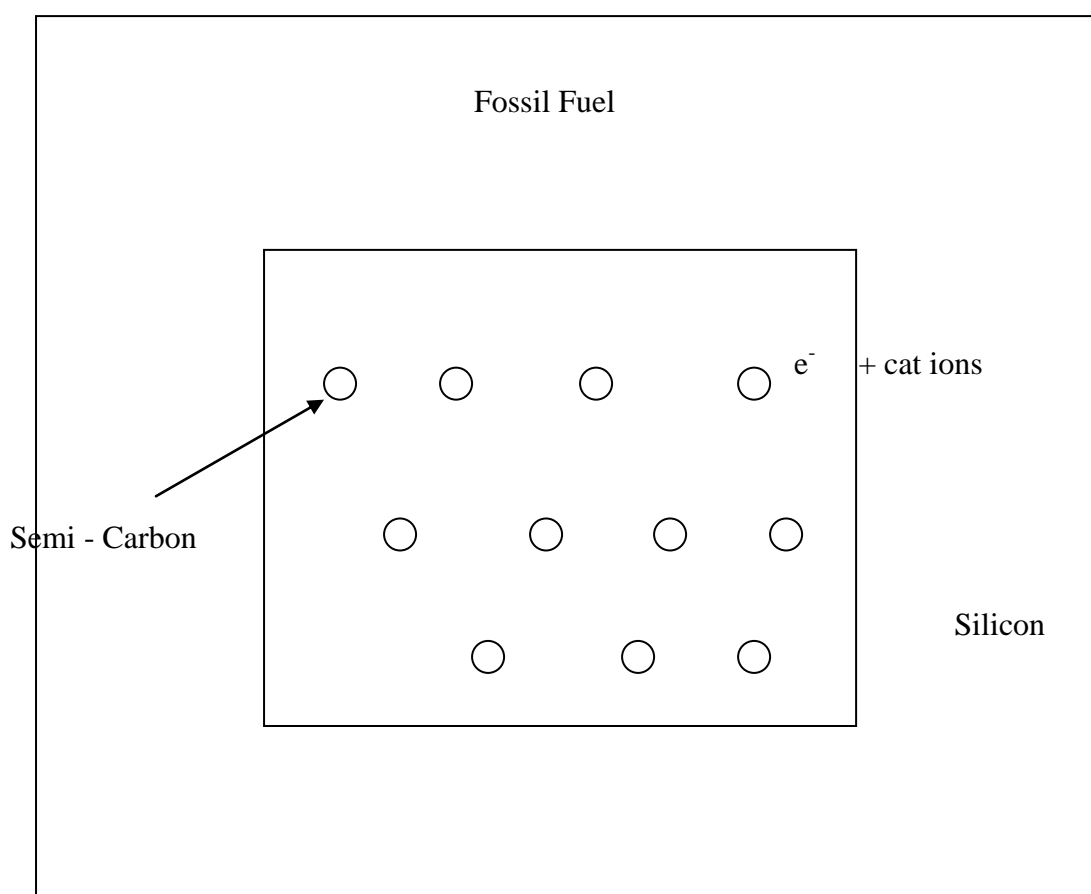


**Jalpa** tried to know the amount of release of carbon dioxide to the environment and searched this matter through internet. She informed carbon dioxide is splitting to carbon monoxide. She showed such splitting in a diagram (**Learning log 5.7**).

**Mamata and Neelam** drew the diagram.

**Learning log 5.7:**

**Figure of Splitting of carbon dioxide into carbon monoxide and oxygen**



She explained how carbon dioxide is split into carbon monoxide and oxygen.

**Deepti** supported by saying that “carbon monoxide is converted into liquid form”.

**Jalpa** further said that this idea may be accepted in future. She informed that this was experimented at California.

### **Observation-VIII**

One teacher trainee had presented content map of his explanation to other trainees. The mapping of subject helped all trainees to understand. Hence, it was conclusive. It appeared that he had good command over the topic. Thus, it made clear the relationship between roles of teacher trainees when two trainees were leading, others were good followers in listening and doing the work in group. Again, it was possible due to the authentic content and its explanation in comprehensive manner. It demonstrated confidence behavior of trainees. It illustrated the leading role of the teacher trainee. In another situation, while two teacher trainees were surfing the internet, at that time another two teacher trainees were drawing the figure from the screen of the computer and the other was explaining the content of the figure. This clearly proves collaborative work in a group. Thus, *leadership, confidence and collaboration* were other attributes of group learning.

### **Illustration-IX**

#### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Saket** located GWP (Global Warming potential) and CFC (Chloro Fluoro Carbon) as factors of carbon dioxide. He further pointed out that carbon dioxide has high rate of absorption. Teacher trainees collected a case-study to know the quantity of carbon dioxide obtained in the atmosphere. They attempted to calculate the emission and uptake of carbon dioxide. Mathematical calculation was systematically done (**Learning log 5.8**).

### Learning log 5.8:

#### Table of Emission and uptake of carbon dioxide

Overview of the CO<sub>2</sub> fluxes/year

(i) Emissions by use of fossil fuel —	$20 \times 10^9$ (billion) tonnes of CO <sub>2</sub>
(ii) Emissions by deforestation & changes in land use —	$5.5 \times 10^9$ tonnes of CO <sub>2</sub>
(iii) Uptake in oceans,	$5.5 \times 10^9$ tonnes of CO <sub>2</sub>
(iv) Uptake by CO <sub>2</sub> fertilized	$7.3 \times 10^9$ tonnes CO <sub>2</sub>
Total emission of CO <sub>2</sub> = $20 \times 10^9 + 5.5 \times 10^9 = 25.5 \times 10^9$ billion tonnes	
Total uptake = $5.5 \times 10^9 + 7.3 \times 10^9 = 12.8 \times 10^9$ tonnes	
Net in atmosphere = $25.5 \times 10^9 - 12.8 \times 10^9 = 12.7 \times 10^9$ tonnes CO <sub>2</sub> per year	
It can be cut down appreciably say by stopping deforestation.	

#### Observation-IX

It illustrated the *fact finding and data collection behavior* of teacher trainees towards finding a solution.

#### Illustration-X

##### Group TT<sub>2</sub>

##### Problem Scenario-1

Anita presented the data related to green house gases (Learning log 5.9). She started explaining that the potential of a green house gas causes green house warning. It is expressed by global warming potential. The chemical reaction is stated as  $\text{CFC} > \text{N}_2\text{O} > \text{CH}_4 > \text{CO}_2$ . She tabulated the rate of increase of gases per year.

## Learning log 5.9:

### Table on Global warming potential

Green house gas	Concentration <sup>n</sup> (ppm)	Increase (%) Per year
CO <sub>2</sub>	356	0.4
CH <sub>4</sub>	1.7	1.0
H <sub>2</sub> O	0.3	0.3
CFC <sub>5</sub>	0.0005	5

**Nikita** asked for repeating the data to comprehend the environmental situation. She made meanings of data more clearly.

It was also supported by **Komal**. There was silent for a while.

Then **Komal** and **Nikita** asked Geeta to make note of it.

### Observation-X

It looked more authentic and scientific data base. It was openly agreed. All of them understood the significance of the data. Hence, all were free to express their understandings. The discussion was done co-operatively. Thus, behaviours like *leadership and co-operation* were also exhibited by the teacher trainees during PBL process.

### Illustration-XI

#### Group TT<sub>2</sub>

#### Problem Scenario-1

**Nikita** informed about her last night dream to the group. The dream was that “clouds were burning”. All laughed and shouted!

**Palak and Darshana** frightened and came into silence. They were shocked about the matter.

**Nikita** was also serious and she desperately asked others to know about the matter.

**Komal** said that “it is precarious”.

**Geeta, Nikita, Palak, and Darshana** all together made a promise to protect global warming. All felt the danger is alarming!

**Geeta** raised terrific issue of globalization. She related its cause to endanger the global warming.

**Palak** took a turn in her seating position and assured to the group by informing a case-study of global warming. She queried about the cold weather in Siberia which safeguard the situation of global warming.

**Anita** also tried to put forward an issue of global warming. She informed splitting of carbon dioxide to explain the cause of global warming.

**Palak** raised question about tropical region of world. She discussed about geographical condition of Africa.

**Darshana, Komal, Nikita** were silent.

**Geeta and Komal** were rubbing and touching their eyes and ears.

When others were confused, **Anita** pointed the case of acidification of ocean.

**Geeta** inquired.

**Komal** all on sudden attempted to clarify the cause to her. She told that the cause is due to carbonic acid. All accepted and told Ok!

### **Observation-XI**

The future shock of global warming was understood. It hurt to all teacher trainees. Trainees remain silent for a while after it was said by others. It was *thoughtfulness situation* in the group. They were *putting their evidences* of global warming which were to be true and likely to be occurred in future. Thus, it was important message for all. This was another instance of *communication* between teacher trainees within a particular group.

## Illustration-XII

### Group TT<sub>1</sub>

#### Problem Scenario-1

**Mamata** was computing the PH value to know the extent of acidification of carbon dioxide. At that time, all had firm eye contact towards Mamata. She sat straight with an erect posture and was telling others. Her speech was slow paced and had low pitched voice, hands were placed besides her hips and her palms were open. Her finger tips were pointed towards the center of the table. She was presenting her data related to pollution that “peat bogs are contributing 15% of the carbon dioxide produced by fossil fuel combustion”.

**Saket** appreciated for the data about pollution.

**Mridula and Deepti** clapped after her explanation.

## Observation-XII

The teacher trainee was clear to present her data regarding carbon dioxide. Her gesture-posture showed that she was *excited and confident*. Other trainees were understood her explanation. They agreed with her statements. Her gesture and posture proved her *confidence* behavior. At the same time, others had *agreement* to her.

## Illustration-XIII

### Group TT<sub>1</sub>

#### Problem Scenario-1

**Neelam** queried the percentage of carbon dioxide produced by fossil fuel from Mamata. Her arms were vertically placed on the table. She was tapping her hands, while clarifying her doubts.

At that time, **Saket** joined with his argument and took up the responsibility to explain and make understandable to Neelam.

**Mridula, Deepti and Mamata** had eye contact towards Saket. The view points of Saket were appreciated by all. All were recording that information.

**Mamata** further added points to support the discussion.

**Mridula** kept her face up and was listening to the words of Mamata.

**Deepti** was writing the discussed points slowly.

**Jalpa and Neelam** raised their head upward. They had eye contact with Mamata. One by one they picked up the points to supplement the views. There was no overlapping of voices; one after another had joined in conversation.

**Jalpa** asserted her right to the table with the ease without hurting others.

At the end, **Deepti** convinced to others that cloud density changes due to global warming.

**Saket** also replied that water condensation was another reason.

**Jalpa** was listening to Saket with care.

### **Observation-XIII**

At first instance, in a group, first trainee had raised the question. It had taken up by second trainee. First trainee was resistant to that situation. She was tapping her hands while clarifying the doubts. Her posture signified that she was *interested* towards the topic. Second one's reply was appreciated by others. Therefore, it was recorded by all. It implied they were *attentive*. One after another, in the group, teacher trainees had joined in the conversation. During that time, there was eye contact towards each other. This illustration showed that within a group each had joined in the conversation. There was individual contribution and eye contact to each other during conversation. Hence, it was *synchronizing conversation*. It also proved that trainees were *assertive*. They had come to *general agreement* to find cause of global warming. Thus, it was *collaborative work*.

### **Illustration-XIV**

#### **Group TT<sub>2</sub>**

#### **Problem Scenario-2**

**Geetanjali** questioned to Anita what are useful bacteria for food?

**Anita** named a few bacteria.

**Geetanjali** was tapping her hands. She spoke the same question in a high pitched voice to the group.

**Komal** answered about bacteria which produces the vitamins. she was maintaining firm eye contact towards Geetanjali.

**Geetanjali** sat in reverse to the chair. She was erectly sitting.

**Nikita** inquired about bio-degradable.

**Palak** was listening to her.

**Anita** clarified. She had an eye contact towards Nikita and Palak.

**Palak** clarified further and wrote on her diary.

**Komal** informed about Ribosome bacteria. She told that these are useful towards soil conservation.

**Palak** identified those bacteria as useful to human being. she noted on her diary.

**Komal** appreciated Palak

#### **Observation-XIV**

It was observed that when one was questioned about useful bacteria, another was confident to answer. Different issues were put forth from one teacher trainee and it was clarified by another. It was then recorded by another trainee. This proved **openness to agree** among teacher trainees. As it was recorded by another trainee, it developed **sharing responsibility** among the trainees.

#### **Illustration-XV**

##### **Group TT<sub>2</sub>**

##### **Problem Scenario-1**

**Geeta** informed diatomic position in the formation of oxygen and carbon dioxide. She had direct eye contact with komal while others were looking towards her and listening attentively.



**Nikita** came closer and nearer to Geeta.

**Anita, Darshana and Palak** had bent their body around right and left side of Geeta.

**Palak** shared her views with Geeta.

**Komal** indicated her finger pointing towards those points.

**Nikita** was repeating the sentence which was interesting to her. She had also invited Geeta to read out the points. The summarized points were typed. This was the learning material.

**Anita** put up that learning material positively and said O.K., O.K.

### **Observation-XV**

The teacher trainees' gesture and posture indicated one-to-one relationship within the group. Hence; it proved *inter-personal relationship* among the potential trainees.

### **Illustration-XVI**

#### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Deepti** took active part in searching the meaning and its effect in use of different words during discussion. She made explanation to the group according to her understanding. She had eye contact towards Saket.

**Other teacher trainees** were easy to talk to other through discussion points.

**Deepti** asked for Jalpa to give example on Sulphur containing environment situation.

**Mridula, Jalpa, Neelam** were serious to know about the balance of nature.

**Jalpa** further added another question 'How carbon dioxide (CO<sub>2</sub>) is produced over the sea? 'The question was discussed with others in the group. She replied that 'due to development of aquatic life, it is produced in the sea'.

**Mridula, and Deepti** repeated the same sentence for answering that question.

**Jalpa** exclaimed! **Deepti and Jalpa** resolved that the rise of temperature on the earth brought sequential change from hot to cold in the temperature.

### **Observation-XVI**

One teacher trainee was willing to find solution on the rise of temperature. She resolved that the rise of temperature on the earth brought sequential changes from hot to cold in the temperature. It was understood that teacher trainees were *approaching each other* to find solution. It implied teacher trainees were *willingly participating*. Again, while one took active part in group, other was joining in team work. Hence *interest, curiosity, concentration and attention* were certain behaviours found among trainees.

### **Illustration-XVII**

#### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Deepti** explained about the precarious situation of the environment. Her eyes were focused; palms were open while explaining others. She used examples to find the cause-effect relationship. She was serious and logical to prove the ill effects of carbon to the environment.

**Mamata and Neelam** were leaning forward to the table to listen attentively.

**Jalpa** was nodding her head and uttering Haa! Haah! Sometimes, clarifications were sought, gesture-posture of hands were seen in the group.

**Mridula, Jalpa and Deepti** were pointing their fingers, nodding their heads while Saket was convincing to them. The ideas and information presented to them were shared actively.

**Jalpa** was reacting and saying Yaah! She was pointing her fingers open to the table. She was encouraged.

## Observation-XVII

One of teacher trainee's eyes was focused, palms were open, and her gesture towards explaining the precarious situation of the environment was open. So, she was *convincing to others*. At that time, one of the trainees was leaning towards other trainee. Other was nodding her head and uttering the word haah! Other two trainees were pointing fingers towards another to seek clarifications. It proved that all were *considerate for the group*. Thus, all were active in *accepting the ideas* gently. It proved successful *communication* within the group. Further *showing interest* towards knowing precarious situation of the environment, *sharing others*, *asking for help to others* and bringing a *common agreement* on that point were specific behaviours demonstrated among teacher trainees.

## Illustration-XVIII

### Group TT<sub>1</sub>

#### Problem Scenario-1

**Saket** informed Sulphates, Nitrates, Black Carbon, Alides, Aerosols and other pollutants spread over an area of 10 million square kilometer over South Asia. The region ranges from Afghanistan to Sri Lanka. The layer of the pollutants is of 3 k.m. thicknesses. He also intimated the reason of formation of such clouds. He narrated the reasons for that. He pointed out significant factors are the product of forest fire, burning of agricultural wastes and fossil fuels, emissions from vehicles and burners\chulahas" using wood and coal or cow dung.

**Neelam** was interested to record the data. So, she asked Saket to take a pause during his description. She faced towards Saket and asked 'How Brown clouds are seen?'

**Mridula** simplified about certain points giving some logic.

**Saket** then reduced the matter of explanation and gave the substance of the matter to the group. He showed the scientific meanings to that matter and made exchange of related views.

**Mridula** accepted his analysis.

**Jalpa and Mridula** were satisfied with this justification.

**Saket** was pleased in convincing thereasons to the group. He then read out ‘possible solutions’.**All teacher trainees** agreed to those points. Other trainees in the group were repeating the same with loud voice; their fingers were upward; and were looking around the group.They weresmiling. Allwere utteringokay, yes, Han! And there was shouting for a while.

**Neelam and Mamata** were very prompt to record the data provided by Saket.

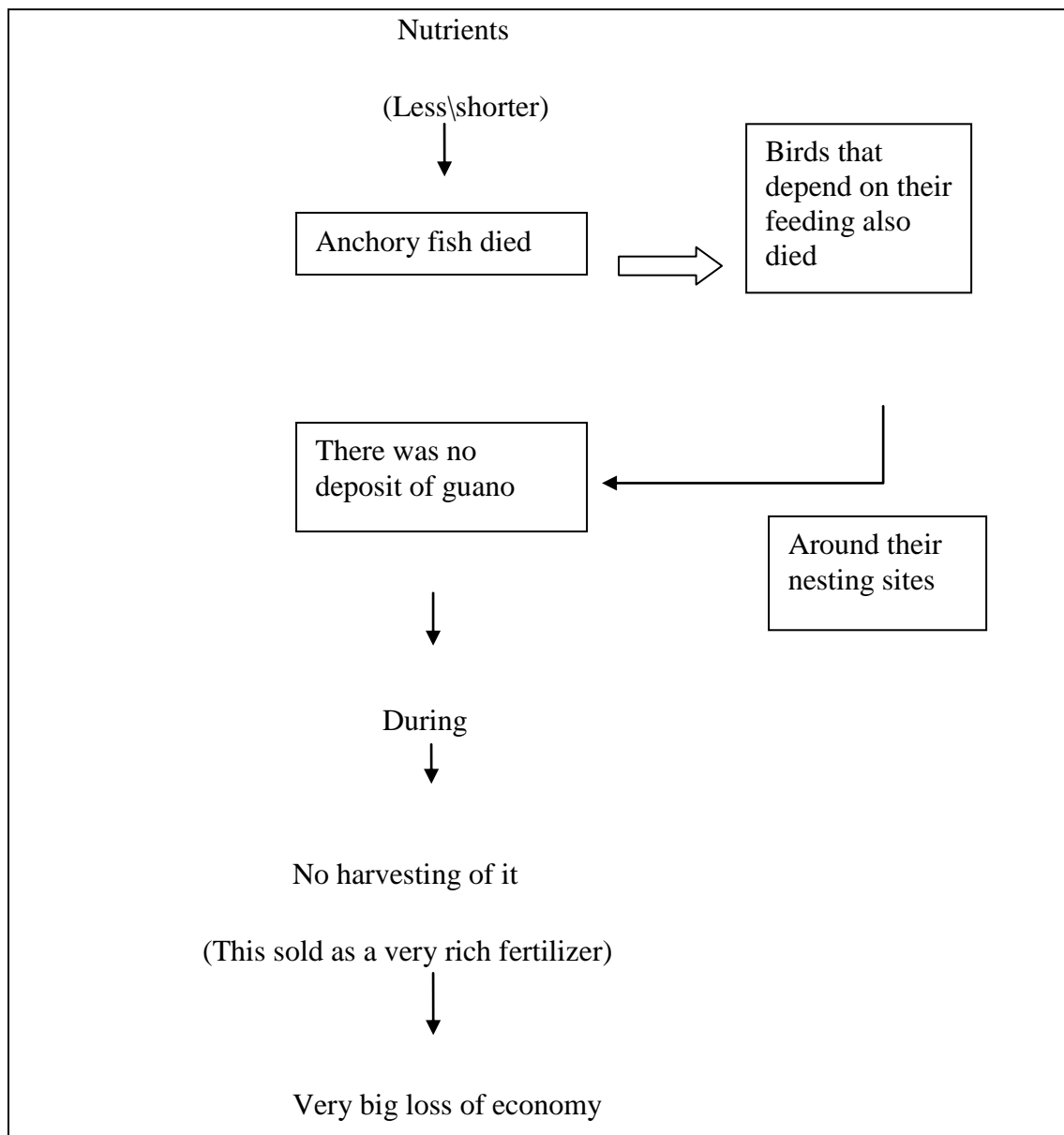
**Mridula** had firm eye contact towards Saket while listening to his facts.

**Jalpa** was smiling. She had kept her hands below the chin while listening to Saket’s analysis. **Neelam** asked question to clarify herdoubts.

**Saket** was glad to tell the answer.Saket then continued to narrate ‘EL Nino’ phenomenon. He showed the effect of global warming and emission of greenhouse gases. He informed that “the water of eastern pacific off Ecuador, Peru and northernChile are sparingly cold”. Hedescribed the effect withthe help of concept mapping (**Learning log 5.10**). He was bold to show the mapping. His tone of voice was loud.

### Learning log 5.10:

#### Figure of effect of global warming



#### Observation-XVIII

One teacher trainee provided the factors responsible towards dangerous situation of the environment. The evidences put forward by him revealed that he had *greater access to authentic resources*. The mapping displayed in the group clearly establishes the fact that learning log was prepared. It was an instance of *building portfolios at work*. The flow of contents in mapping was also learnt to the teacher trainees. Thus, *tutoring* among teacher trainees was held. The meanings of content were analysed, the reasons and justification to that end were found out. So, the activity

was scientific. It develops the behavior of *scientific outlook* among trainees. Further, *convincing the arguments* to one another was a pleasant situation to them. It showed their *agreement* to a certain point. Hence, they were *more open to agree with others*. The data was recorded by them. So, the group was also *preparing an evidence*. Thus, the conducive environment in the group was developed. They feel *proud being in the group*. Taking all aspects of behavior into consideration, it can be observed that the type of behaviours demonstrated by teacher trainees include *access to resources, preparing an evidence, building portfolio at work, shows more open to agree with others, scientific outlook, peer tutoring, pleasing others, leadership, feeling proud being in the group and confidence*.

### **Illustration-XIX**

#### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Jalpa** thought of a diagram in order to give a solution to global warming. She initiated to draw a hypothetical diagram.

All other trainees joined in her work to complete the different components of diagram. During this work, a hidden topic was found within the group. ‘How to save earth’ was queried by teacher trainees. The group found it as one of learning issue and this was agreed as ‘needs to know’ for its problem solution by all the teacher trainees.

**Neelam, Mamata and Mridula** stacked pen in their own chins. Their eyes were sparkling. They were clapping. The drawing of picture was kept on the table.

### **Observation-XIX**

A hypothetical situation was reflected through diagram. The diagram was completed with the co-operation of all teacher trainees. So, group work involves either more or less intense of *co-operation and collaboration*. It evolved a possible solution to the problem. It implies finding a *greater source of learning issues* was possible in a group learning. Teacher trainees were *self-confident* to undertake such work which is inferred from their gesture, posture and body movements. Hence, the learning situation was *enjoyable* to them.

## Illustration-XX

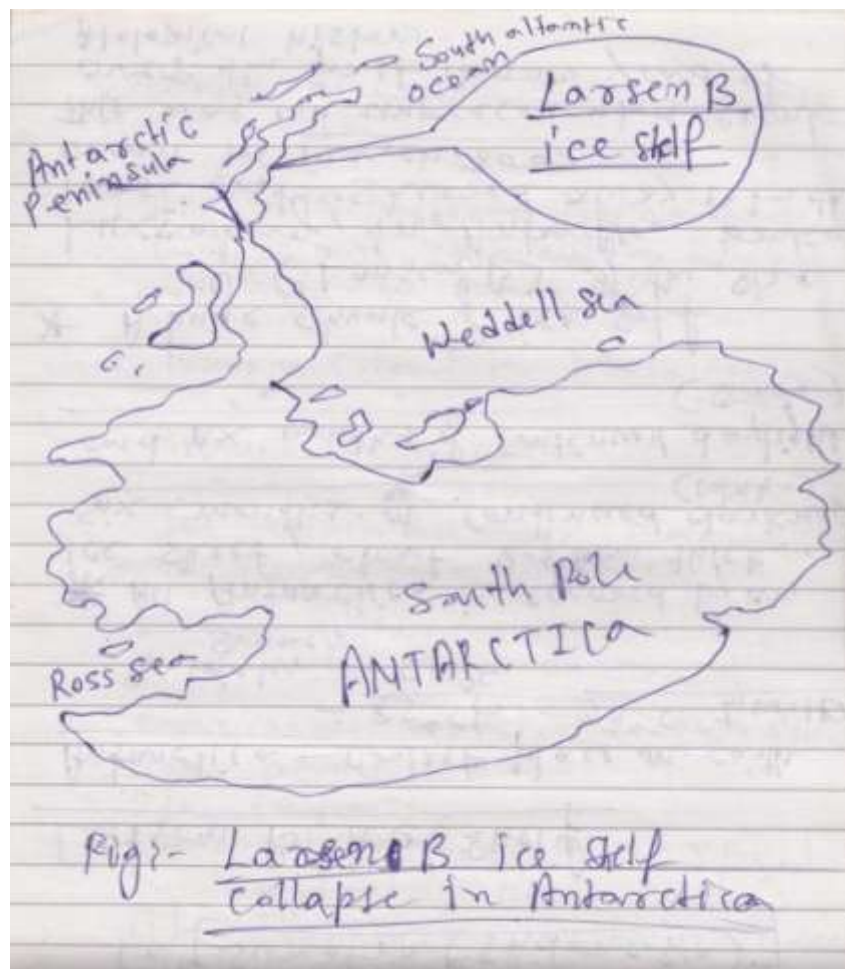
### Group TT<sub>1</sub>

#### Problem Scenario-1

**Saket** informed Larsen B ice Shelf on Antarctica, the coolest place on earth (**Learning log 5.11**). The data showed that the temperature in winter fell to  $-85^{\circ}\text{C}$  to  $-90^{\circ}\text{C}$  and in summer, it reached to  $-55^{\circ}\text{C}$ . In winter, darkness remains for six months. A huge chunk of ice self (Larsen B) of the size Luxemburg, in Antarctica was diminishing. This event warned off global pollution. All on a sudden, such explanation was shown into picture by him. Other trainees recorded the same on their respective diaries.

#### Learning log 5.11:

#### Figure of Larsen B ice shelf collapse in Antarctica



**Saket** informed the grave situation of Antarctica. It took a longer period of discussion within the group.

During such discussion, **Jalpa** made further query from Saket. She had put her hands interlocked, speaking in stuttering voice.

**Deepthi and Mridula** made conversation with each other. **Deepthi** was vertically placed on the table while the hands were gripping the edge.

At the same time, **Neelam and Mamta** were ready to accept the case-study. They were ready to agree. All thought of future shock!

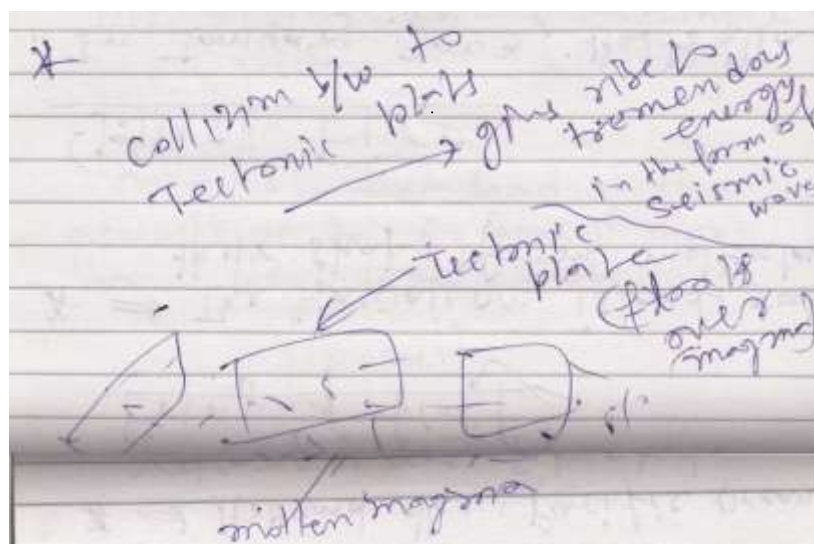
**Jalpa** supported Saket by narrating the case-study of Nalia locality (situated on and around Kutch in BHUJ of Gujarat) which caused  $-5^{\circ}\text{C}$  during winter. All understood the effect of global warming and the cause of environment pollution.

**Neelam** recalled 'Tsunami', natural disaster which occurred in Japan.

**Saket** narrated Tsunami, the historic event hitting Indian sub-continent. He then eagerly drew a diagram to show its dangerous effect (**Learning log 5.12**). He explained the seismic waves which shake the ground violently and caused earthquake resulting the calamity. He informed that Tsunami effect caused series of earthquakes (9 richter) and shook 1000 k.m. of the sea bed to give result of violent seawaves.

### Learning log 5.12:

Figure on seismic waves





## Observation-XX

Teacher trainees presented a case-study. It gave a clue towards possible solution. One of trainee's posture inferred she was in *tense*. Similarly, another was *resistant* to this situation and during such situation others were engaged in explaining. It implied that the teacher trainees were *responsive*. It was also observed that teacher trainees were *working in pair*. Thus, the natural behaviour pattern like *resistant behaviour, tense behaviour and responsive behaviour* to a problem were happened during group learning.

## Illustration-XXI

### Group TT<sub>1</sub>

#### Problem Scenario-1

**Mamata** supported that global warming affects migration.

**Jalpa** presented her argument with a case-study. Her case-study was based on the cause of global warming and effect of migration.

**Mridula** countered and pointed out that economic condition causes migration. she informed 'migration' is caused for better living and economic condition of people.

This was supported by **Deepti, Jalpa and Neelam**.

**Saket** related the cause of migration with effect of global warming.

**Deepti** and others remarked population growth as another reason to migration. For a while, the group was silent.

After that **all teacher trainees** stated that migration and population growth are reported factors towards cause of global warming. Teacher trainees were seating straight forward with an erect posture, heads were inclined forward.

**Mridula** was arguing. Her palms were crossed.

**Jalpa, Deepti, Mridula** were opened. Their eyes were wide opened.

**Deepti, Mridula and mamata** supported to the issue of migration as the agenda of discussion.

**Neelam and Mamta** were nodding their heads. Their hands were interlocked. Arms were placed on the table. Eyes were sparking.

**Jalpa** had firmly eye contact towards **saket** while arguing her points. All were listening.

**Deepti and mridula** were arguing against the point viewed on migration.

**Jalpa and saket** emphasised on population growth. They resolved that population growth causes global warming.

### **Observation-XXI**

There was deep discussion for a longer period of time. The cause of migration was found more discussed. Each and every trainee had put either major or minor points for their argument. Different reasons were discussed. It was almost a *brain storming* among the teacher trainees. During discussion one was excited to listen to another. Other trainee was interested towards argument. They were more open to agree on population growth. She had eye contact towards the group. Thus, group learning facilitated brain storming among trainees. Hence, potential trainees were *excited, interested* and others were *more open to agree and attentive* towards an *argumentation*. At first, some trainees did not agree but after series of interaction, they had understood and made solution on population growth. These were the ways towards *resolution of conflict* in a group.

### **Illustration-XXII**

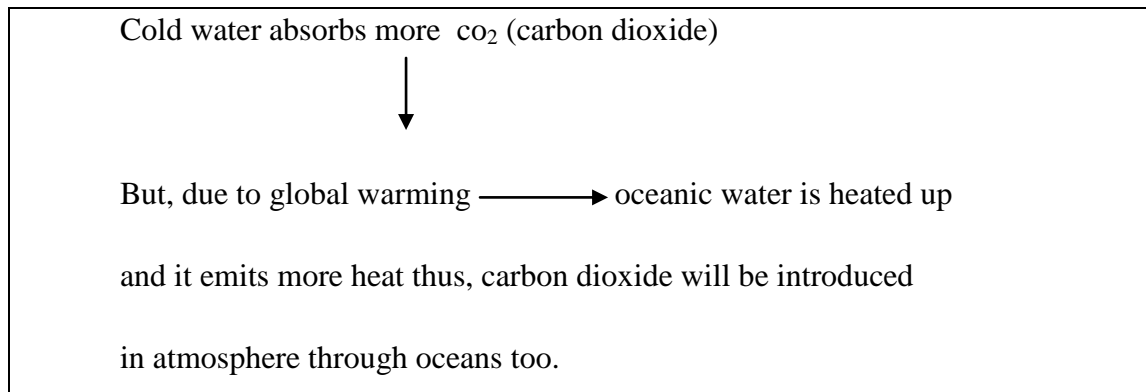
#### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Deepti** argued on reasons of global warming. She developed mapping in front of the group during her discussion (**Learning log 5.13**). She was systematic. She presented her mapping with a cause and effect relation.

### Learning log 5.13:

#### Figure of reasons of global warming



#### Observation-XXII

The development of mapping characterises *deep learning*. It made more comprehensive and also scientific. The case demonstrated her *confidence* in a group. Thus, it developed her *ownership* in learning.

#### Illustration-XXIII

##### Group TT<sub>1</sub>

##### Problem Scenario-1

**Saket** informed a case-study. It was on Kyoto- protocol.

**Jalpa and mamata** were listening with their eye contact towards Saket.

**Mamata** asked about Chloro Fluro Carbon (CFC).

**Saket** answered quickly.

**Jalpa and Neelam** were observing the way of interaction between Saket and Mamata.

**Deepti** was asking composition of CFC \R12.

**Mridula** found the data of CFC in relation to ozone layer.

**Jalpa** read the sentences to highlight the matter.

### Observation-XXIII

The group found different data to find the reasons of global warming. It again confirmed the division of *co-operation* among teacher trainees while finding a solution.

### Illustration-XXIV

#### Group TT<sub>1</sub>

#### Problem Scenario-1

**Mamata** narrated another cause of global warming. She presented case-study of hurricane Katrina which was more violent. She informed CFC as the pollutant of global warming. She put the mechanism to explain CFC as miracle chemical( **Learning log 5.14.1**).

#### Learning log 5.14.1:

#### Figure on mechanism of CFC

-CFC  $\longrightarrow$  Miracle chemical

$\text{Cl}_2 \longrightarrow \text{C-F}_2$

$\text{Cl}_3 \longrightarrow \text{C-F}$

$\text{Cl} \longrightarrow \text{C-F}_3$

One molecule of CFC damages 1 lakh molecule of  $\text{O}_3$  informed Mamata.

In 1987, Montreal protocol discussed about global warming.

She explained R- Refrigerant.

R-12, R-134 A, R-11, R-22, R-35 were also seen. Halomethane is  $\text{R}_{12}$ .

She informed

$\text{SO}_2$  and anhydrous  $\text{NH}_3$  + CFC  $\longrightarrow$  Being Toxic

Is used frequently instead of only CFC.

**Jalpa**, then tried to add further( **Learning log 5.14.2**).

### Learning log 5.14.2:

#### Figure on mechanism of CFC

CFC, Ammonia were toxic

Freon Non-toxic But, general use is  $\text{CHCl}_3$ ,  $\text{F}_2$ .

The code of R as

one's place-Fluorine

Ten's place-Hydrogen

Hundred's place- Carbon

**Neelam** tried to caution the phenomenon of R and suggested to take precautionary measures.

### Learning log 5.14.3:

#### Figure on mechanism of CFC

Before 75 years, CFC was discovered. It caused ozone layer depletion.

The different forms of CFC were named as R12, R-22, R-134A, R-11, R-35.

Halomethane (R-12) was known accordingly.

Initially  $\text{SO}_2$ ,  $\text{NH}_3$  and CFC were used and then Freon and then R-12 were used.

R was coded with 3-digits.

**Deepti** also informed that more toxic chemicals like R-12, R-22, R-134A in addition to  $\text{CCL}_3\text{F}$  which threatened our climate (**Learning log 5.14.3**).

#### Observation-XXIV

The evidence was presented on the mechanism of chemical reactions related to global warming. It was scientific and hence, valid. Individual contribution in explaining effects of CFC was put. It was out of *interest, responsibility curiosity, positive attitude and overall extended thinking* of teacher trainees which made learning comprehensive.

## Illustration-XXV

### Group TT<sub>1</sub>

#### Problem Scenario-1

**Jalpa** was searching contents on the internet. She welcomed other trainees. 'Listen, my dear, Sulphur dioxide (SO<sub>2</sub>) is the pollutant in the environment pollution'.

**Mamata** came forward and read carefully the sentence on the screen.

**Mamata ,Deepti,Neelam and Mridula** all left their seat. There was pin-drop silence. They took their seats in front of the screen to find the content that causes pollution.

When **Deepti, Mridula and Mamata** were searching through internet. **Neelam and Jalpa** were preparing some summary points.

**Jalpa** convinced the same to Deepti,Mridula and Mamata. There was silence to observe the diagram on the screen. The diagrams related in molecular shape and chemical bonding were sorted out.

**Saket** outlined some structures to convince the matter to Neelam.

**Mamata and Deepti** supported to those points. They were interested to discuss with other trainees. They gave some clarifications as per the query of Jalpa and Saket. The clarifications were about chlorine.

## Observation-XXV

This illustrated teacher trainees working together. Individually, they were working with responsibility. Their participation in searching, collecting and analysing the data from the internet was voluntary.

## **Illustration-XXVI**

### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Deepti** articulated the meaning of thermostat clearly.

**Jalpa** joined with her work. She was saying yes!,yes! . She pointed out a very important point. **Deepti** was trying to put the learning issues in final form with the review of others' work. **Mridula** made inquiry about some points.

**Mamata, Neelam, Jalpa** were opening pages from their reflective diaries in order to clarify Mridula's doubts.

**Neelam** was repeating questions for clarifications. She tried to interpret on her ownself.

**Deepti** again raised the previous learning issue of vegetation in order to seek agreement for all trainees.

**Mridula** added the meaning of iyna and barely.

**Neelam** clarified the same.

**Mamata** supported to Neelam's clarification.

**Mridula** asked all whether minor issues need to be rejected. All agreed to include the major issues only. She said to write only the positive points.

**Saket** added mutation to consider under major issue.

**Deepti** was encouraged to explain mutation to Neelam.

**Jalpa** also tried to explain through drawing of pictures.

**Neelam** said o.k, okay!. She was grave. Her eye was focused. She was touching her head with a pen. Her posture was not erect. Her head was bent down to write those things.

## Observation-XXVI

A focused discussion was held on finalisation of learning issues. When one initiated dialogue on 'thermostat' another joined actively in her dialogue. This implied trainees *show interest in others and exchange informations*. During the work, while another trainee questioned and asked for clarifications other share responsibility with others. When one took responsibility to finalise the list of learning issues, others were open to give their view. Some teacher trainees were engaged in scrutinising the minor and major issues and some others were prompt to draw picture and their explanation. This showed that trainees were *more open to agree with others*. Thus, it is clear that in group learning more positive social behaviours like *initiating dialogue, interest in exchanging informations, joining actively in a particular kind of work, asking for clarifications, sharing with others, conversation with ease, sharing responsibility and more open to agree with others* were developed.

## Illustration-XXVII

### Group TT<sub>1</sub>

#### Problem Scenario-1

**Deepti** pointed the economic dimension of global warming.

**Jalpa** added the effects of historical monument due to pollution.

In support to Jalpa, **Mamata** added the destruction of iron rods.

**Deepti** informed the cause through chemical reaction of carbonic form she kept eye contact towards Neelam, while explaining the points.

**Neelam** interested to listen and shared her things with others.

**Jalpa** requested Deepti for other informations. She asserted the inclusion of the point without opposition of others under the learning issue.

**Mamta** was leaning towards Deepti at-a-distance to see the approved learning issues. She was silently looking others.

**Saket** joined in the conversation with Deepti. He pointed out the strength of the learning issue.

**Jalpa** supported him.



**Mridula** concentrated on the same issue and said o.k. for inclusion of the point.

**Jalpa, Mamata and Neelam** considered her suggestion. They expressed thanks for her suggestion.

**Other trainees** clapped for her valuable suggestion.

### **Observation-XXVII**

All contributed towards finding the factors of global warming. There was sharing of points with one another. When one was concentrating on her issue, it was also supported by others to include these points. Hence, there was *amicable consideration* of the points under the issue of global warming. This leads to *negotiating behaviour without hurting others*. Thus, *sharing with others, ability to concentrate on the task in hand, compromising behaviour, asserts her right without hurting others, sharing responsibility, takes care of others and resolving conflict* were the category of social behaviours constructed correctly in the group work.

### **Illustration-XXVIII**

#### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Deepti** informed to the group about the pollutants. She had an eye contact towards Saket.

**Saket** was supporting to her points and suggested to write those points.

**Mamata** argued on “what happens to the pollutant with the increase and decrease of water”.

At that time, **Mridula** was recording the points.

**Neelam and Jalpa** were nodding their heads.

Then, **Jalpa** was pointing her view points.

**Neelam** asked for “EL naino” effect.

**Jalpa** repeated the word ‘EL Nino phenomenon’ with a loud voice. It was pointed by her to write this as ‘case-study’.

## Observation-XXVIII

Each and every body's view points were honoured by one another. When one was supporting in a loud voice, others were nodding their heads. It demonstrated their '*concern to agree*' behaviour. In addition to that, *discussion with ease, approach others easily, joins in discussion with others, approach to show agreements and open arguments to discussion* were other social behaviours well documented in PBL group learning.

## Illustration-XXIX

### Group TT<sub>1</sub>

#### Problem Scenario-1

**Mamata and Jalpa** argued 'Katrina Hurricane Effect'.

Its experiment was narrated by **Neelam**. She argued to consider such case-study as one of the learning issue.

**Saket** was accepting by saying yes, yes.

**Deepti and Neelam** were putting their argument to consider 'Tsunami effect' as one of the current issue of learning.

**Mamata and Deepti** were editing this event. During discussion, the two words 'disappearance' and 'disocurrence' were confused to them.

**Saket** put his argument on the word 'disappearance'.

But, **Mridula** was denying and objected to him. She argued for use of 'disocurrence' word.

**Other trainees** supported Mridula for finding the suitable use of this word. All said o.k..

Carbon and Oxygen were main components in any pollutant informed **Mridula, Jalpa and Neelam**. They were saying all-at-a-time. They were grave and silent. Their eyes were focused towards their note books. They were saying with low voice while recording.

**Mridula** was writing the solutions.

**Saket** was helping in correcting the words and statements to mridula.

**Mamata and Neelam** were silently listening. They were actively observing. They were accepting and agreed with those points.

**Mridula** was conveying the points with loud voice to make sure and confirm about its understanding.

### **Observation-XXIX**

Discussion was initiated on an agreed topic. When it was summarised and decided to edit its words, there was disagreement among teacher trainees. There was confusion in the use of words between two teacher trainees. There was an open interpretation and at last the conflict was resolved with a common word. This act of behaviour clearly illustrated *conflict resolution* which is one of dynamic behaviour developed in a group.

### **Illustration-XXX**

#### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Saket** was asking Jalpa in order to know her understandings.

Allon sudden, **Jalpa** loudly said 'yes'. She then smiled and repeated the sentence to make confirmation from him. Her agreement was also supported by Mridula.

**Neelam** was smiling.

**Deepti** was informing about the spelling error.

**Neelam** supported Deepti to correct the nominal.

**Deepti** told for a scientific name. She was observing what and how the points were noted by Mridula.

**Mridula** was writing all the points which was read and informed by Saket.

### **Observation-XXX**

When one was approaching to one of teacher trainees, the other trainees showed more open to agree. As a result, the teacher trainees were repeating the statements. It confirmed the statement to be recorded. Hence, this demonstrated the behaviours like *approaching others, more open to agree and anxiety among teacher trainees*.

### **Illustration-XXXI**

#### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Saket** started telling some view points about the effect of carbon dioxide. Nuclear fuel and carbon dioxide were compared with data base with respect to positive and negative effect.

**Mridula** was agreed to those points.

**All teacher trainees** noticed its feasibility of solutions.

**Mamata** strongly said to include the nuclear fuel.

**Mridula** appreciated saying good, good! She said welcome!

**Saket** was also saying yes, okay.

**Deepti** was writing through confirmation of the points of the participants in the group. She was taking consent of all before writing.

**Mridula** kept her hands relaxed on the table, had an eye contact towards Deepti, her facial expression was pleasant and she was easily expressed.

**All others** were listening to Mridula and understanding Deepti's body language.

### **Observation-XXXI**

The non-verbal behaviour through gesture and posture of teacher trainees was easy and comfortable. It illustrated *openness* of both trainees. They were caring. They expressed thanks. This demonstrated their positive *grateful behaviour* in the group.

### **Illustration-XXXII**

#### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Neelam** informed about 'kyto protocol' held in 1987.

**Deepti** was interested to narrate about the details of the principles of 'off-setting'. She told 'what we are emitting or buying our right to pollute the environment?'.

When **Neelam** was explaining, all were attentive to listen her. She had eye contact towards Deepti and Saket.

**Mridula** repeated what was said by Neelam. She was honest to trace out Neelam's view.

**Neelam** was pleasant, easily expressed her view, her speech was relaxed, slow and objective. Her hands were at the sides of the table.

**Mridula** informed about some anticipated effects for reducing the ozone layer. She explained the matter with gesture and posture of her fingers. She had eye contact towards Deepti.

**Deepti** was encouraging Mridula by saying yes, yes!.

While **Deepti** was giving feedback, **Saket** was smiling. There was noise while conversation was going on.

One after another, **teacher trainees** were trying to put their views. They were also clarifying while recording their discussion.

**Mridula** was clarifying the doubts asked by Neelam and Mamata.

**Mamata** was putting her arguments in response to Neelam's question.

**Deepti** was listing out the solutions. She was considering Mridula's argument, others were smiled and clapped.

**Other trainees** were looking towards Mridula.

### **Observation-XXXII**

Neelam's gesture-posture proved that she was confident while others were *interested and approachable* towards her. So, he felt happy being in the group. During scrutinisation of the points, one trainee was nodding her head, other was listening with focused eye and another was recalling the accepted points. Thus, it conveyed a *detailed and common resolution* in the group. And therefore, the success of group learning depends on certain social behaviours like *showing interest on others, sharing with others, acceptance to view points of others, dignity of work, show more open to agree with others, active listening, joins conversation with others, action oriented and natural curiosity*.

### **Illustration-XXXIII**

#### **Group TT<sub>1</sub>**

#### **Problem Scenario-1**

**Jalpa** explained further to highlight on 'Bio-char'. She brought her reflective diary to the centre of the table. She leaned towards the group to do some written work on the paper. She presented her views in a systematic way. She communicated orally and through written work simultaneously. Her approach towards explanation was simple and easy. Her explanation was based on a figure (**learning log 5.15**). The diagram was appreciated due to its newness in idea.

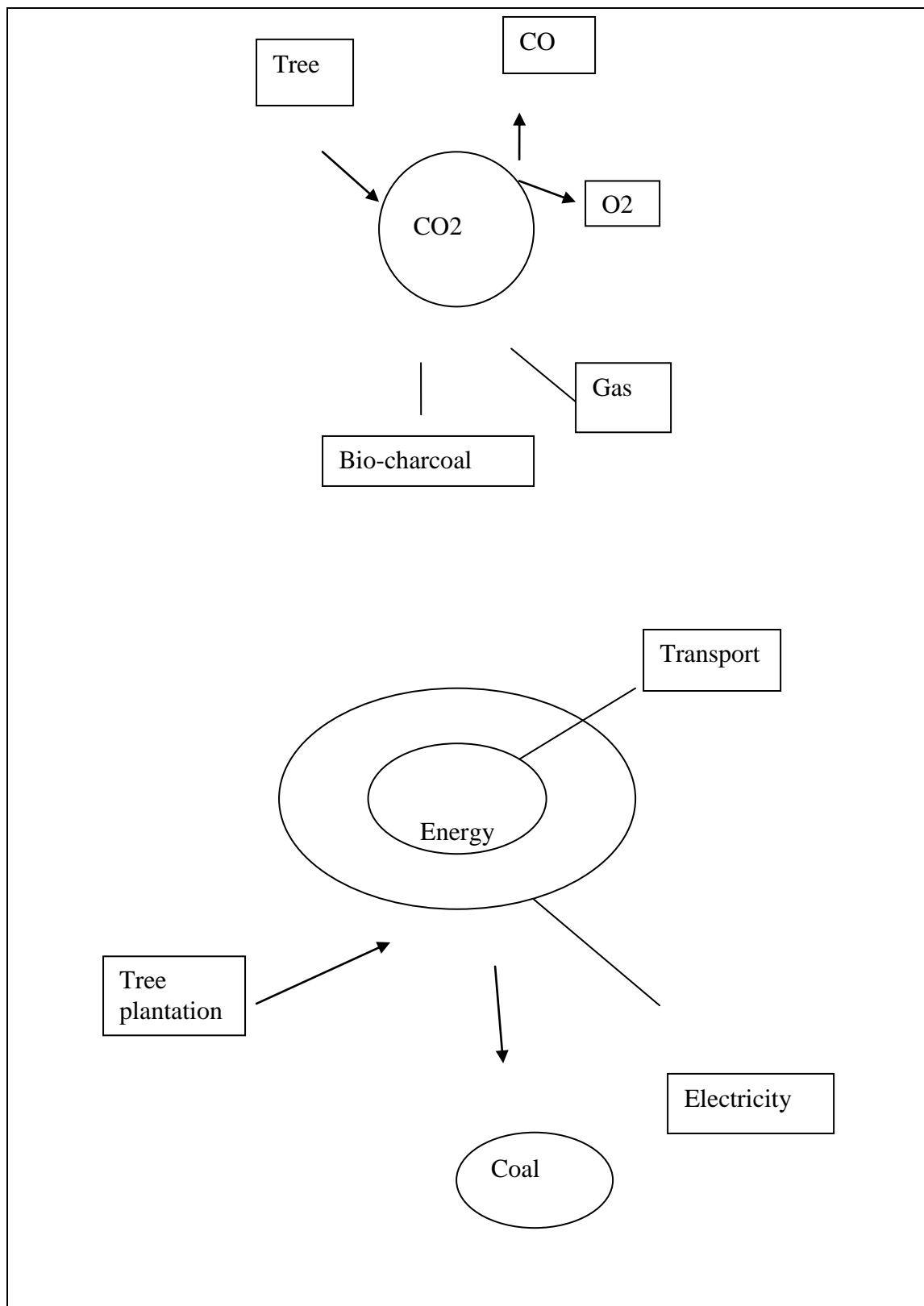
**Mamata** put a summarising line to her.

**Mridula and Deepti** repeated what had told by her.

Similarly, **Saket** added something in the picture to clarify the points on Bio-charcoal. The points were related on release of oxygen and carbon dioxide. It was understood by all.

**Learning log 5.15:**

**Figure of Bio-char**



### **Observation-XXXIII**

A learning journal was prepared. The teacher trainees used verbal and written way of communication to present their ideas. They found an innovation while diagram was presented. There was much scope of summarising the ideas. This demonstrated the development of behaviours of dignity of work, reflective behaviours, active listening, taking the points positively, natural curiosity, sharing responsibility and confidence behaviour as a whole during PBL group process.

In order to explore the social skill behaviours concretely, the qualitative analysis was also carried out through display of field data.

## **II. Display of Data**

The second major flow of activity of analysis was display of data. A visual format was designed to present the information systematically so that valid conclusions could be drawn. Designing a display was based in the form of matrix in order to facilitate the entering of data into the cells.

### **5.5 Choosing A Display Type**

The research was exploratory and therefore, partially ordered display in the form of check list matrix was dealt with to specify the variables.

#### **5.5.1 Check List Matrix of Dynamics of Behaviour**

It was a format for analysing field data on construction of social skill behaviors. The basic way was that the matrix included several components of social skill behaviour. It showed the dynamics of behaviour of teacher trainees. The check list matrix revealed the list of social skill behaviours that were developed among the teacher trainees during PBL process. Dynamics of behaviour identified in different situations are described. The check list matrix showing dynamics of behaviour of each teacher trainee is prepared separately in tabular form (**Appendix-I**). A sample of matrix describing 'confidence' as social skill behaviour of one teacher trainee is presented below for illustration. It includes the following particulars.



**Table 5.1:**

**Sample of Checklist Matrix of Dynamics of Saket's Behaviour**

<b>Behaviour</b>	<b>Example</b>	<b>How important</b>	<b>Why important</b>
Confidence	Saket explained green house effect through diagram. He informed about green house gases causing pollution. During his explanation, he had firm eye contact towards Deepti and other trainees. His attention was distributed over the group. He sat in an erect posture and his chest was projected forward. He was speaking slowly with a pause. Other trainees were joined in his explanation. His view point was considered by all. Teacher trainees expressed thanks to Saket.	strong	The view point was true, valid and resourceful

**Column-1 :Behaviour**

It is a type of social skill behaviour. The behaviours which were constructed during PBL process are categorised into different types. For example, a particular behaviour is 'confidence'.

**Column-2: Example**

The example of social skill behaviours are described in this column. The verbal and non verbal behaviours observed during PBL process are described.

**Column-3: How important?**

It answers to what extent a particular behaviour described in the column-2 is important? The extent of importance is rated on three point scale. The points are **Basic, Strong, Very strong.**

#### **Column-4: *Why important?***

This column indicates the explanation of reasons of behaviour demonstrated by six teacher trainees of the first group (T<sub>11</sub>, T<sub>21</sub>, T<sub>31</sub>, T<sub>41</sub>, T<sub>51</sub> and T<sub>61</sub>) and the second group (T<sub>12</sub>, T<sub>22</sub>, T<sub>32</sub>, T<sub>42</sub>, T<sub>52</sub> and T<sub>62</sub>) during PBL process.

**Note:** The abbreviation T<sub>11</sub> represents First Teacher Trainee of the first group, T<sub>21</sub> represents second Teacher Trainee of the first group and similarly, T<sub>62</sub> represents sixth teacher trainee of the second group.

#### **5.5.2 Content Analysis Summary of Dynamics of Behaviour**

The PBL process in a group of teacher trainees was video recorded. The transcript of such audio-video recordings was prepared. The sequence of utterances and body movements in recordings were transcribed. The text in the transcript was examined in order to find out meanings. Therefore, a careful, systematic and objective analysis of text to convey coherent pattern was carried out through content analysis. The contents of the transcript were focused to find out the category of behavior. The verbal behaviours through dialogue, quotes, examples and emotional words as well as non-verbal behaviours like gesture and posture and even body movements were the valuable elements in selecting the categories of behavior. A category of behavior is a well defined integration of verbal and non verbal behaviours. With reference to check list matrix of dynamics of behavior, the specific categories of behavior were enlisted. The frequency of occurrences of those categories of behavior was calculated. Tally marks were used for the frequency calculation. How many times a particular category of behavior was demonstrated by each teacher trainees were calculated and these frequencies of dynamics of behavior are displayed in tabular form (**Appendix-J**). **Forty seven** categories of behavior were traced out among teacher trainees in group-1 and **Forty four** categories were found in group-2 (**Table 5.2**). One category of behavior demonstrated by teacher trainees in group-1 is shown in **table 5.3**.

**Table 5.2:****List of dynamics of Behaviour among Teacher Trainees**

<b>SN</b>	<b>Dynamics of behaviour of Group-1</b>	<b>Dynamics of behaviour of Group-2</b>
<b>1</b>	Takes active part in group-work	Joins in conversation with others
<b>2</b>	Joins in team work with other children	Joins in team work with others
<b>3</b>	Willingly participates in all steps of problem solving	Shows interest towards others
<b>4</b>	Easily makes relationships	Shares with others
<b>5</b>	Invites peer to join an ongoing activity	Active listener
<b>6</b>	Has ability to concentrate on the task in hand	Takes active part in group work
<b>7</b>	Take things positively	Shares responsibilities with others
<b>8</b>	Feels happy when she is in a group	Requests information from others
<b>9</b>	Joins in conversation with others.	Works in pairs
<b>10</b>	Works in pairs to complete the task	Shows interest in others and exchange informations
<b>11</b>	Works in peer tutoring	Feels happy when she is in the group
<b>12</b>	Works well along with a team	Works well along with a team
<b>13</b>	Dignity of labour	Approaches others easily
<b>14</b>	Acceptance to view point of others	Joins actively in group work
<b>15</b>	Thoughtfulness within the group	Natural curiosity
<b>16</b>	Action oriented	Approaches to show agreements
<b>17</b>	Active listening	Open agreements to discussion
<b>18</b>	Shows interest in others and exchange informations	Easily makes relationships
<b>19</b>	Does express his wishes to others	Ask for clarification
<b>20</b>	Approaches others easily	Willingly participates in problem-solving
<b>21</b>	Ask for clarifications when talking with others	works in peer tutoring
<b>22</b>	Sincerely expresses thanks for the help received	Conversation with ease

23	Starts conversation with ease	Sincerely expresses thanks for the help received
24	Requests information from others	Has ability to concentrate on the task in hand
25	Shares each other	Takes care of others
26	Joins in activities with others	Works well along with other
27	Asserts his right without hurting others	Shows more open to agree with other
28	Shows interest in others	Negotiates and compromises with others
29	Shares his things with others	Asserts his right without hurting others
30	Can please others easily	Resolves conflicts easily
31	Can adopt according to the situations	Keeps eye contact while talking with others
32	Resolves conflict easily	Build up a portfolio of work
33	Build up a portfolio of work	Prepares an evidence
34	Greater access to resources	Initiate dialogue
35	Initiate dialogue	Take things positively
36	Prepare an evidence	Thoughtfulness within the group
37	Share your work with others	Anxiety
38	Takes care of others	Extended thinking
39	Shows more open to agree with others	Access to resources
40	Negotiates and compromises with others	Reflecctive behaviour
41	Natural curiosity	Dgnity of labour
42	Scientific outlook	Explains others
43	Keeps eye contact while talking with others	Confidence
44	Leadership-	Helps when one was behind in her undrstanding
45	Reflective behaviour	
46	Asks if she can be of any help to others	
47	Helps out when others are behind in work	

**Table 5.3:****Sample of Content Analysis Summary of Dynamics of Behaviour**

SN	Dynamics of behaviour	Demonstrated by teacher trainees					
		T <sub>11</sub>	T <sub>21</sub>	T <sub>31</sub>	T <sub>41</sub>	T <sub>51</sub>	T <sub>61</sub>
1	Takes active part in group-work	5	3	6	7	5	3

**‘Takes active part in group work’** was deduced from one’s verbal and non verbal actions. The following verbal and non verbal actions illustrate the above category of behaviour.

*“One was looking towards the writings in the diary. She was inclined forward while talking with others. Her eye movement was distributed towards the face of others. Her palms were open while listening others. She was nodding her head during listening one’s explanation.”*

### 5.5.3 Social Skills Check List

The teacher trainees of both the groups demonstrated a good deal of social behaviours. It was found that 47 and 44 number of categories of social behaviours was developed during PBL process in group 1 and 2 respectively. Such a large number of categories of behavior can’t be dealt meaningfully. There was relatedness among certain category of behaviours. So, it was necessary to find major dimensions of social skills. Hence, a check list was prepared to find the unit of social skills. This was prepared in a tabular form which is presented in Table 5.4

**Table 5.4:****Social Skills Check List**

SN	Interpersonal skills	Understanding others	Nurturing communication	Learning Autonomy	Positive Self-perception
	I-Factor	U-Factor	C-Factor	A-Factor	P-Factor
1	Request informations from others	Take active part in group work	Keep eye contact while talking with others	Has ability to concentrate on the task in hand	Take things positively
2	Ask for clarifications when talking with others	Join in team work with others	Initiate dialogue	Greater access to resources	Has leadership qualities
3	Shows interest on others	Invite peer to join ongoing activity of the group	Start conversation with each	Willingly participates in all steps of problem-solving	Feels happy when she \he is in agroup
4	Asserts his\her right without hurting others	Join in acitivities with others	Ask if he/she can be of any help to others	Action oriented	Can adopt according to the situations
5	Approach others easily	Acceptance to viewpoints of others	Joins in conversation with others	Thoughtfulness within the group	Natural curiosity
6	Shares his\her things with others	Work in pairs to complete the task	Active listening	prepare an evidence	Easily makes relationships
7	Does express his\her wishes to others	Dignity of labour		Build up a portfolio of work	Scientific outlook
8	Share his\her work with others	Show interest in others and exchange informations		Reflective behaviour	

<b>9</b>	Share each other	Help out when one of them gets behind in his/her work			
<b>10</b>	Sincerely express thanks for the help received	Work well along with a team			
<b>11</b>	Take care of others	Show more open to agree with others			
<b>12</b>	Can please others easily	Work in peer tutoring			
<b>13</b>	Resolve conflict easily	Negotiate and compromise with others			

This table is known as *social skills check list*. The procedure was to sort out number of categories of social behaviours into major factors of social skills. A number of categories of behavior having common features were clustered into one place. A well defined nature of social behaviour was found out which is known as factor. In this way five factors were derived. **The five factors were**

- Interpersonal skills – **I factor**
- Understanding others- **U factor**
- Nurturing Communication – **C factor**
- Learning Autonomy – **A factor**
- Positive self Perception – **P factor**

These factors are abbreviated as '**IUCAP**'. Each column in the table represents a factor and its underlying items.

### **III. Generating Meaning**

#### **5.6 Factor Analysis**

Factor analysis was used to identify a small number of factors. It was used to represent relationships among sets of inter-related variables (e.g. the five descriptors). Five descriptors have been found to describe the social skill behaviours. These were 'IUCAP' factors. Interpersonal skills, understanding others, Nurturing Communication, Learning autonomy and Positive self-perception are subsumed under IUCAP.

In order to find meaningful factors, the analysis was done. SPSS version 13 Program was used to conduct factor analysis. The analysis was done separately for each of the two groups. As per the step-by-step of SPSS following basic steps were followed to conduct a factor analysis:

- 1. Calculation of factor matrix of all factors used in the analysis**
- 2. Factor extraction**
- 3. Factor selection through rotation**

#### **Result:**

The results of analysis of both the groups are presented below.

#### **Step-1 Calculation of Factor Matrix**

The intercorrelations among descriptor variables (factors) were calculated. The correlation coefficients were found out by Pearson Correlation formula method. The intercorrelations among I-Factor, U-Factor, C-Factor, A-Factor and P-Factor were shown in the tables (**Appendix-K and Appendix-L**). The correlation matrix of factors of social skill behaviours of teacher trainees of group-1 and group-2 were displayed in the tabular form.

#### **Step-2 Factor Extraction**

In this phase, the principal component method of analysis was used to extract factors. The communalities were found out. The initial communalities were shown to be value of 1.0. After extraction, the communalities were found to be less than 1.0 (**Table-5.5 and 5.6**).



**Table-5.5:**

**COMMUNALITIES OF GROUP-1**

**(EXTRACTION METHOD)**

<b>FACTORS</b>	<b>INITIAL</b>	<b>EXTRACTION</b>
<b>I</b>	<b>1.000</b>	<b>.957</b>
<b>U</b>	<b>1.000</b>	<b>.928</b>
<b>C</b>	<b>1.000</b>	<b>.911</b>
<b>A</b>	<b>1.000</b>	<b>.841</b>
<b>P</b>	<b>1.000</b>	<b>.757</b>

**Table-5.6:**

**COMMUNALITIES OF GROUP-2**

**(EXTRACTION METHOD)**

<b>FACTORS</b>	<b>INITIAL</b>	<b>EXTRACTION</b>
<b>I</b>	<b>1.000</b>	<b>.985</b>
<b>U</b>	<b>1.000</b>	<b>.940</b>
<b>C</b>	<b>1.000</b>	<b>.670</b>
<b>A</b>	<b>1.000</b>	<b>.822</b>
<b>P</b>	<b>1.000</b>	<b>.627</b>

**Table-5.7:****Total Variance of Group-1 Explained (Extraction Method)**

The Eigen values were calculated in **table-5.7** and **table-5.8**. Eigen values indicated the proportion of variance accounted for by each factor.

<b>Factor</b>	<b>Initial Eigenvalues</b>			<b>Extraction Sums of Squared Loadings</b>		
	<b>Total</b>	<b>% of Variance</b>	<b>Cumulative %</b>	<b>Total</b>	<b>% of Variance</b>	<b>Cumulative %</b>
1	2.745	54.898	54.898	2.745	54.898	54.898
2	1.649	32.989	87.887	1.649	32.989	87.887
3	.402	8.044	95.931			
4	.142	2.845	98.775			
5	.061	1.225	100.000			

**In group-1**, referring to **Table 5.7**, the first factor which explained the greatest amount of total variance was **I-factor**. Because its' Eigen value is 2.745. It contributed around **54% of the variance**. The two components whose Eigen values are greater than 1 were extracted. The second factor was **U-factor** having Eigen value 1.649. It contributed approximately **33% of the total variance**. Cumulatively these two factors accounted for more than **87% of variance**.

**Table-5.8:****Total Variance of Group-2 Explained (Extraction Method)**

<b>Factor</b>	<b>Initial Eigenvalues</b>			<b>Extraction Sums of Squared Loadings</b>		
	<b>Total</b>	<b>% of Variance</b>	<b>Cumulative %</b>	<b>Total</b>	<b>% of Variance</b>	<b>Cumulative %</b>
1	2.620	52.401	52.401	2.620	52.401	52.401
2	1.422	28.446	80.847	1.422	28.446	80.847
3	.668	13.355	94.202			
4	.279	5.585	99.787			
5	.011	.213	100.000			

In group-2, referring to **Table 5.8**, it is understood that Eigen values of the two extracted factors are 2.620 and 1.422. The first factor having high **Eigen value of 2.620**, explained around **52 % of total variance**. The second factor having second highest **Eigen value of 1.422** contributed only **28% of the total variance**. The two factors cumulatively contribute **80% of the total variance**.

Factor-1 and Factor-2 with an Eigen value larger than 1.0 were retained. Other factors having Eigen values less than 1.0 explained less variance than first and second factors in both the groups. Hence, these were not selected.

**Step-3 Factor Selection through Rotation**

In order to know factor loadings on one another, the rotation was needed. It was found in group-1 that I-factor had factor **loadings of 0.963** to one component which is very high and loadings of **0.174** to another component which is low. After rotation, C-factor was found as the second factor. It has **high loadings of 0.952** to one and **low loadings of 0.064** to another (Table-5.9).

**Table 5.9:**

**Rotated FactorMatrix (a) of Group-1**

**Varimax (Method)**

Factor	Component	
	1	2
I	.963	.174
U	-.340	.901
C	.952	.064
A	.397	.827
P	.377	.784

**a Rotation converged in 3 iterations.**

Similarly, in group-2, the selected two factors were I- factor and U-factor. The I-factor has high loadings of **value 0.981** to one factor and low loadings of **value 0.146**. The U-factor has high loadings of **0.954** to one and low loadings of **0.174**.

**Table 5.10:**

**Rotated Component Matrix (a) of Group-2**

**Varimax (Method)**

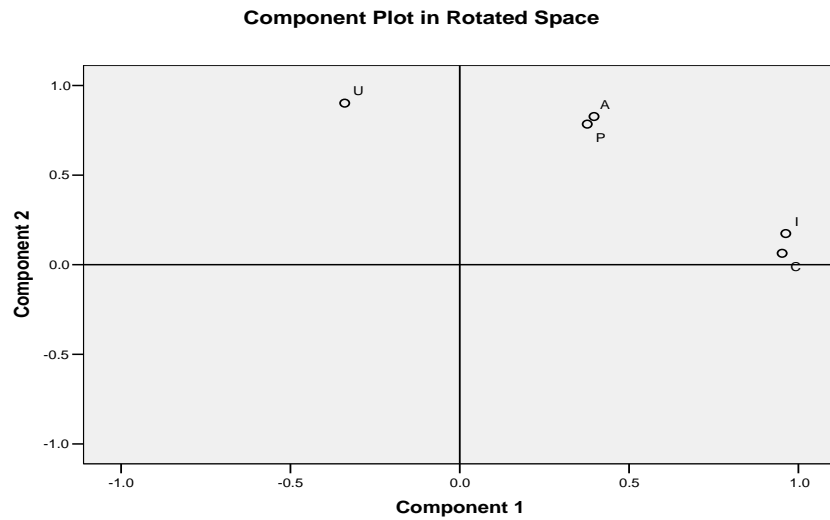
Factor	Component	
	1	2
I	.981	.146
U	.954	-.174
C	.094	-.813
A	.728	.540
P	.171	.773

**.a Rotation converged in 3 iterations.**

After rotation, from the plottings between I-factor and C-factor in group-1 and I-factor and U-factor in group-2 found that the two factors were close towards rotation axes (**Figure-5.1 and Figure-5.2**). It was understood that the strength of their relationship was very high.

**Figure-5.1:**

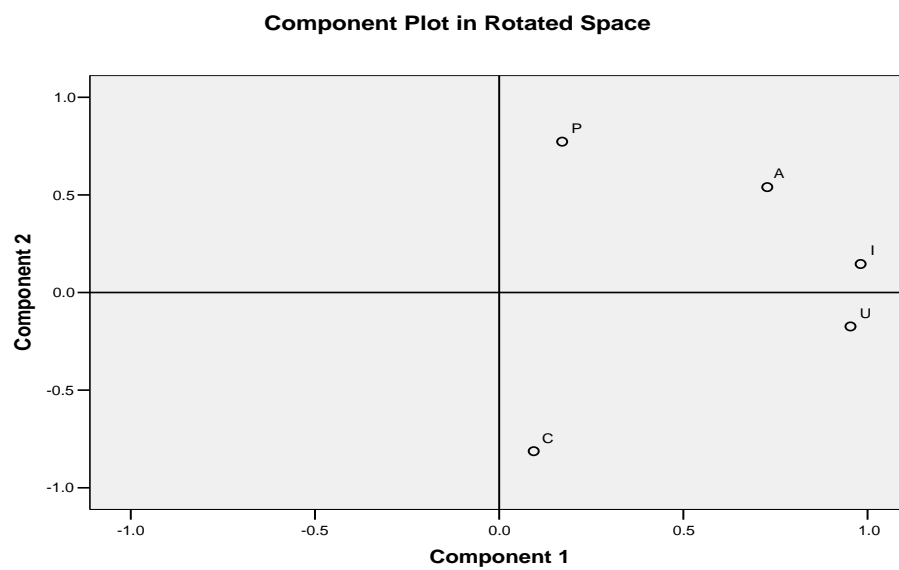
**Component Plot in Rotated Space of Group-1**



The above graph shows the plotting of factors of social skill behaviours of group-1 in rotated space

**Figure-5.2:**

**Component Plot in Rotated Space of Group-2**



The above graph shows the plotting of factors of social skill behaviour of group-2 in rotated space.

### **Interpretation:**

The two factors, I-factor and C-factor were loaded highly having values of 0.963 and 0.952 respectively on one factor and low 0.174 and 0.064 respectively on all others. The I-factor in both the groups has very high loadings and hence it possessed high face validity. It led to make possible to find out other underlying variables.

It is also inferred that the two factors like I-factor and C-factor in case of group-1 and I-factor and U-factor in group-2 were lying on the rotated axes. So, their strength of relationship is very high.

It is also observed that the two factors have high Eigen values. Others possessed low Eigen values. Hence, it can be understood that A-factor and P-factor in both the groups were not main contributor towards the description of social skill behaviours. Further, U-factor in group-1 and C-factor in group-2 were also not representing towards social skill behaviours. From the data, it was observed that these factors contribute only around **13% of total variance**. Hence, their contribution towards description of social skill behavior was very low.

## **5.7 Perception of Teacher Trainees towards PBL**

In order to know to what extent the PBL process was effective to illuminate the different types of behavior and social skill behavior in particular, perception of teacher trainees was estimated. A teacher made perception scale was administered to the teacher trainees. There were 10 items in the scale out of which eight were of favourable statements and the rest two were unfavourable statements. The scale considered scores in descending order from 4 to 0 to the responses of MT, LT, VT, T, & NT respectively for favourable statements. The scoring was done in reverse order in case of unfavourable statements. In this way, scores of each individual trainee with respect to items were collected. Scores of group-1 are presented in Table-5.11 and of group-2 are in Table-5.12.

**Table 5.11:****Scores of Rating on Perception of Group-1**

<b>SN</b>	<b>Statements</b>	<b>T<sub>11</sub></b>	<b>T<sub>21</sub></b>	<b>T<sub>31</sub></b>	<b>T<sub>41</sub></b>	<b>T<sub>51</sub></b>	<b>T<sub>61</sub></b>
<b>1</b>	The scenario made me think about the discovery process	3	3	3	3	3	4
<b>2</b>	The scenario was interesting	4	4	4	4	4	3
<b>3</b>	The scenario was engaging	2	3	4	3	3	3
<b>4</b>	I found the feedback comments useful	4	3	4	3	4	3
<b>5</b>	I enjoyed the exercise	4	3	4	3	3	3
<b>6</b>	The exercise improved my knowledge to suggest remedial measures	4	3	3	3	4	3
<b>7</b>	I would have learnt more from tutorial on the subject	2	3	4	3	2	3
<b>8</b>	I Would have learnt more from self readings on the subject	2	3	4	3	2	3
<b>9</b>	My horizon of knowledge became broadened	3	3	4	4	4	3
<b>10</b>	I learnt the way of living and working together	4	4	4	4	4	4
<b>Total</b>		<b>32</b>	<b>32</b>	<b>38</b>	<b>33</b>	<b>33</b>	<b>32</b>

Table-5.11 displays the socres of teacher trainees of group-1.

**Table 5.12:****Scores of Rating on Perception of Group-2**

SN	Statements	T <sub>12</sub>	T <sub>22</sub>	T <sub>32</sub>	T <sub>42</sub>	T <sub>52</sub>	T <sub>62</sub>
1	The scenario made me think about the discovery process	3	3	3	4	3	3
2	The scenario was interesting	3	4	4	4	4	3
3	The scenario was engaging	4	4	4	3	3	4
4	I found the feedback comments useful	4	3	4	4	4	3
5	I enjoyed the exercise	3	4	3	4	2	3
6	The exercise improved my knowledge to suggest remedial measures	3	3	3	3	3	3
7	I would have learnt more from tutorial on the subject	3	3	2	4	3	3
8	I Would have learnt more from self readings on the subject	3	3	3	3	3	3
9	My horizon of knowledge became broadened	3	3	3	4	3	4
10	I learnt the way of living and working together	3	3	4	4	4	4
Total		32	33	33	37	32	33

The scores of perception scale of teacher trainees of group-2 are given in the above table.

**Result**

The calculations of Z-score and T-score are presented below in a table.



**Table 5.13:****Calculations of Z-score and T-score**

SN	Names	Scores	Deviation (d)	d <sup>2</sup>	Z- score	T-score=10Z +50
<b>Group-1</b>						
<b>1</b>	S1.1	32	1.3	1.69	0.684	6.84+50=56.84
<b>2</b>	S1.2	32	1.3	1.69	0.684	6.84+50=56.84
<b>3</b>	S1.3	38	4.6	21.16	2.421	24.21+50=74.21
<b>4</b>	S1.4	33	0.3	0.09	0.157	1.57+50=51.57
<b>5</b>	S1.5	33	0.3	0.09	0.157	1.57+50=51.57
<b>6</b>	S1.6	32	1.3	1.69	0.684	6.84+50=56.84
<b>Group-2</b>						
<b>7</b>	S2.1	32	1.3	1.69	0.684	6.84+50=56.84
<b>8</b>	S2.2	33	0.3	0.09	0.157	1.57+50=51.57
<b>9</b>	S2.3	33	0.3	0.09	0.157	1.57+50=51.57
<b>10</b>	S 2.4	37	3.7	13.69	1.947	19.47 +50=69.47
<b>11</b>	S2.5	32	1.3	1.69	0.684	6.84+50=56.84
<b>12</b>	S2.6	33	0.3	0.09	0.157	1.57+50=51.57
				$\sum d^2 = 43.75$		

Group 1 –Mean=  $32+32+38+33+33+32=200/6 = 33.3$

Group 2- Mean= $32+33+33+37+32+33 = 200/6 = 33.3$

Average perception of the group = M comb =  $(33.3 \times 6) + (33.3 \times 6) \div 12 = 400 \div 12 = 33.3$

T-score =  $10Z + 50$

$$Z = \frac{X - M}{S}$$

Where Z= Standard score

X=Score

M=Mean

S=standard deviation= $\sqrt{\sum d^2 \div N}$

Here, S= 1.90

T-score is calculated in column 6 of table-5.13

## **Interpretation**

Mean value of 33.3 represents the typical or average perceptions of the group. Scores of each participant are at a small difference from the average score. The two scores 38 and 37 are far away from 33.3. It indicates that the two are highly favorable towards PBL.

Five scores of 32 each is laying just below the mean score of 33.3. It points out that these five are less favorable towards PBL.

Other five scores fall on the average score itself. So, it can be said that they are more favorable.

The difference between the raw score and average score is so small that the degree of favorable perception can not be estimated properly. So, the perception scores should be expressed as Z-score and T-Score to yield the new distribution of scores keeping mean value as 50.

The table showed that the value of T-scores ranges from 51.57 to 69.47 and 74.21 through 56.84. It proved that all scores are higher than mean score of 50. Hence, it was concluded that the perception of students are demonstrated from more favorable to higher favorable towards PBL.

Considering the scores of teacher trainees in group 2 (Table 5.12), the similar trend was also found out. All teacher trainees were put tick mark under “mostly True” (MT) to the items like 2, 3, 4, & 10. This remarked that PBL scenario was engaging and was also interesting to them. Further they learnt the way of living and working together as a result of this learning. Scores of 5 trainees were approximately equal with each other (i.e. 32, 33, 32, 33, and 33). It indicated that the trainees considered the utility of PBL process very turely. Again from the analysis of scores, it was understood that two trainees clearly demonstrated positive and most favourable attitude towards the PBL process.

## **5.8 Content Analysis of Feedback of Teacher Trainees**

The feedback of teacher trainees towards overall effectiveness of PBL was collected in the written form. The content of each feedback was analysed to understand the behavioural changes in a meaningful way. The analysis was focused to know the change of behavioral pattern of teacher trainees. The two dimensions of behaviours were extracted when the organization of PBL was successful. These were

- Personal social behavior
- Group social behavior

The analysis was based on the following steps.

### **Step-1: Categorization of Contents**

Written matters describing appreciation to PBL group work were selected. It was defined to categorize the social behavioral patterns of teacher trainees. The contents of each one's feedback is presented(**Appendix-M**)

A sample of the written feedback of T11(first teacher trainee of the first group) is presented below.

- A very live discussion was going on.
- The content related to cause effect of "Green house effect" were new discoveries, experiments and case study.
- It was worthful content.
- I covered vast content.
- We liked to participate.
- Help from my friends was rendered.
- We work together.
- It was very great experience on my part.
- I suggest it is good technique of learning.

### **Step-2: Identification of Categories**

The size of the text, dialogue, quotes, and similar such things were considered in selecting the category. The following categories were identified keeping "Social skill behavior" and "Effectiveness of PBL" in focus. The considerations were based on the following question.

- What was said?
- How the written matter was treated either favourable or unfavourable\ strong or weak?

- What goals were revealed?
- What were the behaviors used in the description of teacher trainees

### **Step- 3: Categorizing and Sorting Into Key Areas of Social Skill Behaviors**

In this step, key areas of social skill behaviors were sorted out and then categorization was done. The categories that were used fall into the following areas (Table-5.14).

**Table: 5.14:**

#### **Particulars of Categories of Content Analysis of Feedback**

<b>SN</b>	<b>CATEGORIES</b>	<b>FREQUENCY</b>
1	<b>Concentration in new knowledge</b>	10
2	<b>Approachable</b>	04
3	<b>Cooperative</b>	04
4	<b>Problem solver</b>	02
5	<b>Dominant behavior</b>	03
6	<b>Interesting</b>	10
7	<b>Conversational with ease</b>	09
8	<b>Inter-personal relationship</b>	04
9	<b>Self/auto learned</b>	02
10	<b>Distribution of work</b>	03
11	<b>Listener</b>	01
12	<b>Language development</b>	01
13	<b>Curious</b>	03
14	<b>Enthusiastic</b>	05
15	<b>Confident</b>	03
16	<b>Punctual in joining</b>	02
17	<b>Working together</b>	04
18	<b>Sharing</b>	05
19	<b>Attitude change</b>	02
20	<b>Adjustable</b>	02
21	<b>Communicative</b>	05
22	<b>working hard</b>	01
23	<b>Argumentative</b>	01
24	<b>Enjoyable</b>	07

Twenty four categories of behavior indicating social skills were located. The number occurrences were calculated using tally marks. These numbers were frequencies which are given in the table. In this table “Cooperation” is a category of social skill behavior given an example. The frequency is four. The statement describing “helping behavior” and “working behavior in a group” were categorized under the area of **cooperation**.

#### **Step- 4: Finding the Factors**

The categories of behavior were based on the area of skills. Two sections were generated from list of categories of behavior. These were put into the followings.

1. Personal social skill behavior
2. Grouped social skill behavior

**1. Personal Social Skill Behavior:** The following skills were demonstrated within a teacher trainee during problem based learning. These were known as personal social skill behaviors.

**Table 5.15**

#### **List of Personal Social Skill Behaviours**

<b>Personal social skill behaviors</b>	
<ul style="list-style-type: none"> <li>• Working hard</li> <li>• Adjustable</li> <li>• Argumentative</li> <li>• Attitude change</li> <li>• Self/auto learned</li> <li>• Curious</li> <li>• Listener</li> </ul>	<ul style="list-style-type: none"> <li>• Dominant</li> <li>• Inter-personal relationship</li> <li>• Punctual in joining</li> <li>• Confident</li> <li>• Language development</li> <li>• Approachable</li> </ul>

**2. Group Social Skill Behavior:** The following skills were demonstrated among teacher trainees within a group during problem based learning. These were known as group social skill behavior.

**Table 5.16:**

**List of Group Social Skill Behaviours**

Group social skill behaviors	
<ul style="list-style-type: none"><li>• Conversational with ease</li><li>• Cooperative</li><li>• Problem solver</li><li>• Working together</li><li>• Distribution of work</li></ul>	<ul style="list-style-type: none"><li>• Communicative</li><li>• Sharing</li><li>• Interesting</li><li>• Enjoyable</li></ul>

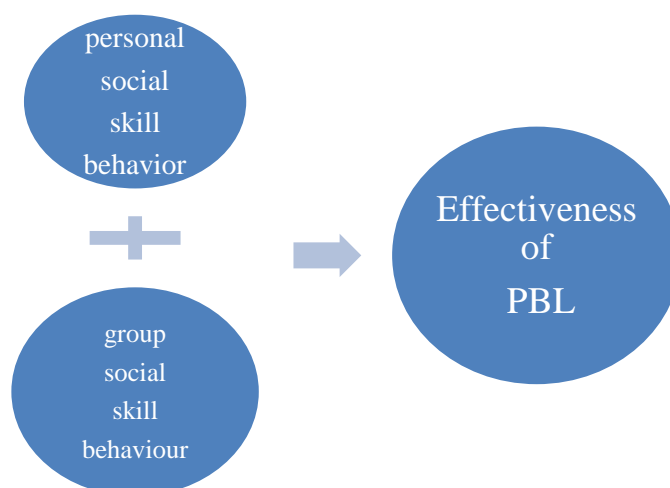
Thus the effectiveness of PBL was determined by construction of particular as well as group social skill behaviors.

**Step- 5: Comment on the Groups and Review**

It was concluded that PBL process within small group was operative on the ground of building of social skill behavior. It has been shown through the following figure that PBL was effective due to the development of both personal as well as group social skill behaviours.

**Figure-5.3**

**Effectiveness of PBL**



The effectiveness of learning was understood from the socially oriented behaviours. Thus, the social text regulated the process of learning.

## 5.9 Major Findings

The major findings of the study were:

- The teacher trainees became the **potential participants** exhibiting certain behaviours like working together, sharing ideas through weighing others' perspectives, resolving the problems, and learning to share responsibilities towards new learning during the PBL process.
- The **social skills** exhibited by teacher trainees were construed into personal and group social skills.
- **Forty seven** categories of **dynamics of behaviours** were manifested among the first group of teacher trainees during PBL process.
- **Forty four** categories of **dynamics of behaviours** were manifested among the second group of teacher trainees during PBL process.
- The dynamics of social behaviours were interpreted under five factors abbreviated as '**IUCAP**' factors.
- The **five factors** underlying these social skills were
  - ❖ Interpersonal skills
  - ❖ Understanding others
  - ❖ Nurturing communication
  - ❖ Learning autonomy
  - ❖ Positive self Perception
- **Interpersonal skill** was abbreviated as the I-factor. It extracted 13 categories of dynamics of behavior. They are
  - ❖ Request informations from others
  - ❖ Ask for clarifications when talking with others
  - ❖ Shows interest on others
  - ❖ Asserts his\her right without hurting others

- ❖ Approach others easily
  - ❖ Shares his\her things with others
  - ❖ Does express his\her wishes to others
  - ❖ Share his\her work with others
  - ❖ Share each other
  - ❖ Sincerely express thanks for the help received
  - ❖ Takes care of others
  - ❖ Can please others easily
  - ❖ Resolve conflict easily
- U-factor was **Understanding others**. It obtained 13 categories of dynamics of behaviours. They were.
    - ❖ Takes active part in group work
    - ❖ Joins in team work with others
    - ❖ Invites peer to join ongoing activity of the group
    - ❖ Join in activities with others
    - ❖ Acceptance to view points of others
    - ❖ work in pairs to complete the task
    - ❖ Dignity of labour
    - ❖ Shows interest in others and exchange informations
    - ❖ Help out when one of them gets behind in his/her work
    - ❖ work well along with a team
    - ❖ show more open to agree with others
    - ❖ work in peer tutoring
    - ❖ negotiate and compromise with others



- The third factor was **nurturing Communication** denoted as C-factor; Six categories of behaviours were covered under this domain.
- The dynamics of behaviours placed under **C-factor** were
  - ❖ Keep eye contact while talking with others
  - ❖ Initiate dialogue
  - ❖ Start conversation with each other
  - ❖ Ask if he/she can be any help to others
  - ❖ Joins in conversation with others
  - ❖ Active listening
- The fourth one was **learning Autonomy**, denoted as A –factor.
- Eight categories of dynamics of behavior were included under this **A-factor**. They were.
  - ❖ Has ability to concentrate on the task in hand
  - ❖ Greater access to resources
  - ❖ Willingly participates in all steps of problem-solving
  - ❖ Action oriented
  - ❖ Thoughtfulness within the group
  - ❖ Prepare an evidence
  - ❖ Build up a portfolio of work
  - ❖ Reflective behaviour
- The last one was P-factor, known for **positive self-Perception**. Only seven categories of dynamics of behaviours were identified under **P-factor**. They were
  - ❖ Take things positively
  - ❖ Has leadership qualities

- ❖ Feels happy when she \he is in a group
- ❖ Can adopt according to the situations
- ❖ Natural curiosity
- ❖ Easily makes relationships
- ❖ Scientific outlook
- From the **factor analysis**, it was understood that
  - ❖ The category of behaviours, producing five factors (IUCAP) were found **meaningful**.
  - ❖ InGroup-1, **I-factor and C-factor** were contributing up to 80% towards the description of social skill behaviours.
  - ❖ In Group-2,**I-factor and U-factor** were responsible factors to describe the social skill behaviours
  - ❖ In both the groups, other factors like **A-factor and P-factor** were responsible amounting to 20% to bring about the social skill behaviours.
- From the **content analysis** of teacher trainees' written feedback, it was found that the PBL process in group setting was operative and effective.
  - PBL was determined effective on the grounds of **personal social skill behaviors** as well as **group social skill behaviors**
  - The written feedback of teacher trainees about PBL generated 24 categories of behavior in the area of social skills.
  - **Personal social skill behaviours** which were constructed among the teacher trainees were
 

<input type="radio"/> Approaching	<input type="radio"/> Hard worker
<input type="radio"/> Adjustment	<input type="radio"/> Argument
<input type="radio"/> Curiosity	<input type="radio"/> Listener
<input type="radio"/> Inter-personal relationship	<input type="radio"/> Punctuality in joining
<input type="radio"/> Confidence	<input type="radio"/> Language development

- The following **group social skill behaviours** were constructed among the teacher trainees within a group
  - Conversational with ease      ○ Co-operative
  - Problem solver                      ○ Working together
  - Distribution of work              ○ Communicative
  - Sharing                                  ○ Interesting
  - Enjoyable
- From the estimation of perception of teacher trainees, it was found that their **perception** demonstrated more favourable to higher **favourable** towards success of PBL.

From the above list of findings, it is concluded that PBL process within the small group of teacher trainees was effective on the grounds of construction of social skills.

## 5.10 Discussion and Conclusion

The present study was carried out on the helping behaviours, interactions, the construction of social skills, and perceptions of teacher trainees as they worked on mathematics and science related PBL problem scenarios. The results showed that during PBL process, the teacher trainees demonstrated social skill behaviours over the period of the learning. The PBL process was operative which extracted 'IUCAP' factors of social skills. The task of PBL was an *exposition to problem scenarios*. The situation, where the teacher trainees worked was a *small group*. They learnt how to socialize. The group members provided assistance to each other such as explanations and other types of helping responses. At times, in a group, teacher trainees provided more help to each other such as providing directions and directions with prompts like 'that is right', 'okay', 'see the level of the picture' etc.. These were *approaching behavior* with others. These were proved *soliciting behavior* as a part of their socially oriented behaviours. Verbal as well as non verbal behaviours were seen among teacher trainees.

The group was involved in activities, which was more innovative. When teacher trainees were involved in PBL activities, the *social and communicative values* to each individual were developed. Teacher trainees were more verbally communicative in small groups. It was such involvement with each other about the task that encouraged teacher trainees to ask questions, provide explanations, clarify the points and participate in discussions. Through this engagement, teacher trainees learnt to plan how to proceed with their work and communicate their new ideas to their mates. In effect, as Vygotsky (1978) observed that they used language as medium to relate each other, to facilitate others to learn, to *scaffold* each other's learning. So, it became their own and it developed "*ownership of their learning*".

Teacher trainees' skill in communication particularly non-verbal communication during interaction, discussion and dialogue was nurtured. The gesture, posture and body movements symbolized their communication during discourse. These were part of their socialization. Along with verbal, face to face communication, non-verbal behaviors were focused to ascertain social skills. Because, the verbal and non verbal communications were concurrently focused for discourse.

The socially desirable behaviours like greater involvement with others, showing interest on others, approaching others, sharing his\her work, and taking care of others promoted a healthy community. It enabled the proper functioning of learning environment. PBL was effective to evolve a conducive learning environment and overall to create community environment to enable improved learning. Then interpersonal skills were generated within the community.

While the teacher trainees were working together on the problem, the elements of co-operation and collaboration like face to face interaction, *individual responsibility* etc, surfaced. The same was found in a study by Wade (1994) that in a social context, peer collaboration allowed to solve problems. Similarly, an ethnographic study by Lavin (2002) revealed that active interaction led to collaborative learning. After the teacher trainees had an opportunity to explore the problem for about 25 minutes, the researcher led the group in a discussion in which each of the groups present their solution strategy, ideas and insights. It was important for the facilitator to maintain a neutral stance during this session and to not correct any 'wrong' answers, but allowing the teacher trainees to discuss them. The mentor's

role was crucial. Establishment of relation between mentor teacher and teacher trainees was an ongoing process. It was produced through social interaction. The sharing was supporting to their learning by assisting them in completing the responsibilities. As a result, it promoted desirable social skills. The key findings of a study by Fraser (2003) suggested that “the heart of the class-room is the *affective development* in teacher education”. Thus, the main contribution of pedagogy is the development of affective behaviors. The social orientation of learning made the base of the pedagogical process. So, Vygotsky (1978) viewed the child-in-social-activities.

PBL was effective in creating learning environment. The teacher trainees solved problems through sharing of knowledge, collaboration and socialisation. So, PBL explored the social constructivist components. It could be revealed from the study that the success of PBL was accountable on three components: ***Tasks, Groups, and Sharing***. It could be justified as

- The task was a problem scenario which was based on real-life problems.
- The teacher trainees worked on these tasks in small groups.
- Finally, the group was convened as a whole for a time of sharing. It was the time, during which the researcher, the advance learner attempted to convey collaborative work as a goal.

Nuy (1991) supporting this argued that PBL is structured in three dimensions; **Content, Organisation and Social setting**. Thus, the result of the present study in respect to learning process through PBL accrued to be valid.

Further, the study confirmed that discussion; question-answering, sharing with others through dialogue and conversation were the strategic learning behaviours. It was possible to develop active learning behaviours. Hence, active learning was successful in a constructivist framework. It allowed the teacher trainees to develop their own knowledge and experiences which supported construction of knowledge to some degree.

Opportunities for teacher trainees to construct mathematical and science knowledge arise as they interact with their peers. As a consequence, their mathematical and science interpretations; first constrained by the group's

interpretation and then consensus was reached. This led the teacher trainees in reflecting their discussions. How they participated in and explained their discussions made them reflective. So, the constructivist framework provided safe and secure environments that promote learner's active reflection which is supported by Owen(1993). Again, in another study, Weldon (2002) explored a social constructivist theory and research and found reflection impacted science and mathematics content and pedagogical content knowledge. Hence, real life situations intermingled with mathematics and science were the tasks of group learning in a constructivist framework.

No doubt, constructivist framework facilitated learners' learning in creating their own environment and engagement in meaning-making activities. It was possible that teacher trainees' knowledge construction were greatly aided by strategies like small group discussion and facilitation through instructor's explanations. Further developing constructivist pedagogy required a process of active reflection and dialogue. Thus, it may be re-emphasised that constructivist learning approach brought the teacher trainees (the learners) in focus with participative role in construction of knowledge. As a result, the personal and group social behavior in the social context were exhibited by them during the process of knowing. Hence, it should be recognised that Vygotsky's social constructivist approach of learning has premises to develop *social skills*.

This study also investigated teacher trainees' *perception towards effectiveness of PBL*. Perceptions of teacher trainees were collected through a perception scale that focused on

- Small group learning
- Attitude
- Teacher trainees social skill behaviours in group learning

The results showed that the teacher trainees demonstrated more favourable to higher favourable perception towards PBL. This finding is identical to some characteristics of a small group identified by (Michelle, 1999; Mary, 1999) where, participants work together, like each other, talk about the task, and work hard to complete it.

The teacher trainees demonstrated some interesting result into their group experiences during the completion of group task. They were responding to others' request for help and providing help that was not explicitly requested. This indicated '*a sense of responsibility*' for each other and *a willingness* to work together to complete the group task.

There was noticeable positiveness in teacher trainees' likingness towards task, group and sharing components of PBL. Their responses towards living and working together supported a clear development of socially accepted behaviours. This is a concern because this study proved that there were clear academic and social benefits to teacher trainees who participated in small group learning experiences.

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