CHAPTER - IV
DEVELOPMENT OF
INSTRUCTIONAL MATERIAL
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4.0.0 INTRODUCTION
In previous chapter the Methodology and process of Tool Development was given. The term Instructional Material was used widely in previous chapters. The present chapter is about the development of that Instructional Material. It is given under different captions like Rationale, Important Criteria, Format, Steps, Selection of Area, Course Content and Task Analysis, Specification of Objectives, Criterion and Achievement Test, Development of Verbal Instructional Material and Development of Non-Verbal Instructional Material.

The objectives of the present study have been stated in chapter I. The objectives clearly reflect that development of Instructional Material was the main aspect of the study. The present study entitled “Effectiveness of Instructional Material based on Thinking Skill of Identifying Pros/Cons in terms of students’ Cognitive and Affective domain related variables at Secondary school level” has been completed in two phases. In the first phase, Instructional Material for developing Thinking Skill of IPC was prepared and in the second phase, the experiment was carried out with the help of the developed Instructional Material. In the present chapter, the details related to the development of Instructional Material have been presented under the following headings:

4.1.0 RATIONALE OF PREPARING INSTRUCTIONAL MATERIAL
The prime objective of the present investigation was to develop Instructional Material by taking important topics of Science to facilitate the development of Thinking Skill of IPC. The investigator has selected Science because Science is considered to be the basis of learning, as Sciences are fundamental aspects of our mental lives and humanity.

Drill exercises unaccompanied by the explanation of the concepts involved can never enable a student to handle the concept confidently. Practice will always remain
incomplete without conceptualization. On the other hand, too much emphasis on conceptualization may make the subject dry and uninteresting. So what was needed was thinking in action, i.e. basic scientific concepts defined and explained with the help of simple illustrations followed by a variety of exercises to enforce conceptual grasp. These content exercises both verbal and non-verbal in nature were designated to facilitate the IPC skill. The IPC skill was chosen because the IPC skill is the prerequisite for many activities in curriculum like concept formation and concept attainment. Many underlying skills such as thinking, memory, organization, note-taking and drawing boundaries also depend on the ability to compare and categorize. It also widens the scope of understanding and ultimately it becomes an aid to spread the knowledge properly and systematically.

From the discussion in Chapter I, it has been made clear that it is possible to develop thinking skill of IPC amongst students by adopting various ways, by designing different types of Instructional Material. From Chapter II i.e. review of related literature it has been observed that there were several procedures and enrichment programs tried out by researchers for facilitating the development of thinking skill at different levels. Some of the procedures/techniques and styles were:

(i) Specially designed thinking skill course
(ii) Memorization drill based on Thinking Skill
(iii) Curricular Arrangement
(iv) Identification of attribute sand sorting into categories
(v) By providing well planned activities
(vi) Selecting and prioritizing the criteria.

All these were found to facilitate the development of Thinking Skill of IPC but the availability of such material was less and the varieties of Instructional Material and their validity too were to be ascertained. Further, due to the advancement in technology, a revolutionary and rapid change was noticed in the field of education, which made students more aware and curious about their surroundings. Thus to quench their thirst of knowledge, there is a need to develop
different types of exercises which may be appropriate for the pupils. Many researchers have conducted studies related to the development of Instructional Material based on Creativity, Advance Organizer Model and Operant Conditioning model (Jarial, 1981; Buddhisagar, 1986; Sharma, 1994) and positive results have been obtained by these studies. But very few studies were taken up related to the development of Instructional Material taking different topics of Science to teach IPC skill. Apart from this, the exercises already developed by other researchers have not been tried out at all levels of students or it did not suit to all students at all levels. Hence a need was felt to think of such a procedure which could be free from several constraints, focus the attention of students on different and new types of instructional techniques and could promote self-learning environment better suited to the secondary school level students.

The investigator thoroughly scrutinized and surveyed all the possibilities to invent such a procedure. For this purpose the material prepared by other investigators related to the topic were thoroughly studied and screened. Certain important features/steps prescribed for developing valid Instructional Material were followed. The experts from the field of Science were consulted. The investigator had also taken students’ responses to different aspects of Science lessons presented by the teacher in the regular classrooms and these responses were also observed and analyzed. It was thought that in comparison to various possible techniques, procedure for strengthening teaching learning process to develop the potentiality of students and to bring qualitative improvement in classroom teaching, the development of Instructional Material was more suited to the present group. Hence to fulfill objectives of development of Thinking Skill of IPC amongst students it was considered appropriate to follow the procedure for the development of Instructional Material. While preparing the Instructional Material the development of verbal and non-verbal form of Instructional Material for facilitating the development of thinking of IPC were selected. As the combination of both verbal and non-verbal Instructional Material provide wider scope for students to think in diversified way, create interest and thus help to facilitate learning.
4.2.0 IMPORTANT CRITERIA FOR THE DEVELOPMENT OF INSTRUCTIONAL MATERIAL

Instructional techniques are important as they directly influence students’ achievement. It has been observed that outcome of research favoring the innovative treatments are due to the use of well framed, well designed Instructional Material and proper selection of its content material. The quality of Instructional Material to a great extent is responsible for the quality of output of a teaching-learning process. The education is considered to be a lifelong process. Instructional Material plays an important role to shape the future of an individual because an individual uses it in order to update his/her knowledge, strengthen cognitive structures and to gain content mastery. Keeping in mind the importance of Instructional Material, the following precautions were taken while developing Instructional Material.

* **Language** - As language acts as a powerful means to communicate with others and knowing the written content. The language of the Instructional Material, as far as possible should be according to the level of the child which he or she can understand easily, interpret in his or her own way. The sentence should be simple. Vague or double meaning words should be avoided.

* **Pictures** - While incorporating pictures or sketches in the Instructional Material one should see that pictures or sketches are clear and large enough to have an impact as Dale (1969) has remarked that “one picture may be worth a thousand words.” Pictures can motivate the individual; modify their interests, attitudes and opinions. They should be closely related to the text and must have a harmonious relationship with words in order to create an effective teaching instrument. It has been observed that systematic use of varied pictures and sketches can make subject matter clear and appealing to students of diversified background and varying abilities. Picture or sketch is also helpful for effective learning for the individual who is not verbally gifted (Sansanwal and Buddhisagar, 1982).
Verbal & Non-Verbal - The designed and developed Instructional Material should be of both verbal and non-verbal type. This is because the combination of both verbal and non-verbal Instructional Material creates interest, involves students to have maximum participation in teaching-learning process, focuses attention and breaks the monotony of traditional method.

Clarity - The development of Instructional Material should be such that it may provide systematic guidelines and reflect what the teacher needs to accomplish, what the students need to do/learn and in terms of the content to be included in the course so that objectives may be easily achieved.

Self - Instructed - The Instructional Material should be based on self-instruction, so that students can easily read themselves and complete the exercises without any assistance. It may save time also.

Nature - The design of the Instructional Material should be according to the nature of the learner i.e., goal directed, self-regulating and can link new information with existing knowledge in a meaningful way.

Construction - The content of the Instructional Material should be such that it may bind the attention and concentration on the content and in given exercises. Its standards and ways of assessment should be appropriately high and challenging and difficulty level be increased slowly. The content should cover wider and diversified area and should have the potentiality to facilitate the development of Thinking Skill of IPC.

Impact - Talmadge and Eash (1979) observed that teaching through different types of instructional techniques and material are important, but proper care must be
taken before its use as Instructional Material. It directly influences students' achievement and performances. It has been suggested to use process skills, concrete skills, and attitudinal development and to provide innovative treatment to students. Moreover, the expectation should also be that treatment should not only result in short-lived effects of one or two weeks duration but yield effects that may be long lasting if not permanent.

Hence, keeping this in mind it was thought necessary to prepare such a material, which could be relevant to the topic and be best suited to the development of Thinking Skill of IPC.

4.3.0 FORMAT OF INSTRUCTIONAL MATERIAL

As far as the format of Instructional Material is concerned, no fixed format has been prescribed by any researcher or expert for developing Instructional Material. It has been left open to the insight, proficiency, capabilities, academic standing, artistry, imagination, competency, creativity innovative ideas of the researcher. In developing the Instructional Material for present study, the format decided was as follows:

The researcher began the topic by giving general instruction related to the importance and usefulness of Instructional Material. In each verbal exercise, a topic was taken and presented in nutshell along with the instruction as to what to do. On the other hand, in case of non-verbal Instructional Material, in the beginning of each exercise, instructions were given. This was followed by the presentation of real things, 3D objects, charts, video, etc.

4.4.0 STEPS OF INSTRUCTIONAL MATERIAL DESIGN

Proper structure and steps were followed for the systematic design of Instructional Material. Care was taken to accomplish the goal and to fulfill the needs of the learner. Focus was on the learner and learning activities were designed not only to engage students in learning process, but to develop interest in them to acquire the targeted competencies for the course. The steps followed were:
STEP 1

I. It described the learning students' needs, but are not getting (the gap between what they should know/be able to do, and what they currently know/are able to do).

II. How the researcher comes to the conclusion that this Instructional Material is needed.

III. Whether the designed Instructional Material clearly represents the need or not.

IV. Consider the body of knowledge and skills that need to be taught to the students.

STEP 2

I. State the overall learning goal: Express clearly what the learner should be able to do as a result of the treatment given through Instructional Material.

II. Describe prerequisite skills required for the course, skills that enable students to perform the competencies the researcher plans to teach. Include and give brief description of the skill that researcher will not teach directly, but expect students to exhibit the knowledge related to this.

III. Describe the characteristics of students i.e. age, upper/lower level, academic standing etc.

IV. Determine the methods the researcher will use (tests, paper etc) to measure levels of competency for each competency statement.

V. Outline the basic content which the receiver needs to cover for students to gain competencies. This step helps in the selection of text and other media to use in development of Instructional Material.

STEP 3

I. Incorporate active learning strategies. Select learning activities and assign them that are appropriate and effective in helping students acquire each competency specified for Instructional Material.

II. Select/design the Instructional Material taking help from texts, journals, online resources, video etc so that knowledge can be updated.
III. Sequence and segment course content of Instructional Material into chunks, balancing the students’ workload approximately in each class section and select proper media for delivery of each segment of instruction.

STEP 4

I. To determine whether the Instructional Material is filling the gap between what the students need to be able to do and what they were able to do without the Instructional Material (treatment).

II. To ascertain what classroom assessment the researcher will employ to assess the effectiveness of teaching (treatment).

4.5.0 SELECTION OF AREA

For developing Instructional Material, the first priority was the selection of the area. Before the selection of area, the investigator thoroughly reviewed the related literature and scrutinized the material prepared by other investigators related to the topic. From the review of the literature and other sources, it was very clear that Instructional Material based on Thinking Skills have been designed and developed in various subjects taking different areas, concepts and ideas such as:

Worsham and Austin (1983) developed a program ‘THINK’ for high school seniors in Baltimore and made students engaged in problem solving activities.

Vora (1984) investigated the impact of Divergent thinking program in Mathematics on creative level of the children of classes 7th and 8th. Gill (1990) studied the effect of training strategies on Identifying Pros/Cons skills and cerebral dominance in relation to Intelligence and cognitive style.

Asthana (2007) studied Effectiveness of Instructional Material on Thinking Skill of IPC in terms of students’ achievement and reactions at middle school level. Shukla (2014) studied Effectiveness of Instructional Material and Traditional teaching method based on Problem solving and Identifying Propaganda Thinking Skill in Social Science in terms of students’ achievement and reaction at higher secondary level.
From the review given in the 2\textsuperscript{nd} chapter, it is clear that, till now very few studies were conducted at higher secondary level and no Instructional Material was developed taking different topics of Science at higher secondary school level to develop Thinking Skill of IPC. That's why the researcher has selected Science for the development of Instructional Material to teach the skill of IPC.

4.6.0 COURSE CONTENT AND TASK ANALYSIS

For development of Instructional Material for facilitating Thinking Skill of IPC, the course content related to Science were analyzed in detail. Based on this analysis, the content of the course was divided into following ten units.

- **Unit I**: Matter in Our Surroundings
- **Unit II**: Is Matter Around Us Pure
- **Unit III**: Gravitation
- **Unit IV**: Motion
- **Unit V**: The Fundamental Unit of Life
- **Unit VI**: Why Do We Fall Ill
- **Unit VII**: Natural Resources
- **Unit VIII**: Diversity in Living Organisms
- **Unit IX**: Force and Laws of Motion
- **Unit X**: Improvement in Food Resources

The main aim of the present study was to find out where the Science course at secondary school level (IX) can be taught effectively by Instructional Material based on different Science topics such as Health and diseases, Pollution, Motion etc. It was decided to select more than 50 percent of the units for the purpose of development of Instructional Material. While selecting units important points kept in mind were - the difficulty level of the content, importance, usages and linkage between the contents. On the basis of these criteria, out of ten units the following five units were selected for the purpose of development of Instructional Material to provide treatment.
The proper sequence of the presentation of the content was decided on the basis of a flow chart prepared to identify the interdependency of the different concepts to be covered. Flow charts present the analysis of the content included in above mentioned five units separately. Based on the sequencing, detailed task analysis, specific outlines of the topics to be covered under each unit were prepared. The content outlines of the selected five units have been given below:

**Unit I : Is Matter Around Us Pure**
I Mixture - Types of Mixture
II Solution – (a) Colloidal Solution (b) Suspension
III Separating the Component of a Mixture
IV Physical and Chemical Changes
V Types of Pure Substances

**Unit II : Motion**
I Describing Motion – Uniform and Non Uniform Motion
II Speed with Direction
III Uniform Circular Motion

**Unit III : Why Do We Fall Ill**
I Health and it’s Failure - (a) The significance of Health
(b) Personal and community Issues
(c) Distinctions between ‘Health’ and ‘Disease - Free’
II Disease and its Causes - (a) Signs and Symptoms
(b) Acute and Chronic Diseases
(c) Infectious and Non Infectious Diseases

Unit IV : Natural Resources
I The Breath of life : Air
II Air Pollution
III Water : A Wonder Liquid
IV Water Pollution
V The Green House Effect

Unit X : Improvement In Food Resources
I Improvement in Crop Yields
II Crop Production Management - (a) Manure (b) Fertilizers
(c) Pesticides (d) Cropping Patterns
III Animal Husbandry - (a) Cattle Farming (b) Poultry Farming
(c) Fish Production (d) Bee – Keeping

4.7.0 SPECIFICATION OF OBJECTIVES
To get the maximum output of any work in a desired direction sound planning, proper execution and fair evaluation are considered to be the main criteria. In educational system evaluation is always done on the basis of well defined and specified instructional objectives, with value judgment about the educational status or achievement of students. It is through well defined and specified instructional objectives we can clearly know about how much the students have achieved.

The educational objectives can be written in two forms
(1) Entry behavior
(2) Terminal behavior.
4.7.1 Target Population

The Instructional Material was specifically prepared for bringing some change and breaking the monotony of lecture and text book method also utilizing it as self-Instructional Material in Science for IX class students of New Father Angel Higher Secondary School, Indore. This school is affiliated to M.P. Board, Bhopal. So the target population for this study was class IX students of New Father Angel Higher Secondary School. The medium of instruction was English.

Instruction should always be based upon student’s previous knowledge, because previous knowledge build trust, and unshakable confidence, motivate and energize to do productive thinking, develop mental toughness, link new information with existing knowledge in a meaningful way. So previous knowledge is the foundation block for future learning and if the foundation block is weak, the future learning will not be so fruitful and will be directionless. Thus to make teaching process more effective and goal directed, it is essential to formulate the entry behavior which would help in turn to make the terminal behavior more feasible to achieve. Dececco(1970) described the entry behavior as the present status of the student’s knowledge and skill in reference to a future status the teacher wants him to attain.

4.7.2 Entry Behavior

The unit wise entry behaviors are given below:

**Unit I: Is Matter Around us Pure**

i. Students are able to tell about readymade food material.

ii. Students are able to show relationship between food and diseases.

iii. Students are able to distinguish between natural and artificial food items.

**Unit II: Motion**

i. Students are able to tell the meaning of motion.

ii. Students are able to distinguish between the objects at rest and moving position.
iii. Students are able to show relationship between speed and direction.

Unit III: Why do We Fall Ill

i. Students are able to identify healthy and diseased person.

ii. Students are able to list ingredients in balanced diet.

iii. Students are able to distinguish between hygienic and unhygienic surroundings.

Unit IV: Natural Resources

i. Students are well-acquainted with the word pollution.

ii. Students are able to define a particular kind of pollution.

iii. Students are able to tell the meaning of industrialization.

Unit 5: Improvement in Food Resources

i. Students are able to write names of different crops.

ii. Students are able to tell the meaning of cropping patterns.

iii. Students are able to define animal husbandry in their own words.

iv. 4.7.3 Terminal Behavior

Taking into consideration the capability and proficiency of students, terminal objectives were specified in behavioral terms for the units mentioned above. The terminal behaviors for five units have been presented in the following way.

Unit 1: Is Matter Around us Pure

1. Students will be able to define mixture.

2. Students will be able to list different types of mixtures.

3. Students will be able to discuss that Indian traditional system of serving food in ‘Donas and Pattal’ was better than present ‘Plastic plate’ system.

4. Students will be able to trace the importance of natural food.

5. Students will be able to differentiate between the mixture and pure substances.

6. Students will be able to classify the following types of food material.
i. Maggie  
ii. Banana  
iii. Pizza  
iv. Rice  
v. Coke  

7. Students will be able to compare homogeneous and heterogeneous mixture.  
8. Students will be able to formulate different types of mixture.  
9. Students will be able to reorganize the components of a mixture.  
10. Students will be able to explain types of solutions into their own words.  

Unit II: Motion  
1. Students will be able to tell the definition of motion.  
2. Students will be able to tell few examples of motion.  
3. Students will be able to classify the objects showing motion.  
4. Students will be able to discuss different types of motions.  
5. Students will be able to use different formulae to measure motion  
6. Students will be able to make charts related to different types of motion.  
7. Students will be able to classify types of motions.  
8. Students will be able to select kind of motion from varieties of tracks like rectangular, circular etc.  
9. Students will be able to explain speed with direction.  
10. Students will be able to classify the situations showing different types of motion.  
11. Students will be able to modify uniform and non-uniform motion on the basis of their velocity.  
12. Students will be able to draw graphs showing uniform and non-uniform motion of the objects.  

Unit III: Why do We Fall Ill  
1. Students will be able to tell proper definition of health.  
2. Students will be able to make list of the different diseases.  
3. Students will be able to discuss types of cleanliness.
4. Students will be able to trace types of health from the given examples.
5. Students will be able to group different types of diseases.
6. Students will be able to differentiate between the following types of health.
   i. Individual health.
   ii. Social health.
   iii. Economic health.
   iv. Healthy and disease free.
   v. Good health and poor health.
7. Students will be able to solve different exercises related to public cleanliness.
8. Students will be able to compare different qualities of different health like economic, social etc.
9. Students will be able to illustrate their own examples.
10. Students will be able to make chart/models, flash cards related to cleanliness.
11. Students will be able to differentiate between the types of diseases.
12. Students will be able to classify between the symptoms and signs of diseases.
13. Students will be able to compare the pictures of healthy and unhealthy kids/persons.
14. Students will be able to list essential conditions for good health.

Unit IV: Natural Resources
1. Students will be able to define pollution correctly.
2. Students will be able to identify different types of pollution.
3. Students will be able to make list of all resources on which life on earth depends.
4. Students will be able to reproduce suitable examples of different types of pollution.
5. Students will be able to differentiate the following types of pollution.
   (a) Water pollution.
   (b) Air pollution
   (c) Soil pollution
1. Students will be able to give suitable examples to describe water as a wonder liquid.
2. Students will be able to modify the given reason according to the different kind of pollutions.
3. Students will be able to discriminate between the situations showing different kind of pollution.
4. Students will be able to arrange life resources into different categories on the basis of their common attributes.
5. Students will be able to define Green house effect.

Unit V: Improvement in Food Resources
1. Students will be able to define vermi-composting.
2. Students will be able to identify different types of crops.
3. Students will be able to make list of all cropping patterns.
4. Students will be able to reproduce suitable examples of different cropping patterns.
5. Students will be able to differentiate between the macro nutrients and micro nutrients.
6. Students will be able to use suitable examples to explain animal husbandry.
7. Students will be able to define fertilizers.
8. Students will be able to develop new cropping patterns.
9. Students will be able to discriminate between manure and fertilizers.
10. Students will be able to show relationship between use of fertilizers & crop production.
11. Students will be able to arrange crops into different categories on the basis of their common attributes.
12. Students will be able to compare bee keeping & fish production.

4.8.0 CRITERION AND ACHIEVEMENT TEST

The success of any instruction solely depends on the achievement of desired goals or the terminal behaviors. So to make sure that the terminal behaviors were attained by the students, it was necessary to evaluate at the end of the instructional work. This can be done by administering a test of terminal behaviours also known as criterion test or posttest. A criterion test is one that determines the extent to which the terminal
behaviours are attained unlike an Achievement Test; its objective is not to discriminate between high and low achievers, but to find out how many objectives were attained. Hence, it provides feedback to the researcher which helps to modify the Instructional Material.

As mentioned earlier, the Instructional Material was developed for five units. The terminal behaviours for these units have been incorporated in caption 4.7.3. In order to test the achievement of students on terminal behaviours of the five units, one achievement test was prepared. The achievement test consisted of fill in the blanks, Give reason, Multiple choice questions, Short answer type question, Classify, Picture description, Comparison etc. examples from few units are given below.

**Unit wise**

Example-1 Classify the following as Chemical or Physical Changes and give the answer in the space provided.

(Unit I Q. 1)

<table>
<thead>
<tr>
<th>i.</th>
<th>Cutting of trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>ii.</td>
<td>Melting of Butter in a pan</td>
</tr>
<tr>
<td>iii.</td>
<td>Rusting of almirah</td>
</tr>
<tr>
<td>iv.</td>
<td>Boiling of water to form steam</td>
</tr>
<tr>
<td>v.</td>
<td>Dissolving common salt in water</td>
</tr>
<tr>
<td>vi.</td>
<td>Making a fruit salad with raw fruits</td>
</tr>
<tr>
<td>vii.</td>
<td>Burning of paper and wood</td>
</tr>
</tbody>
</table>

Example-2 Under which of the following conditions are you most likely to fall sick?

(Unit III Q. 6)

i. When you are taking examinations.

ii. When you have travelled by bus and train for two days.

iii. When your friend is suffering from measles.

Ans. ————————————————————————————————————————————————————
Example-3 List any three human activities which would lead to an increase in the carbon dioxide content of air. (Unit IV Q. 3)

Ans. .....................................................................................................................................................................
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4.9.0 DEVELOPMENT OF VERBAL INSTRUCTIONAL MATERIAL

The present investigation was confined to the facilitation of development of verbal and non-verbal Thinking Skill of IPC. The verbal Thinking Skill of IPC constituted of those elements which help students to develop this skill i.e. Identification of the statement/concept, listing the statements showing strengths and opportunities of the concept, listing the statements showing weaknesses and threats of the concept, selecting the more applicable sentences for the statement/concept, selecting the more harmful sentences for the statement/concepts, finding arguments for the selected sentences in favor of the concept, finding the arguments for the selected sentences against the given concept and drawing the boundaries by specifying for the judgment. Hence, it was necessary to think of such a material which could be best suited and fulfill the criteria for the development of all the above mentioned aspects of verbal Thinking Skill of IPC.

4.9.1 Content of Verbal Instructional Material

From the review of the literature and discussion with experts, it was decided that the content of verbal Instructional Material can be of two types, namely

(i) Content from syllabus

(ii) Subject free content or content from the experiences of students.

In order to make teaching - learning process interesting and teach clear concepts about Thinking Skills many researchers tried to develop students’ Thinking Skills in particular academic subjects by taking content from the prescribed syllabus of the students. Furth
and Wachs (1974) designed tasks that require the identification of attributes and sorting into categories according to some rule. A number of logical puzzles, problem-solving activities and wide variety of games were designed taking Math and Science subjects. Dhade (2008) developed Instructional Material in Science to study its effectiveness in the development of Thinking Skill of Creative Problem Solving at middle school level. Tiwari (2010) constructed Instructional Material in Science to develop Thinking Skill of Identifying Pros/Cons at secondary school level. Shukla (2014) constructed Instructional Material in Social Science to develop Problem Solving and Identifying Propaganda Thinking Skill at higher secondary level. Nearly all the programs and practices investigated were found to facilitate Thinking Skills.

It has been observed that although providing training for the development of Thinking Skills in English, Science and Math, it helped the development of that skill into that particular subject only, but the general Thinking Skills of students do not increase significantly. Thus the possibility of transfer of Skill of IPC developed on the basis of training in a particular school subject seems to be precarious. In the present study apart from the syllabus content, subject free content was also included. This was because Science is such that it cannot be taught in a restricted and confined way as all the topics of Science are related to each other. Students can exhibit their competency if they possess sound previous knowledge and experience, so few exercises in Instructional Material were included, related to students’ previous knowledge and experiences.

Instructional Material(IM) includes video and audio recordings, motion pictures, film strips, module, CAI, photographic and similar visual material, audio and video transmission, computer program, three dimensions and exhibits, which are prepared or produced in whole or in parts by a faculty and which are used to assist or enhance
Instruction. In the present study some types of the given instructional material were used their examples with the topic they used for are given as follow

I. **Tour – during summer vacation we should go on a tour for social health.**
   1M – Real visual Experience

   The real experience of school trip or students tour with family or friends during summer vacation was used here to discuss their importance for social health of an individual.

II. **Individual Health- one should not waste one’s time in social gathering.**
    1M – Co-Curricular Activities

   Co-curricular activities or social gathering are important for the overall development of a student. For the present topic the student were involved into co-curricular activities like festivals celebration, social work, art and craft, etc. and then the topic was discussed in the class according to the steps of Thinking Skill of IPC that one should get involved in them or not.

III. **Being disease free is a symbol of good health.**
    1M – Module

   For this topic one module entitled ‘Health and Diseases’ was developed via researcher. Some information about the Thinking Skill of IPC was given in brief initially in the module. Then the instruction about the module like description of boxes, structure of module, entry behavior and terminal behavior was given in the module. Students were free to read the module according to their own pace.

   The module was an attempt to make students well acquainted with teaching methods and techniques. The purpose, structure, organization and instructions regarding module were given in easy language to the students. Module provides them an opportunity to self-study and freedom for critical thinking. It provides immediate reinforcement to each correct response of the learner. It also gives opportunity for the development of divergent thinking. Module facilitates the individual differences in learning situations and assesses the students’ progress in learning.
The module was having so many attractive pictures related to the topic and student friendly language with the use of similes, stars etc that reduced the routine aspect of instructions to the students. The module used in this topic is given in appendix – V.

IV. Vermicompost should be used than chemical fertilizer.
IM – Real 3D object

Figure 4.1 – Vermi-Compost and Chemical Fertilizer

For the discussion about this topic according to the steps of Thinking Skill of IPC real 3D objects as vermicompost and chemical fertilizer (urea, etc.) were shown to the students.

V. High amount of fertilizer is good for high crop production.
IM – Real 3D objects
Hybrid and desi vegetables (Tomato, bottle guard, cucumber, etc.) were shown to the students. Students were made to compare their positive and negative attributes. Then student were made to establish relationship between the uses of adequate amount of fertilizer with crop production to discuss the topic according to the steps of IPC Thinking Skill.

VI. Nomenclature- should apply or not?
IM – Module
For this topic a module was constructed by the researcher. The description of module and its importance are same as given under the topic III.
VII. Use of Pesticides should be banned in agriculture.

IM – Real 3D objects

Figure 4.2 - Pesticides

In this topic the pesticides were shown to the students and they were told about the benefits of pesticides as well as the defects or the diseases may happen due to the food material in which high amount of pesticides was used. Then students were allowed to discuss the topic according to the steps of IPC Thinking Skill.

VIII. Use of Poly bags should be banned.

IM – Power Point Presentation

Different kind of poly bags like thin and thick, colored and transparent, etc. were shown to the students and a power point presentation made on the use of poly bags and the problems arising now-a-days due to the poly waste were shown to the students. Then students were told to discuss the topic according to the steps of IPC Thinking Skill.

IX. Readymade food materials.

IM – Real 3D Objects
In today’s era students are fond of readymade food material. So the packets of Maggie, wafers, cold drinks, cake, etc. were shown to the students. Then students were asked to list their positive and negative attributes according to the steps of Thinking Skill of IPC.

X. Animal husbandry - Poultry farming should be banned.
IM - Module
For this topic a module was constructed by the researcher. The description of module and its importance are same as given under the topic III.

XI. Indian traditional system of serving food in community programs in ‘Donas’ & ‘Pattals’ was better than present ‘Plastic Plates’ system.
IM - Real Object

Figure 4.4 – Dona Pattal and Plastic Plates
Students use to go on parties. In the different celebrations in school and home like annual functions, birthdays, etc. They use to have food in plastic plates. So, in this topic different types of plastic plates used nowadays and donapattal were shown to the students to follow the steps of IPC Thinking Skill.

XII. Water Pollution- Do not use fertilizer and pesticides.
IM – Short Video Film
Water Pollution is a very big problem in present situation. The excessive use of fertilizer and pesticides in agriculture are polluting the water. A short video film showing the use of pesticide and fertilizers in agriculture, they are mixing with water and polluting the large water source was shown to the students, so they can deal with the topic according to the steps of IPC Thinking Skill.

XIII. Playing games only is better way to explain motion.
IM – Real Visual Material
In this topic, firstly the motion was explained in the classroom on blackboard. Then the students were bring to the playground to see other students playing and via that visual material different kind of motion were explained. After that the students were told to discuss about the better way to understand motion.

XIV. Being disease free is a symbol of good health.
IM – Module
The same module used in topic third was used for this topic. That module was covering the sub-topics of both, the Health and Diseases. So was used here too. The module was having so many attractive pictures related to the topic and student friendly language with the use of similes, stars etc that reduced the routine aspect of instructions to the students. The module used in this topic is given in appendix – V.
XV. Newspaper is a waste material.
IM - Real 3D Object
The newspaper of the same date and the past dates were given to the students as Instructional Material in this topic. Then the steps of IPC Thinking Skill were followed.

XVI. Industries should be banned.
IM - Short Video Film
A short video film showing industrialization, its benefits and its consequences was shown to the students as Instructional Material. The film was giving information about the changes occur in the society due to industrialization like employment, growth rate etc., as well as the increasing pollution type of negative points were also shown by the film. Then the students were told to follow the steps of IPC Thinking Skill about the topic.

XVII. Growing vegetables in our garden is alternative to avoid diseases.
IM - Real 3D Object

Figure 4.5 - Vegetable Peels

Due to the use of pesticides and chemical fertilizers the quality of vegetables has been changed. It was shown to the students in previous lessons. It is giving birth to many diseases. In present lesson the garden vegetables (Tomato, Chili, Potato, Bottle Guard, etc.) were shown to the students to discuss them as an alternative to avoid diseases according to the steps of IPC Thinking Skill.
XVIII. Air pollution- Only public vehicles should be allowed on roads.

IM – Short Documentary

Now-a-days vehicles are easily available for all kind of people at different prices. Due to this, there is tremendous increase in air pollution. A short documentary film showing air pollution via a number of vehicles, due to not using appropriate fuel, consequences of air pollution etc was shown to the students, so that they can deal with the topic according to the IPC Thinking Skill.

XIX. Human being is responsible for Green House Effect.

IM - Experiment (Real Visual Material)

Greenhouse effect is a very important issue nowadays before discussing that firstly, the students need to understand it properly. For this purpose Investigator made students to perform an experiment on the first day of this topic to understand greenhouse effect. The experiment was as follows.

Requirements

- 2 small thermometers
- Notebook
- Pen and pencil
- Jar or other clear container
- Clock or watch
- Access to a sunny area to perform the experiment inside or outside

Procedure

i. Give all the material to the students. They were told to place both thermometers in direct sunlight.

ii. Wait for three minutes before reading the thermometers, to give them time to adjust to the temperature.

iii. In their notebook, they were told to create two columns, one for thermometer A and one for B. alternatively, they can label them as left and right whatever they prefers for identification.
iv. After three minutes researcher asked them to read both thermometers and record the temperature in their notebook along with the time of readings.

v. Now, students were told to turn the jar upside down and place it over one of the thermometers so the jar is completely covering it. Conversely they can put the thermometer into a see-through container and put the lid on it. Make sure that the jar doesn’t cast a shadow over the other thermometer. If the thermometer is too long to lie flat on the table with the jar over it, just prop it up inside the jar.

vi. Once every minute for 10 minutes, record the readings for both the thermometers, without touching them, in their observation chart.

vii. After the 10 minute look over the chart. How did the temperature of the thermometer inside the jar change compared to the other one?

In this way the experiment was performed by the students. And then Green House effect was explained to them with the reasons responsible for it and the problems arising in the world due to it. After that they were told to discuss the topic according to the steps of IPC Thinking Skill.

XX. Frequent use of mineral water should be avoided.

IM – Real 3D Object

Pure water is basic human need but availability of pure water at every time and at all the places is not feasible. The people using mineral water all the time may fall ill if some time they need to use normal water (as at public places like gardens, schools, hospitals, cinema halls, etc.). The mineral water bottle and the normal water were shown to the students to discuss about the topic according to the steps of IPC Thinking Skill.

It is evident from the above presentation that content from syllabus and subject free content both were used to design verbal instructional exercises. Many verbal
exercises and module of 'Health and Diseases' were developed related to Thinking Skill of IPC taking different aspects of Science, providing well planned activities including arrangements of pros and cons about the topic, listing the applicable and harmful sentences, categorizing on the basis of similarities, differences or essential characteristics or attribute etc. In these exercises the level of difficulty increases and in some topics subjects were asked to think of different situations and their possible solutions.

4.9.2 Tryout of Verbal Instructional Material

The main purpose of the try-out was to know the functional utility, suitability of the developed items and also to avoid the drawbacks of the teacher made test such as ambiguous questions, excessive wordings, lack of appropriate formats etc. The criteria fixed for judging the suitability of the Instructional Material was to find out the clarity of the items in terms of language, instructions, examples, content and also to find out the difficulties encountered by the students in responding them. For this purpose the material was given to the experts from the field of Science teaching, researchers and those who have already worked in this field and they were requested to give their comments and observation in respect of the above mentioned criteria and also to judge whether the items fairly represented the content or it has the potentiality to facilitate verbal Thinking Skill of IPC. The observations and opinions of these experts were noted down. The developed Instructional Material was also tried out on class IX students, Indore. At this stage, suggestions, innovative ideas and responses of students related to items were also collected and the material was modified to know the suitability of the modification made by adopting this process and on the basis of the suggestions made by the experts, the problem faced by the students, the Instructional Material was suitably modified. The modified Instructional Material was used at the stage of experimentation.
4.10.0 DEVELOPMENT OF NON-VERBAL INSTRUCTIONAL MATERIAL

Development of non-verbal Instructional Material was another aspect of the study. It comprised of originality of expression, and composition of the given topics. Originality refers to an individual’s uncommon relevant responses, expression of ideas to a given task. Non-verbal exercises have been designed as they have tremendous potentiality to develop hidden talent, powerful expression and they bring forth the innovative ideas of students. The examples of some nonverbal instructional material used in the studies are as follows.

I. Public cleanliness – classification of waste material.
   IM – Chart
   In this topic chart was used having figures of hygienic and unhygienic environment. The chart was having different points to explain students that how public cleanliness is important for good health like use of antiseptic liquids, pest control, etc.

II. Only balanced diet is enough for good health, no effect of environment.
    IM – Chart
    For showing the relationship between balanced diet - good environment and Balanced diet - bad environment, a chart having figures of all of these was used. As well as they were motivated to give examples of their surroundings and there relation with their diet to understand the topic properly.

III. Only good economic conditions are enough for good health.
    IM – Charts
    Some charts having pictures of people and kids, healthy and financially well-established, as well as financially strong but suffering from some diseases like obesity, weak eye sight, overweight, laziness, etc. have been shown to the
students so that they can discuss on the topic that ‘only good economic conditions are enough for good health.’

4.10.1 Content of Non-Verbal Instructional Material

Not many studies have been carried out with the aim to develop Instructional Material or procedure so as to facilitate non-verbal Thinking Skills. Worsham and Austin (1983) developed a program ‘THINK’ for high school seniors in Baltimore and made students engaged in problem solving activities in which they were encouraged to discuss the rational leading to higher level thinking. Inhelnder (1969) attempted to develop non-verbal Instructional Material based on classification skill and refers to it as “graphic collection” and concluded that children initially classify by sorting groups of completely different objects by using a consistent criteria. Austin and Shore (1993) taught the concept of sequencing and comparison by introducing classic-cards which covered twelve semantic fields and then transferred it to curriculum.

De Bono (1992) suggests that Thinking Skill is most effectively taught when taught directly and deliberately. The use of diagrams, sketches, pictorial representation will be beneficial for the development of Thinking Skills in children, because

(i) All the children are not always able to express their ideas in words.

(ii) Visual images are clear and unambiguous and

(iii) Drawing or picture presents the whole idea that can be added, altered and modified.

He further added that in promoting Thinking Skill amongst children the teacher may encourage the use of actual objects, graphic representation, semantic maps, prepared worksheets showing categorization and comparison skills, complex vocabulary conveying similar and different meaning etc. to explore a variety of alternative formations. This can be understood via the example of figure given below to identify pros and cons of Green Transportation.
Hence, considering the views expressed by the persons well known in the field of development of thinking and promoting Thinking Skills like De Bono, Inhelder etc. and by thoroughly scrutinizing the studies conducted in the field of development of non-verbal IPC skill, discussing the problem with the researchers, the investigator decided that the non-verbal Instructional Material should comprise of all the above mentioned aspects which have potentiality to develop non-verbal IPC skill as well as its components.
4.10.2 Try-Out of Non-Verbal Instructional Material

The purpose of the try-out was to ascertain suitability of the designed Non-verbal Instructional Material. The criteria fixed for judging the suitability were instructions, picture identification, different types of sketches showing similarity and differences in concepts. The developed Instructional Material was given to the experts and they were asked to throw light and put their observations in respect of different aspects mentioned above. They were also requested to see whether the Instructional Material has the potentiality to facilitate non-verbal Thinking Skill of IPC. The observations made by experts were noted. Instructional Material was also tried out on class IX students Indore. Students were also requested to give their suggestions, ideas and responses related to the items and on the basis of their suggestions and observations, modification was made to ensure the suitability of the prepared Instructional Material. On the basis of the suggestions and observation made by the experts and difficulties mentioned by the students, the non-verbal Instructional Material was made ready for experimentation.