Chapter 4

METHODOLOGY

4.1. METHOD ADOPTED.
4.2. VARIABLES OF THE STUDY.
4.3. TOOLS USED IN THE STUDY.
4.4. SELECTION OF THE SAMPLE.
4.5. PROCEDURE ADOPTED IN THE EXPERIMENTATION.
4.6. STATISTICAL TECHNIQUES EMPLOYED.
METHODOLOGY

INTRODUCTION

Methodology includes the description of the techniques, methods and tools that the researcher has used for collecting, organizing, analyzing and interpreting data. It describes the various steps of the plan of action to be adopted in solving the research problem. Thus, Research methodology involves ways of organizing the fund of available knowledge as well as of exploring, creating new knowledge, adoption of appropriate techniques and adoption of suitable statistical procedures (Best, 1983).

The present study was primarily intended to investigate the effectiveness of Drawing Skill Oriented Instructional Approach on achievement in Basic Science of students at primary level. As a secondary part of the study, effectiveness of Drawing Skill Oriented Instructional Approach on drawing skill improvement, drawing attitude development and drawing interest enhancement were also intended to study.

As part of this study, discussions were made with resource people, principals and teachers by the investigator. In order to discover the extent of necessity and use of a new drawing skill oriented instructional approach, a preliminary inquiry was made among the primary school teachers. It was meant for getting the views and opinions of primary school teachers regarding the implementation of drawing skill oriented instructional approach and the difficulties if any. The investigator made unstructured interview with primary school teachers for their suggestions, and modifications were made in the light of their relevant suggestions. Feedback from the preliminary inquiry proves the necessity of a new Drawing Skill Oriented Instructional Approach
for Basic Science teaching at Primary level and also helped the Investigator to gain familiarity and clarity with the topic of study.

The details of the method adopted, variables of the study, tools used, and samples selected, and procedure adopted in the administration of the tools and statistical techniques used for the analysis of the data are given below.

4.1 METHOD ADOPTED

Since the study was intended to compare the effectiveness of Drawing Skill Oriented Instructional Approach, and present Activity Oriented Approach on achievement in Basic Science at primary level, experimental method has been used for the study. It is the most sophisticated, exact and powerful method for discovering and developing an organized body of knowledge (Best, 1992). The experimental method is a systematic and logical method of hypotheses checking under carefully controlled conditions.

4.1.1 Design selected

Experimental design is the blueprint of the procedures that enable the researcher to test hypothesis by reaching valid conclusions about relationship between independent and dependent variables. Since the students belong to different schools, it is administratively difficult for the investigator to arrange equivalent groups for the purpose of experimentation. Hence, without disturbing the natural settings, the classroom intact groups which are normally non-equivalent were selected for the experimentation. Therefore pre-test post-test non-equivalent group design (Best & Khan, 2005) was selected for the present study. This design is often used in classroom
experiments when experiment and control groups are such naturally assembled groups as intact classes which may be similar.

4.2 VARIABLES OF THE STUDY

Variables are the conditions or characteristics that the experimenter manipulates, control or observes (Best, 1995). In the present study, investigator takes into consideration mainly two types of variables—
independent and dependent variable.

4.2.1 Independent Variables

The independent variables are the conditions or characteristics that the experimenter manipulates or controls in his attempt to ascertain their relationship to observed phenomena. It is under direct control of the experimenter, who may vary it in any way desired. In this study, Drawing Skill Oriented Instructional Approach and present Activity Oriented Approach are the two independent variables.

4.2.2 Dependent Variables

The dependent variables are the conditions or characteristic that appear, disappear or changes as the experimenter introduces, removes or changes independent variable (Sidhu, 1999). In the present study the dependent variables are the achievement of students in Basic Science, improvement in drawing skill, development of drawing attitude and enhancement of drawing interest.

4.2.3 Extraneous variables

Extraneous variables are variables other than the independent variable that may bear any effect on the behaviour of the subject being studied. In the present study the major extraneous variables are previous year Basic
Science achievement, Intelligence, Age, Sex, Locality of schools etc. of the students.

4.3 TOOLS USED IN THE STUDY

To gather necessary data, the investigator prepared various tools. The following tools were used for the present study.

4.3.1 Lesson transcripts based on Drawing Skill Oriented Instructional Approach.

4.3.2 Lesson transcripts based on present Activity Oriented Approach.

4.3.3 An Achievement Test in Basic Science (prepared by the investigator).

4.3.4 A Drawing Skill Test for Students at Primary level (prepared by the investigator).

4.3.5 A Drawing Attitude Scale for Students at Primary level (prepared by the investigator).

4.3.6 A Drawing Interest Inventory for Students at Primary level (prepared by the investigator).

4.3.7 The Raven’s Standard Progressive Matrices.

The details regarding the tools used for the study are given below.

4.3.1 Lesson Transcripts based on Drawing Skill Oriented Instructional Approach

The investigator developed the lesson transcripts based on Drawing Skill Oriented Instructional Approach under the instructions of the supervising teacher. Mainly four theories serve as the basis for developing the lesson transcripts according to Drawing Skill Oriented Instructional Approach. They are Romiszowski’s (1999) skill mastery model, Flow theory of Csikszentmihalyi (1990), Gestalt theory in Art by Armheim (1983) and
Systems Model of Creative Learning by Vijoy Prakash (2007). The theories were discussed in the second chapter.

Besides these theories, previous research has shown that drawing a perceived figure/object/concept significantly increases a child's visual memory (Lansing, 1981). So the more a person draws a given object, the more his or her memory of that object will improve. Drawing activities accompanied with discussions about the drawings provide a way to avoid student's misconceptions about a scientific phenomenon.

Based on the understanding of these theories the investigator designed a Drawing Skill Oriented Instructional Approach by integrating the essential characteristics of the above described theories and in consultation with experts in the art field.

4.3.1.1 Design of Drawing Skill Oriented Instructional Approach

The investigator examined the theories of Romiszowski, Armheim, Csikszentmihalyi and Vijoy Prakash which were in great use in preparing Drawing skill Oriented Instructional Approach. By integrating the three basic categories of skilled behaviour postulated by Romiszowski into the three phases of Systems Model of Creative Learning by Vijoy Prakash, the investigator developed the design of Drawing skill Oriented Instructional Approach. Gestalt theory in drawing by Armheim and Flow theory of Csikszentmihalyi were used simultaneously in the three phases of Drawing Skill Oriented Instructional Approach as lesson development factors like - as a whole perception, involvement, challenge, creativity, self realization, flow etc.
4.3.1.2 Drawing Skill Oriented Instructional Approach-Theme based

Science is simply the study of nature, and there are certain underlying themes, that unite the study of all areas of science. A theme is a big concept, problem, or issue providing both a focus and organizing framework that guide the development and implementation of lessons or activities. The investigator classified the Basic science concepts under eight Unifying Themes, or big ideas. These themes are intended to meld facts and ideas and to provide a context for discussing the textual matter in a meaningful way. Teachers can employ these themes as an organizational tool for developing the lessons in Drawing Skill Oriented Instructional Approach. All the activities whether it is drawing or discussion in the lesson should be centred on any one or more of these Basic Science themes. A summary of these Unifying Themes is given below.

![Figure 4.1 Eight themes in Basic Science](image-url)
**Theme -1. Systems and Energy**

This theme involves the ability to think about a whole in terms of its parts, and about parts and how they relate to one another as well as the whole. It includes order and organization, interactions, interdependence, equilibrium, energy transfer and cycles. The learner should be able to identify the parts of a system and recognize how the parts work together as the system functions. Drawing experiences should help the learner to understand that most things are made up of parts, that if parts are missing the system may not work, and that putting parts together enables the system to do things that the parts themselves can’t do e.g. living systems, human body systems, the ecosystem, food chains, food webs.

**Theme- 2. Models**

Model is something that ‘represents’ another thing, concept or idea. It exemplifies the concept. It may be a type, symbol, sign, thing or image and represents the essential characteristics of a concept or idea. By investigating the details of a ‘model,’ one can explore the attributes of a concept. This may be hard at first for young children to understand. At primary school level, the students should know that geometric figures, graphs, diagrams, sketches, number lines and maps can be used to represent objects, events, and processes in the real world. Models are very effective tools for learning about many ideas in Science.

**Theme- 3. Constancy and Change**

Basic Science has to do with understanding of how change occurs in nature and systems. Certain features of things may remain constant while other features of the same things may change. Students should understand
that things may change in steady, repetitive, or irregular ways. In primary classrooms, students should collect, observe and draw things and phenomena that occur in their world. They can observe and measure changes in colour, size, weight, pattern and movement. Tables and graphic organizers should be used by students to record the changes they observe.

**Theme – 4. Scale**

Scale refers to the size and quantity. Students encounter with a lot of variables, such as temperature, velocity, size, distance, weight, volume, and force, in their environment. Students should understand and appreciate that, those things in the world around them have different sizes. Drawing an object is a simple way of comparing sizes, volumes, distances, weights, and speeds. This is a simple way to demonstrate ranges and limits.

**Theme- 5. Form and Function**

There is a relationship between the structure and its function. Structure means the existing shape or formation of a thing. The existing shape is due to its function. In otherwise, form and functions are complementary aspects of an object, organism or a system in the natural and designed world. Instruction of this theme may focus on understanding of form and function in both the natural and designed world.

**Theme- 6. Organization**

It deals with how things work. It is the arrangement or pattern that exists in a particular thing. Students should organize and classify the objects and events that they observe.
Theme- 7. Cause and effect

Things happen for a reason. It is based on the scientific assumption that, there is a cause or a set of causes for every effect. Nothing takes place in the world by mere chance. Science is mainly based on this theme.

Theme- 8. Variation and Diversity

Everything whether living or nonliving, has a set of characteristics, or properties that makes it different from others. It is the most obvious characteristic of the living world. It is a condition of having or being composed of differing elements. Students compare and contrast examples of a concept with non-examples. They then separate them into groups and make drawings on the concept.

4.3.1.3 Drawing Skill Oriented Instructional Approach- Geometry based

The basis of all realistic drawing technique is solid geometry. In drawing, an object is conceived as an inter-relation of component geometric forms or shapes. For example, a flower may be conceived as a composite of circular and ovoid shapes or a combination of the two. The foundation of realism in drawing is learning to find the basic shapes inherent in every object. There are many geometric shapes and forms that are seen such as circle or sphere, square or cube, triangle or cone etc. Anyone can draw these geometric shapes.

Small children may be interested in the kinds of shapes they see. It can be useful in Basic Science understanding. It also helps their observation and may give a useful foundation for art. To really good at drawing skills, student learns to see forms and objects abstractly. So, the first phase of Drawing Skill Oriented Instructional Approach is designed in such a manner
that each student should be able to see the abstract qualities of an object by identifying forms, their qualities of size, shape, colour, value, spatial position, structure, etc. In this new approach, the Investigator uses the basic shapes and forms as the basis of drawing. Learning to see and think in terms of simple shapes is very useful in drawing. When the student begins to recognize these basic shapes and see them as parts of objects or things, they are beginning to see like an artist. A detailed description about the principles and elements of drawing is provided in chapter II.

In the present Instructional approach, consider every student generated drawing as a collection of shapes. Simple shapes become more complex through the application of value and shadow. This creates the illusion of light source and in turn, the illusion of form. Therefore, a circle becomes a sphere, a square becomes a cube, and a triangle becomes a pyramid or cone. These are the basic forms that make up the complex objects that we draw. By practicing drawing shapes and transforming them into forms through value, a student gains a better understanding of the fundamentals of drawing and improves their drawing skill. By studying through drawing, a student can achieve the correct concepts in Basic Science.

4.3.1.4 Structure of lesson transcripts in Drawing Skill Oriented Instructional Approach

The acquisition of skill requires practice. Mere repetition of a task does not ensure the acquisition of a skill. Skill acquisition is achieved when an observed behaviour has changed due to experience or practice. Drawing skill development is a kind of information processing.
In Drawing Skill Oriented Instructional Approach each unit is divided into lessons of 45 minutes duration. Each lesson centres on any one or more of the eight scientific themes explained above. These eight themes provide the context and framework for understanding and applying any concept in Basic Science. Each lesson in Drawing Skill Oriented Instructional Approach is progressing through three phases

1. Receptive phase,
2. Processing phase and
3. Productive phase.

The design of the Drawing Skill Oriented Instructional Approach and the three phases are schematically represented in the following figure.

**Figure 4.2 Design of Drawing Skill Oriented Instructional Approach**

The investigator designed the three phases of Drawing Skill Oriented Instructional Approach by integrating the three basic categories of skilled behaviour as proposed by Romiszowski into the three phases of Systems
Model of Creative Learning and modifies it to include various stages in each phase. A detailed description of each phase is given below.

**First phase - Receptive phase**

- **Perceive — perform (observe /imagine/comprehends the stimulus - draw it.)**

  - **Object / idea / paragraph as stimulus.**
  - **Observe the Stimulus in detail or think critically and creatively about the topic or problem or content.**
  - **Draw it**
  - **Drawing**

**Figure 4.3 Receptive phase in Drawing Skill Oriented Instructional Approach**

The first phase of any learning process is to receive stimuli through sensory organs. A set of such stimuli works as raw data for processing. These data when processed become information. The information so obtained is stored for further processing in our brain as and when required.

The first phase of each lesson in Drawing Skill Oriented Instructional Approach starts with the learner's initial confrontation with the task. During this phase, the learner begins to understand the basics of Drawing.

An introductory orientation about the basic principles and elements of drawing
for this lesson and a prerequisite test to check the student’s existing knowledge about the lesson is necessary at this phase. Performance of students at this phase is slow, effortful, and error prone. Then the learner receives information using his sensory organs.

The receptive phase of Drawing Skill Oriented Instructional Approach involves (1) Entry stage and two more stages, (2) Observation (analysis or imagination) stage and (3) Drawing stage.

1. Entry stage

This stage helps to ‘warm them up’ and engage the learner, so that they are receptive to the lesson. An entry usually takes not more than 3 minutes and it allows a time buffer between the start of the drawing activity and the start of the lesson. It should fit into the theme of the lesson. So, the entry stage begins with a motivation in relation with the theme. The teacher states the objectives and provides an introductory orientation for the lesson. Next the teacher provides suitable object (in the case of observation type of lessons), puzzling task or thought provoking ideas (in the case of memory type and schematic type of lessons) for drawing. The stimulus that is provided elicits all the characteristic of the topic of the lesson and is in connection with the theme/s.

Then the teacher introduces the theme of the lesson to the class, leading them to the next stage of receptive phase. The teacher provides directions, and lets the children to observe/imagine/think and draw. Teachers can provide objects/idea/concept/puzzle that is related to the topic. If the stimulus is an object it should have some interesting details but not be very small, very large, or complex. Objects/idea/concept/puzzle to sketch must be
related to the topic/theme of the lesson and must motivate the children. Objects for drawing are placed on a table or other elevated places.

2. Observation (analysis or imagination) stage

All drawing comes from observation. Observation means, the prolonged perception of things or events directed and sustained by attention. Drawing usually refers to a careful process that includes greater attention to detail. Observation implies thinking. It aims at perceiving a number of details but a few significant ones. It involves mental processes like attention, selection, analysis, classification etc. Students should observe carefully, find out and list the geometrical shapes and forms, colours, composition and other details of the given object (stimulus) in the left side page of their Science diary. An observation criteria table is given in table 4.1.

**Table 4.1.**

**Observation criteria table**

<table>
<thead>
<tr>
<th>Unit-</th>
<th>Topic-</th>
<th>Theme-</th>
<th>date-</th>
</tr>
</thead>
<tbody>
<tr>
<td>What basic geometrical forms and other features will you find in the object?</td>
<td>Rough sketch.</td>
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</tr>
<tr>
<td>-Circle</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>-Triangle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Rectangle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Oval</td>
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<td></td>
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<tr>
<td>-Texture</td>
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<td></td>
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<tr>
<td>-Smell</td>
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<td></td>
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<tr>
<td>-Colour</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>-Pattern</td>
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<td></td>
</tr>
<tr>
<td>-Rhythm</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>-Unity</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>-Balance etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What do you want this drawing to convey?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Drawing stage

Then the student should each have a select set of geometric shapes and a rough sketch to draw a picture, by using the basic principles and elements of drawing. In this stage, the students will create drawings of the given object(s)/concept(s)/theme(s) related with the lesson content on the right side page of their Science Diary. They would also be able to develop skills in drawing by applying the principles of drawing.

When children draw and colour, teacher gives some directions about to

- Make decisions about what to emphasize and include in drawing.
- Consider which aspects of an object are most important to include.
- Finding out more about the objects or living things they draw.
- Have opportunities to notice multiple perspectives on a single object.
- Become familiar with the importance of using basic geometrical forms (circle, oval, square, rectangle and triangle) for making their drawings or representations to express ideas.

The drawing can be as simple or complex as they like, and when they are finished, they can take a few minutes to colour the picture with crayons or colour pencils and let them to select a suitable title for their drawing.
### Table 4.2.

**Evaluation Criteria of student Generated Drawing**

<table>
<thead>
<tr>
<th>Use of Geometric shapes in the drawing.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Simple, straightforward, or typical shapes</td>
</tr>
<tr>
<td>2. Decorated or three-dimensional shapes</td>
</tr>
<tr>
<td>3. Multiple forms, embedded or arranged</td>
</tr>
<tr>
<td>4. Simple but meaningful shapes</td>
</tr>
<tr>
<td>5. The shapes in concrete context</td>
</tr>
<tr>
<td>6. Reflections of the shape, unique perspectives</td>
</tr>
<tr>
<td>7. The shapes in abstract context</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drawing skills.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Drawing is attractive in how realistically the object(s) has been drawn. (quality)</td>
</tr>
<tr>
<td>9. The drawing includes only those features that were actually observed and not inferred. (application)</td>
</tr>
<tr>
<td>10. As many details as possible are included: size (with metric measurements), colours, textures, shapes, and relationships to surroundings. (application)</td>
</tr>
<tr>
<td>11. The principles and elements of drawing are well employed in this drawing. (application)</td>
</tr>
<tr>
<td>12. Multiple perspectives are drawn to provide the viewer with a complete picture of the structures under study. (application)</td>
</tr>
<tr>
<td>13. An accurate and creative title is provided for the drawing. (quality)</td>
</tr>
<tr>
<td>14. Drawing is clearly labelled, if necessary. (knowledge)</td>
</tr>
<tr>
<td>15. Written explanation of what the drawing is intended to show is included. (knowledge)</td>
</tr>
<tr>
<td>16. A key or legend, if needed to explain the drawing is provided. (quality)</td>
</tr>
<tr>
<td>17. The drawing is of an appropriate size and scale for details to be easily recognized. (application)</td>
</tr>
<tr>
<td>18. A very precise scale and proportion is used consistently. The scale is stated and uses the metric system when possible. (application)</td>
</tr>
</tbody>
</table>
Figure 4.4.

Process of drawing
Second phase - Processing phase

Perceive — recall prerequisites — perform (observe the drawing - analyze conceptually - acquire the right concepts)

After receptive phase comes the processing phase, in which the 'drawing' that is created by the student in the receptive phase works as stimuli for activating the discussion. These leads to correct concept acquisition. This phase has been termed the “Processing phase” of Drawing Skill Oriented Instructional Approach because the key element of drawing Skill development and concept acquisition in Basic Science takes place during this phase. It happens through increasing the strength and efficiency of associations between stimulus and the underlying concepts in the stimulus. The associations are formed in the first phase, but are strengthened in
the second phase of Drawing Skill Oriented Instructional Approach. That is, performance at the first phase of Drawing Skill Oriented Instructional Approach can be focused on observational or imaginary or schematic drawing, using basics of drawing. It should be a stimulus for the discussion/interaction process in the second phase.

When the students finished the drawing activity, talk about their drawings. Ask them to integrate their drawings with the theme or topic of the lesson. Encourage them to notice the features of the concept and how far it is depicted among their drawings. Sharing and discussing their own and classmates’ drawings with one another and the teacher’s contributions may enhance children’s concept acquisition on the topic of the lesson. These drawings can also become the basis for making more complex representations in the next phase. Discussions about the drawings can provide a window on his or her ability to move from nonverbal to verbal expression.

This phase involves three stages. They are concept integration stage, concept exploration stage and concept acquisition stage. This phase is typically marked by the increase in the accuracy and aptness of concept acquisition in Basic Science. Conscious mediation and correction by the teacher takes place during this phase.

**Third phase-Productive phase**

| Perceive — recall prerequisites — plan — perform. (Perceive and sorting the acquired information – recollect the all the features of information –plan and organize innovatively – organize information and add own ideas to create artistic work) |

110
In the final phase, the students express their point of view about the theme of the lesson in an artistic way. In this phase, student performance is characterized as requiring minimum attention and effort, but at the same time is fast and accurate. Students convey their ideas in a pictorial form or as a graphic organizer. They attempt to arrange the acquired information in a logical pattern and try to present their feelings, opinions, suggestions and plans in a pictorial manner. In this phase, teacher can help to motivate the students to communicate their views, ideas and suggestions through drawings. Students should have the opportunity during this phase to experiment with the geometrical forms, colours, imaginations etc. Teachers do not need to correct too much during this phase. But they can observe the student’s drawings and redirect to the lesson topic if needed and give feedback at the
end of the phase. In contrast to first and second phase, in this phase a student does not require conscious mediation from the teacher. In productive phase students feel the “flow” of creativity (as mentioned by Csikszentmihalyi) and they forget even themselves. This phase includes four stages, which are information sorting stage, recollecting stage, planning stage and creation stage.

For teaching all sorts of lessons in Basic Science like conceptual, factual, procedural, exploratory etc. the investigator developed three types of lesson transcripts in Drawing Skill Oriented Instructional Approach.

1. Drawing Skill Oriented Instructional Approach - Observation type,
2. Drawing Skill Oriented Instructional Approach - Memory type and
3. Drawing Skill Oriented Instructional Approach - Schematic type.

All these three types of lessons in Drawing Skill Oriented Instructional Approach follow the same pattern of lesson development and same format except the first phase- Receptive phase. In Observation type of Drawing Skill Oriented Instructional Approach, student starts the drawing with the observation of a still life or a landscape or an object. In Memory type of Drawing Skill Oriented Instructional Approach, students are provided with a theme or topic or an idea and starts drawing from imagination. In Schematic type of Drawing Skill Oriented Instructional Approach, students comprehends and assimilates the essence of the given concept or content, and represent it graphically. The difference is only in the nature of stimulus for drawing activity. It may be an object in Observation type, a thought provoking idea in Memory type and a paragraph about a specific concept in Schematic type.

The investigator prepared 20 lesson transcripts according to Drawing Skill Oriented Instructional approach. Model lesson transcripts in the three
types of Drawing Skill Oriented Instructional Approach in Malayalam are given as Appendix- I (A), I (C) and I (E) and in English are given as Appendix- I (B), I (D) and I (F). A lesson plan format of Drawing Skill Oriented Instructional Approach is given below.

**Table 4.3 Lesson Format of Drawing Skill Oriented Instructional Approach**

<table>
<thead>
<tr>
<th>Entry stage</th>
<th>Receptive phase</th>
<th>Processing phase</th>
<th>Productive phase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Entry stage:</strong></td>
<td><strong>Receptive phase:</strong></td>
<td><strong>Processing phase:</strong></td>
<td><strong>Productive phase:</strong></td>
</tr>
<tr>
<td>Warm up student’s existing knowledge about the topic</td>
<td>Primary observation</td>
<td>2. Observation/analysis/Imagination stage.</td>
<td>4. Concept integration stage.</td>
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<tr>
<td></td>
<td>Find out and list Basic shapes in the given object.</td>
<td>Find out and list Basic colours in the given object.</td>
<td>Analyze the student generated drawings in connection with topic/theme, give directions, corrections etc.</td>
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<tr>
<td></td>
<td>Secondary observation</td>
<td>Find out Variation in shapes-size, type, modification etc.</td>
<td>All activities are based on student generated drawings, theme and topic of the lesson.</td>
</tr>
<tr>
<td></td>
<td>Find out Variation in size etc.</td>
<td>Tertiary observation</td>
<td>5. Concept exploration stage.</td>
</tr>
<tr>
<td></td>
<td>Find out Others details like sound, smell, temperature.</td>
<td></td>
<td>Discussion on various ramifications of the topic.</td>
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<td></td>
<td>Tertiary observation</td>
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<td>6. Concept acquisition stage.</td>
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<tr>
<td></td>
<td>Find out patterns-repetition, rhythm etc.</td>
<td>Finding rules, formulate laws, make inferences etc.</td>
<td>Acquired concept.</td>
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<td>7. Information sorting stage.</td>
<td>Arranging the acquired information in a logical manner. Information can be better stored in memory, if it is properly &amp; sequentially arranged.</td>
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<td>8. Information recollecting stage.</td>
<td>Student starts to contribute towards the progress of the lesson by producing artistic outputs.</td>
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<td>9. Planning stage.</td>
<td>Plan to create new patterns to symbolize information in an innovative style.</td>
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<td></td>
<td>10. Creation stage.</td>
<td>Present the information in the form of a graphic organizer or a drawing. A graphic organizer is a visual display that depicts the relationships between facts &amp; ideas with in a learning task. Construct drawings, concept maps, story maps, thematic diagrams, problem solving maps, time lines, imageries, fantasies etc. using the basic geometric shapes.</td>
</tr>
</tbody>
</table>
4.3.2 Lesson Transcripts based on present Activity Oriented Approach

To teach the control group the investigator used the same units. 20 lesson transcripts were prepared using present Activity Oriented Approach of teaching. The lesson transcripts were prepared keeping in view of the procedure in lesson transcript development. The teacher gave explanation regarding the terms, facts, concepts, principles and rules etc connected with the topic. Appropriate learning activities were used to transact the content area. Model lesson transcripts based on present Activity Oriented Approach of teaching in Malayalam and English are given as Appendices-II (A) and II (B).

4.3.3. Achievement Test in Basic Science

Since the aim of the study was to find out the effectiveness of Drawing Skill Oriented Instructional Approach on achievement in Basic Science of students at Primary level, the investigator prepared and standardised an Achievement Test in Basic Science on the fourth and fifth units (‘orumichu valaraam’ and ‘sabda prapancham’ of Kerala state syllabus- Malayalam medium) of seventh standard. The investigator administered it to the experimental group and control group as pre-test and post-test. Before preparing the items in the test, the content was thoroughly analyzed. In the preparation and standardisation of the Achievement Test, the following sequence was adopted.

4.3.3.1 Deciding learning objectives

The items in the Achievement Test were prepared keeping in mind the McCormack and Yager’s (1989) taxonomy of science education. They
considered the operational construct of scientific creativity as the abilities of visualizing or producing mental image, combining objects and ideas in new ways, producing alternate and unusual uses of objects, solving problems, fantasizing, pretending, dreaming and designing. According to them, the frame of mind generally consisted of images, feelings, impressions, imaginations and fantasy and more specifically a certain mode of thinking, reflecting and constructing. They proposed the taxonomy with five domains-

1. Knowledge domain (knowing and understanding).
   This domain deals with the content areas that are directly dealt in the textbook. They are symbols, terms, facts, concepts, equation, laws, principles and theories.

2. Process domain (exploring and discovering).
   It focuses on knowing the method of Science and acquiring the thirteen science process skills.

3. Application domain (using and applying).
   In this domain students apply Science concepts and skills to every day or real life issues and problems.

4. Attitude domain (feeling and valuing).
   An important aim of Science education is to develop scientific attitude and values. Develop positive attitude, express personal feelings, take decisions etc are some of the components of this domain.

5. Creativity domain (imaging and creating).
   This domain aims to potentiate the student to develop designs, visualizes mental images, fantasizing, dreams about possibilities, combines objects and ideas in new ways etc.
The Achievement Test covered questions coming under these five domains in McCormack and Yager’s taxonomy namely knowledge, process, application, attitude and creativity.

### 4.3.3.2 Selection of content subunits

Two major chapters from Basic Science curriculum of VIIth standard were selected and they were then divided into four teaching sub units.

1. Resonance and musical instruments.
2. Echo effect and noise pollution.
4. Ecosystem and waste disposal.

### 4.3.3.3 Type of questions

Keeping in mind the judged superiority of objective type items the investigator decided to construct an objective type achievement test. The highly regarded and widely used form of objective test is multiple choice types which is the most effective item type. Keeping this in view the investigator selected objective type multiple choice test items only.

### 4.3.3.4 The preliminary draft

The preliminary draft of Achievement Test consisted of 40 multiple choice items and it was prepared with necessary instructions and directions on the first page. Question of easy, average and difficulty levels were included. Most of the items were intended for average students. Test items are shown to experts to verify the suitability of the items for the target group. The items were modified after scrutiny by the experts and arranged according to their expected level of difficulty. A copy of the draft test in Malayalam is given as Appendix III (A) and its scoring key as Appendix III (B)
4.3.3.5 Try out

For tryout, the Achievement Test was administered to a random sample of 100 primary school students of Kottayam district. Students were given enough time to complete the test. The average time taken was 45 minutes which was fixed as the time limit for the final test. In scoring, one score was given for each correct response. The scoring was done according to the scoring key prepared for these purpose.

4.3.3.6 Item Analysis

Item analysis is a process which examines student responses to individual test items (questions) in order to assess the quality of those items and of the test as a whole. Item analysis is especially valuable in improving items which will be used again in later tests, but it can also be used to eliminate ambiguous or misleading items in a single test administration. From the arranged answer sheets, top 27 percent and the bottom 27 percent of the answer sheets were separately taken. The proportions of the two groups passing a given item were found. The difficulty index and discriminating power were calculated using the formula (Ebel and Frisbie, 1991)

Difficulty index $(Di) = \frac{(U+L)}{2N}$ and

Discriminating power $(Dp) = \frac{(U-L)}{N}$, Where $U$-the number of students in the upper group who made correct response, $L$- the number of students in the lower group who made correct response and $N$- the number of students in each group.

The items for the final test were selected according to the steps supported by Garrett (1973). Items having difficulty index between 0.4 and 0.6,
discriminating power above 0.4 were selected for the final test. The details regarding difficulty index and discriminating power of each item in the achievement test are given in the Appendix-III (C).

4.3.3.7. Preparation of the Final test

Out of the 40 items included in the tryout, 25 items were selected for the final test based on the difficulty index and discriminating power of the items with a maximum score of 25. The selected items were arranged according to the difficulty level. The final test was prepared by giving due weightage to content, objectives, and difficulty level. The final test was printed with all necessary instructions. The achievement test thus prepared contained only twenty five objective type multiple choice questions carrying one mark for each correct response. Thus, the maximum mark is 25 and the time allotted was 45 minutes. The details regarding the weightage given to objectives, content, difficulty level and details of blueprint and the scoring are given below.

4.3.3.7.1 Weightage to Objectives

In constructing an achievement test, proper weightage has been given to each domain viz: knowledge, process, application, attitude and creativity. The weightage given to different objectives in the achievement test are presented in the table 4.4

Table 4.4
Weightage to Objectives

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Objective/domains</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Knowledge.</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Process.</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Application.</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>4</td>
<td>Attitude.</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>Creativity.</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>25</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
### 4.3.3.7.2 Weightage to Content

When the test was prepared, proper weightage was given to each subunit of the content. The whole select area of the content was divided into four sub units; which was again divided into 20 lessons. Description of weightage given to each sub unit is given below in the table 4.5

**Table 4.5**

*Weightage to Content*

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Content</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Resonance and musical instruments.</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>Echo effect and noise pollution.</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Bio diversity and food chain.</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>Ecosystem and waste disposal.</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>25</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

### 4.3.3.7.3 Weightage to Difficulty Level

Proper weighatge was given to the difficulty level of the questions asked. Questions were included to consider the bright, average and dull students. The weightage given to difficulty level of the test is shown in table 4.6

**Table 4.6**

*Weightage to Difficulty Level*

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Difficulty level</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Easy</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Average</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>Difficult</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>25</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
### 4.3.3.7.4 Blue Print of the Achievement Test

Preparation of blue print helped the investigator to have an objective based Achievement Test, giving proper weightage to different objectives, content and type of questions. It is shown in table 4.7

Table 4.7
Blueprint of the Achievement test

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Contents</th>
<th>Form of questions</th>
<th>Objective Type multiple choice questions.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Knowledge</td>
<td>Process</td>
</tr>
<tr>
<td>1</td>
<td>Resonance and musical instruments</td>
<td>(2)1</td>
<td>(1)1</td>
<td>(6)1</td>
</tr>
<tr>
<td>2</td>
<td>Echo effect and noise pollution</td>
<td>-</td>
<td>(1)1</td>
<td>(1)1</td>
</tr>
<tr>
<td>3</td>
<td>Biodiversity and food chain</td>
<td>(2)1</td>
<td>(2)1</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Ecosystem and waste disposal</td>
<td>-</td>
<td>(1)1</td>
<td>(1)1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>4</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

(Figures inside the bracket indicate the no. of questions and outside the bracket indicate marks allotted.)
4.3.3.7.5 Scoring Key

A scoring key consists of the correct answer of the items in the achievement test and marks allotted to them were prepared. Copy of the achievement test in Malayalam and English and its scoring key are given as Appendices -III (D), III (E) and III (F) respectively.

4.3.3.7.6 Reliability of the Achievement Test

Split-half method was used for determining the reliability of the test. In this method, the scores obtained for each individual was divided into two groups by pooling the odd number items and even number items. The reliability of the test was determined by using the Spearman-Brown Prophecy formula.

\[ r_{11} = \frac{2r_{11}/2_{11}}{1 + r_{11}/2_{11}} \]

Where \( r_{11} \) is reliability coefficient of the whole test and \( r_{11}/2_{11} \) is the coefficient of correlation between the half tests. The obtained score is 0.75 and this shows that the test has high reliability.

4.3.3.7.7 Validity of the Achievement Test

As far as an Achievement Test is concerned, content validity, construct validity and statistical validity are important.

Content Validity

Freeman (1965) says that each test item should be a sample of knowledge or performance which the test purpose to measure. Content validity is estimated by evaluating the relevance of the test items, in relation to the objectives and subject matter studied, individually and as a whole. To ensure the content validity, the different subunits of the content were carefully examined and
from each of the subunits, items were included. The content validity was established by the judgment of experts.

**Construct Validity**

Construct validity of a test is the extent to which the test may be said to measure the theoretical construct or trait (Anastasi, 1961). For this, the test items must be specific, concrete and precise. In the present achievement test, the content was organized in a logical manner. Adequate representation was given to sub-concepts. Incomplete sentences were avoided and instead, sentences that convey simple complete idea were incorporated. Specific, concrete and precise test items were prepared. Words were effectively used for giving precise meaning.

**4.3.3.7.8 Objectivity**

The objectivity of a test affects both the validity and reliability of it. In the prepared achievement test, objectivity is ensured by including only objective type items. Objectivity was also ensured by using scoring key for valuation.

**4.3.4 Drawing Skill Test for Students at Primary level**

One of the major objectives of the study was to find out the Effectiveness of Drawing Skill Oriented Instructional Approach on the development of Drawing Skills of students at primary level. For this purpose, the investigator constructed a Drawing Skill Test for primary school students for assessing their drawing skills.

**4.3.4.1 Levels of Drawing Skill**

Drawing skills are evidenced in a drawing as it is the product of human intellect. Drawing skill specifications are the creative outputs from the learner
as an evidence of attainment of understanding about the basic concepts, elements and principles of drawing and improvement in their drawing skills.

For the convenience of the study the investigator developed a classification system of drawing skills into three major levels by integrating the drawing properties described by Broudy (1987), Lampert (2006) and Frank Williams (1993). The three levels of drawing skills are; (1) drawing skill at understanding level, (2) drawing skill at application level and (3) drawing skill at quality level.

The investigator found out and enlisted various drawing skill specifications and sorted them under these three levels of drawing skill.

![Figure 4.7. Three levels of drawing skill](image)

The three major levels of drawing skill are explained below.

1. **Understanding level of drawing skill**

   Understanding level of drawing skill refers to the understanding about the visual language, art forms, media, materials and techniques, signs and symbols, types of image and image development strategies, modes of presentation, ways of seeing etc. Visual language is made up of visual
elements: lines, shapes, forms, space, colours, value and texture; and principles of organization: balance, repetition, unity, contrast, rhythm, proportion, emphasis and movement. At the primary education level, students focus mainly on understanding the characteristics of visual language in relation to their personal and aesthetic experience. They can be used also as the visual language for personal expression and communication. Students should experience and acquire an understanding of a variety of forms. The specifications of drawing skill at understanding level are follows.

1. Comprehends the process of drawing.
2. Familiarizes with the elements (line, shape, form, colour, value, texture, scale, space, etc.) and principles (balance, repetition, unity, contrast, rhythm, proportion, emphasis and movement) of drawing.
3. Understands the importance of the elements and principles of drawing.
4. Understands how to use perspective and other spatial systems in drawing.
5. Understands the importance of proportion and scale in drawing.
6. Distinguishes between different forms, colours and textures.
7. Identifies different forms, colours, textures etc.

2. Application level of drawing skill

Geometrical shapes and forms can be used to construct signs, symbols and drawings that represent people, things, events or activities. Students explore the elements and principles of drawing and employ in their drawing. To develop ways of seeing, ways of thinking and ways of making, students continue to enhance skills such as observation, expression, association, imagination, communicating emotional response, objective
analysis and intellectual interpretation. To visualize feelings, concepts and ideas, students use visual language, and employ suitable types of forms, modes of presentation to express their intentions. Students should explore media, materials, techniques and processes to make their drawings. The specifications of drawing skill at application level are follows.

1. Applies the basic elements of drawing.
2. Records a variety of subjects.
3. Analyzes a variety of subjects.
4. Interprets a variety of subjects.
5. Makes informed critical judgments of the art work executed.
6. Perceives and express visually.
7. Integrates skills and knowledge of other domains and faculties.
8. Finds relationships.
9. Writes and speaks clearly about their drawings.
10. Translates 3D objects into 2D linear drawings.
11. Uses measurement systems in drawing.
12. Identifies and use systems of measurement appropriate for specific subjects in drawing.
13. Compares and contrasts a range of light sources on a variety of subjects.
14. Identifies the ways light may be used to draw.
15. Produces drawings that demonstrate the use of light to influence appearance and meaning.
16. Uses a range of drawing media.
17. Explores the relationships and characteristics of drawing and writing in influencing appearance and meaning.

18. Identifies, uses and creates appropriate signs and symbols for a specified purpose

19. Uses drawing to record and interpret information and to develop ideas for a given purpose.

20. Produces drawings in which the description of surfaces and textures influences the appearance and meaning of the drawing.

21. Produces a 2 dimensional drawing from a 3 dimensional form.

22. Selects and use a range of drawing instruments and materials.

23. Draws neatly and accurately lines and shapes to different scales.

24. Uses the graphic conventions commonly adopted in drawing.

25. Making appropriate use of colour, line, tone, texture, shape and form.

26. Using different approaches to recording images, such as observation, analysis, expression and imagination.

27. Investigates different ways of drawing.

28. Generates, communicates and develops ideas.

29. Investigate forms.

30. Observes, analyses and represents concepts and objects.

31. Founds similarities and differences.

32. Establishes patterns.

33. Manipulates key concepts and relations.

34. Recognizes the scale and proportion, pattern and shapes etc.

35. Establishes hand - mind – eye co-ordination.

36. Explores and uses tools and techniques.
37. Formulate personal viewpoint.

3. Quality level of drawing skill

When discussing about a drawing, one often concentrates on its content and form. Content refers to the subject matter or information that the drawing seeks to communicate. Form is purely the visual aspects of drawing that act as an indicator or evidence of application of drawing skills. It is the manipulation of the various elements and principles of drawing. In otherwise, content is what the learner wanted to say and form is how they say it. Both of them together create the quality of drawing. So, in order to understand the quality of a drawing, thoroughly study the concepts (elements and principles of drawing) involved in producing its final composition. So, the quality of a drawing means the value that the drawing possesses in virtue of its capacity to elicit responses, communicate ideas and to provide feelings by its beauty, elegance, gracefulness, harmony, proportion, unity, etc.; when appreciated or experienced. Quality level of drawing skill is thus dependent on formal features of drawing, contextual or conceptual factors, aesthetic factors, spatial and technical properties, emotional and moral values etc. (Danto, 1981; Walton, 1970; Gaut, 2007).

a. Formal qualities.

1. Flow in marks, lines, pattern and colour.

2. A well finished drawing.

3. Evidence of colour tone or shades.

4. Evidence of choice of colour.
5. Line thickness and quality- All guidelines are very thin and light, all object lines are dark and medium thick, all border lines are dark and thick.

6. All lettering uses guidelines of assigned size, and spacing is appropriate and consistent.

b. Conceptual qualities.

1. Show the evolution of thought, and process leading to a finished drawing.

2. Demonstrates a sense of form in a drawing.

3. Effective and original analysis used.

4. Use of visual elements (e.g. colour, brush strokes, tint and shade) and compositions, and how they enhance the expressiveness of the drawing.

5. Exploration of the concept from various perspectives.

6. Evidence of how ideas are generated and recorded through observation, experience, imagination, and skills.

7. Exploration and development of a theme/topic.

8. Titles and labels.

9. Drawing includes an idea, have no imitation of someone else’s plan.

10. Drawing was created and clearly depicts the idea /theme.

11. The drawing shows an in-depth understanding of the topic.

12. Relationships among Science facts and concepts are clearly, completely, and accurately.

13. Illustrates ideas and expressed clearly in a logical manner.

14. All aspects of the topic are addressed.
15. Elements and concepts in drawing are correctly applied.
16. Lines used in the drawing are appropriate for the needs.

c. Aesthetic qualities.
1. Reflection, evaluation and refining of their own work.
2. Includes many unique ideas.
3. Complete with substantial evidence of effort, beyond what was required.
4. Visual appealing (beauty) and pleasing appearance.
5. Well finished drawing.
6. Abstraction analogy and symbolism.
7. Evidence of empathy and humour.
8. Beauty and rhythm.
9. Drawing is finished, provides evidence of creativity or originality.
11. The drawing is striking in how realistically the object(s) has been drawn.

d. Spatial qualities
1. Logical organization and compilation of elements.
2. Appropriate application of materials evident.
3. Exploration and experimentation of media, materials, skills and techniques for the presentation of the selected theme.
4. Evidence of an understanding of spatial qualities, composition, rhythm, scale and structure.
5. Evidence of the use of safe working practices.
6. Obviously planned and created drawing.
7. Arrangement of elements in drawing (pattern)
8. Accuracy and neatness.

9. Creative components like elaboration, decoration, flexibility, originality and novelty.

10. Perspective, placement and left over spaces utilized well.

e. Emotional qualities

1. The character’s features (facial expressions, postures, etc.).

2. Ways of expressing different characters and compositions.

3. Expression of feelings/ideas about the concept.

4. Psychological effects (moods and emotions) created by visual elements.

5. How ideas, feelings and meanings are conveyed and interpreted in drawing.

6. Nature of drawing- whether it is expressive.

7. Sensual experience of colour and form.

8. Meaning and feeling that the drawing conveys.

9. Evidence of imagination and prediction.

f. Technical qualities

1. Use of materials and techniques.

2. Creative use of materials.

3. Evidence of necessary hand skills.

4. Lack of rub marks.

5. Mind mapping.

6. Paper is clean and flat, no smudges or dirt, no unnecessary folds.

7. Shows consistency, skill and attention to detail.

8. Drawing is completed with minimal effort.
9. Perfect mastery over the colour, brush handling and the instruments used.
10. Technically sound and good to eyes.
11. Clear, accurate, and well-labelled drawing.
12. The drawing includes only those features that were actually observed and not inferred.
13. As many details as possible are included: size (with metric measurements), colours, textures, shapes, and relationships to surroundings.
14. The principles of artistic composition are well employed in this drawing.
15. Multiple perspectives are drawn to provide the viewer with a complete picture of the structures under study.
16. A descriptive and accurate title is provided for the drawing.
17. All the parts of the drawing are clearly labelled.
18. A detailed, written explanation of what the scientific drawing is intended to show is included.
19. A key or legend, if needed to explain the drawing, is provided.
20. The drawing is of an appropriate size and scale for details to be easily recognized.
21. A very precise scale and proportion is used consistently. The scale is stated and uses the metric system when possible.

The investigator used the specifications under the three levels of drawing skill as the assessment criteria in the preparation and development of a drawing skill test. Based on all these criteria the Drawing Skill Test was
prepared. The steps in the preparation of Drawing Skill Test were described below.

4.3.4.2 Preliminary draft

For preparing items in the Drawing Skill Test, the existing reference materials in the area of drawing and art were consulted. The Investigator made an in-depth study of literature which included books, journals, periodicals, research abstracts, encyclopaedias and many other relevant sources. Experts in the field of art and the supervising teacher were consulted. With their suggestions it was decided to follow the basic theoretical constructs of drawing in the development of drawing skill test.

As an initial step for the development of the test the investigator deeply analyzed the concept of drawing and drawing skill. The investigator visited various schools of art and make discussion with the teachers and experts in the field of art, shared various innovative thoughts in tune with the need significance and structure of an art assessment tool. The investigator interacted with teachers at primary level to get their views about an art assessment tool. The responses from the teachers are very valuable sources for the investigator to construct the drawing skill test.

The investigator utilized mainly the theory of Broudy (1987), Lampert (2006) and Frank Williams (1993) to develop the Drawing Skill Test. In order to provide a developmental framework for analyzing the children’s drawings, theories of Kellogg (1969), Lowenfeld(1957), Read (1966) and Betty Edwards (1980)were used.

These theories served as the basis for the design of the test and the creation of scoring key for the test. The investigator sorted the specifications
and properties of drawing skill into three levels for convenience. They are-
understanding level (subject matter, communication and formal properties),
application level (technical competence and sensory elements) and quality
level (extra aesthetic functions and expressive properties).

**4.3.4.3 Qualitative validation by expert opinion.**

In the preliminary draft of the Drawing Skill Test, 25 performing type
items were included. The draft test was exposed to validation with the help of
experts from the field of art. The investigator also made discussion with the
experts. They were requested to validate the draft test questions and their
respected options with their valuable remarks for each item in the draft test.
They were requested to arrange each test item in a logical manner. Expert
validation with their valuable remarks helped the investigator to filter the
difficult items. Based on expert suggestion and discussion with the supervising
teacher, the investigator selected only the items that are according to the
maturity level of primary school students. Necessary modifications were made
in the light of expert opinion and suggestions. So, the methodology adopted
in the development and standardization of the drawing skill test was
qualitative. The list of experts consulted is given in the Appendix-IX.

The draft test was then administered to a sample of 36 seventh
standard students of SMSNHS, Vaikom. Necessary instructions were given to
students before the commencement of the test. The time taken for the test was
noticed. It enabled the investigator to fix the time needed for the completion of
the test. Then the items of the test were edited properly and the instructions for
the test were worded clearly with the help of supervising teacher. The
language and drawing tasks in the test modified and thus made simple and
precise, according to the level of subjects under study, so that it would be comprehensible to all students, there by adding to the validity of the test. The preliminary draft Test in Malayalam is given as Appendix -IV (A).

4.3.4.4 Preparation of the Final Test.

Out of 25 performing type items included in the preliminary draft, 15 drawing task items were selected for the final Drawing Skill Test. The time limit for the test was fixed to be one hour. The final test was printed in booklet form and necessary instructions were provided in it. Along with each test item, enough space for the drawing task was provided. The maximum score of the Drawing Skill Test was 50. Description of each item in the drawing skill test was given in the table 4.8.

Table 4.8
Description of items in the drawing skill test.

<table>
<thead>
<tr>
<th>Q.no.</th>
<th>Level of drawing skill.</th>
<th>Score</th>
<th>Time.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>understanding</td>
<td>2</td>
<td>1 minute</td>
</tr>
<tr>
<td>2</td>
<td>understanding</td>
<td>1</td>
<td>1 minute</td>
</tr>
<tr>
<td>3</td>
<td>application</td>
<td>2</td>
<td>5 minutes</td>
</tr>
<tr>
<td>4</td>
<td>quality</td>
<td>3</td>
<td>5 minutes</td>
</tr>
<tr>
<td>5</td>
<td>application</td>
<td>3</td>
<td>3 minutes</td>
</tr>
<tr>
<td>6</td>
<td>application</td>
<td>3</td>
<td>5 minutes</td>
</tr>
<tr>
<td>7</td>
<td>quality</td>
<td>3</td>
<td>5 minutes</td>
</tr>
<tr>
<td>8</td>
<td>application</td>
<td>3</td>
<td>2 minutes</td>
</tr>
<tr>
<td>9</td>
<td>quality</td>
<td>3</td>
<td>4 minutes</td>
</tr>
<tr>
<td>10</td>
<td>application</td>
<td>5</td>
<td>4 minutes</td>
</tr>
<tr>
<td>11</td>
<td>application</td>
<td>3</td>
<td>4 minutes</td>
</tr>
<tr>
<td>12</td>
<td>understanding</td>
<td>3</td>
<td>4 minutes</td>
</tr>
<tr>
<td>13</td>
<td>quality</td>
<td>4</td>
<td>5 minutes</td>
</tr>
<tr>
<td>14</td>
<td>understanding</td>
<td>2</td>
<td>2 minutes</td>
</tr>
<tr>
<td>15</td>
<td>Application and quality</td>
<td>10</td>
<td>10 minutes</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>50</strong></td>
<td><strong>1 hour</strong></td>
</tr>
</tbody>
</table>
4.3.4.5 Scoring of the Test Items

Each item in the Drawing Skill Test is assessed and assigned a score through the use of a scoring indicator. The scoring indicator provides assessment criteria as value points for each item in drawing skill test and the division of scores according to these criteria. The final drawing skill test in Malayalam is given as Appendix -IV (B) and its English version is given as Appendix IV (C). Its scoring indicator is given as Appendix IV (D)

4.3.5 Drawing Attitude Scale for Students at Primary level

Attitudes are basic to many educational activities. Edward (1975) verified the hypothesis that people select and remember from a stimulus those items which fit their attitudes, rejecting data which conflicts with their point of views. Attitudes which are not firmly established may be modified within a selectively short period by prescription of appropriate information or by a system of procedures.

4.3.5.1 Preliminary draft

In order to study the change in the attitude of students at primary level towards drawing, due to the effect of Drawing Skill Oriented Instructional Approach the investigator decided to measure the drawing attitude of students at primary level. Since a suitable standardized tool was not available, it was decided to construct a drawing attitude scale to serve that purpose.

4.3.5.2 Selection of the Items

A large number of statements which are general and personal in nature and express the attitude of primary school students towards drawing were designed. Both positive and negative statements were included. Against each statement, three alternative responses in a pictorial manner i.e. “expression
faces” representing positive, negative and neutral attitudes towards drawing, namely, Agree, Disagree and Undecided were given. The student have to colour the appropriate ‘expression face’ using crayons to denote their response towards each statement.

![Expression faces](image)

**Figure 4.8** Expression faces representing positive, negative and neutral attitudes towards drawing

Modifications were made in the drawing attitude scale in the light of expert criticism and suggestions.

**4.3.5.3 Tryout**

After constructing the preliminary Drawing Attitude Scale, it was administered to a sample of 100 seventh standard students of Kottayam district in Kerala. The tryout was conducted with a view to find out the reliability and validity of the tool and also to eliminate any ambiguity so that students do not feel any difficulty in responding to the items in the drawing attitude scale.

**4.3.5.4 Item Analysis**

The ‘t’ value of each item was found out by analyzing the responses of the 27 per cent of the subjects with the highest total scores and also the 27 percent of the subjects with the lowest total scores. The 100 response sheets collected were arranged in the descending order of the total scores. The top 27 percent in the group when arranged in the descending order of the total
scores and the bottom 27 percent response sheets alone were used as extreme groups for item analysis. The scores obtained for each item in these extreme groups were used for calculating the discriminating power of each item. The discriminating power was obtained by the formula:

\[
t = \frac{X_H - X_L}{\sqrt{\frac{\sigma_H^2}{N_1} + \frac{\sigma_L^2}{N_2}}}
\]

where

- \(X_H\) = the mean score of upper group for a given statement
- \(X_L\) = the mean score of lower group for a given statement
- \(N_1\) = Number of students in the upper group
- \(N_2\) = Number of students in the lower group
- \(\sigma_H\) = Standard deviation of upper group for a given statement
- \(\sigma_L\) = Standard deviation of lower group for a given statement

The preliminary draft of the Drawing Attitude Scale in Malayalam, its scoring key and the ‘t’ values are given as Appendices V (A), V(B) and V (C) respectively.

4.3.5.5 Preparation of Final test

Items with ‘t’ values less than 2.58 were rejected. The items were then arranged in the rank order according to their ‘t’ values. Out of 50 items 30 items which have the ‘t’ value greater than 2.58 were chosen in order to form the Final Draft, of which 18 items are positive statements and 12 items are negative statements. The statements were arranged with nonverbal responses as ‘expression faces’. The final form of Drawing Attitude Scale (Malayalam and English) is given as Appendices- V (D) and V(E).

Scoring

As described earlier the subjects were asked to give responses according to their attitudes. One score was given for each correct response. Thus, if one chooses ‘Agree’ response (colour the smiling expression face) for
a positive statement, he/she gets one score and for the same response, if the statement is negative one gets a score of ‘0’. Only for the ‘Undecided’ response (expression face with neutral feeling), one gets always ‘0’ whether the statement is positive or negative. If one chooses ‘Disagree’ response (colour the sad expression face) for a positive statement, he/she gets ‘0’ and for the same response, if the statement is negative, gets one score. An individual’s score in this scale is the sum total of the scores for all the statements by the subject. The scores in the final scale of drawing attitude ranged from 0 to 30. The higher the score in this scale, the greater will be the drawing attitude. Scoring key of Drawing Attitude Scale is given as Appendix V(F)

Reliability

The present study employed split-half method to determine the co-efficient of internal consistency. The reliability coefficient of the Drawing Attitude Scale is found to be 0.78.

Validity

The scale contains 30 statements. Due weightage was given to student’s general and personal attitude towards drawing while selecting items. Hence, it has content validity. It has also construct validity as items having the ‘t’ values more than 2.58 were selected. The scale was given to experts in the field of art and education and they agreed that the items in the scale were relevant to the objectives of the study. Hence it has face validity also.

4.3.6 Drawing Interest Inventory for Students at Primary level

Kulashesthra (1984) defines Interest “as a tendency to make consistent choices in a certain direction without external pressure and in the face of
alternatives”. A Drawing Interest Inventory has been developed by the investigator to find out Primary School student’s Interest towards drawing.

4.3.6.1 Preliminary draft

The draft form of the Inventory consists of 25 items. Each item consists of three alternative pictures as apt, related and distant responses. Out of the three pictorial alternatives, one represents the apt drawing interest. The students are asked to put a tick mark (✓) in the column provided below the picture alternative that they prefer to denote their interest about the concerned item.

4.3.6.2 Pilot Study

It is then decided to conduct a pilot study. The main objectives of which were to find out, if there is any need for effecting any change in the form and content of items in the preliminary draft, and their pictorial responses so as to improve the student’s understanding of them and also for item selection. In Pilot-study 100 students, studying in Primary Schools located in Kottayam district of Kerala were selected through random sampling method.

4.3.6.3 Item analysis

From the arranged answer sheets, top 27 percent and the bottom 27 percent of the answer sheets were separately taken. The proportions of the two groups passing a given item were found. The difficulty index and discriminating power were calculated using the formula (Ebel and Frisbie, 1991)

Difficulty index (Di)=(U+L)/2N  and

Discriminating power (Dp)=(U-L)/N
Where U-the number of students in the upper group who made correct response, L- the number of students in the lower group who made correct response and N- the number of students in each group.

Items having difficulty index between 0.4 and 0.6, discriminating power above 0.4 were selected for the final test. The preliminary draft of Drawing Interest Inventory, its scoring key and the details regarding difficulty index and discriminating power of each item are given as Appendices VI (A), VI (B) and VI (C) respectively.

4.3.6.4 Final form of Drawing Interest Inventory.

Final form of Drawing Interest Inventory consists of 20 questions and for each question there are three choices as pictures and provides opportunities for students to make their selection of choices. The duration is limited to 40 minutes. Drawing Interest Inventory is a nonverbal measure of primary school student’s drawing interest; specifically it checks the components of student’s drawing interest like interest in observation, form and symbol recognition, analysis, pattern identification, tools and techniques used in drawing etc.. It is a group test for administration in the age range from standard five to seven. A unique feature of the Drawing Interest Inventory is its use of pictorial illustrations instead of verbal designations or descriptions. The nonverbal character of the inventory recommends it for administration to Primary School students. Furthermore, the investigator thinks that the pictorial format reduces difficulties usually associated with the verbal communication. It acts as a tool to test whether students in primary school level possess different drawing interest or not.
Scoring

If the student selects the pictorial alternative pertaining to the apt drawing interest, he/she will be given 3 score for that item. If he/she selects related (not the apt one) pictorial, 2 score will be given and for the other selections he/she get 1 score. So, if a student selects all the apt drawing interest alternatives for each item, he/she can get a maximum of 60 scores. The score ranges from 0 – 60 in this Inventory. In short, Item responses were scored as follows: 3 for the apt response, 2 for related response and 1 for distant response.

The final form of Drawing Interest Inventory in Malayalam and English and its scoring key is provided as appendices VI (D), VI (E) and VI (F) respectively.

Reliability

Reliability refers to the accuracy of measurement by a test. In this study, the reliability co-efficient has been found to be 0.79 by the split half method.

Validity

The content validity of the Drawing Interest Inventory has been established beyond doubt that the items selected reflect the various planes of drawing interest. Further, the content validity is also established, since the items selected in the tool are more or less equally covering the various components of drawing interest. Thus, it may be inferred that this scale is highly reliable and valid. Thus the final version of the Drawing Interest Inventory has been prepared with 20 valid items. Lower scores indicate the
presence of low interest and the higher scores indicates the presence of high interest towards drawing.

4.3.7 The Raven’s Standard Progressive Matrices

In order to measure the general mental ability of the sample the investigator decided to administer a non-verbal test of intelligence.

Raven’s Standard Progressive Matrices is a test of observation skills and clear-thinking ability. It is published in 1938. It offers insight about someone’s capacity to observe, solve problems, and learn. The test has a total of 60 items presented in 5 sets (A to E), with 12 items per each set. It is a standardized intelligence test that consists of visually presented, geometric-analogy-like problems in which a matrix of geometric figures is presented with one entry missing, and the correct missing entry must be selected from a set of answer choices. Figure 4.9. shows an example of a problem that is similar to one of the problems in the Raven’s Standard Progressive Matrices (SPM).

Figure 4.9 Test item in Raven’s Standard Progressive Matrices
So, the Investigator decided to use Raven’s (2000) Standard Progressive Matrices sets A, B, C, D and E for measuring general mental ability of students in the experimental and control groups. The five sets provide five opportunities for grasping the problem and the five progressive assessment of a person’s capacity to discern and utilize a logical relationship presented by non-verbal materials. The test is intended to cover the whole range of intellectual development of a student.

**Reliability**

The original studies on Standard Progressive Matrices (Raven, 1948) found that the test-retest reliabilities was ranging from 0.83 to 0.93 with the higher values being associated with younger subjects. From the standardization studies of Raven’s Standard Progressive Matrices for children between 6 and 15 years old, the statistical and psychometric properties of the test was established and it was found that the split-half reliability of the test is 0.91. Correlation between sub-tests varied between 0.58 and 0.95. Raven’s Standard Progressive Matrices has an internal consistency between 0.77 and 0.96 was determined in various norm samples.

**Validity**

Raven’s Standard Progressive Matrices assess general intelligence, that is, the various fundamental abilities necessary in everyday life. Correlations between the Raven’s Standard Progressive Matrices and school performances result in values up to 0.70. Correlations with other intelligence and ability tests vary between 0.20 and 0.80.
Scoring

A person’s score on the scale is the total number of problems solved correctly when allowed to work quietly through the series from the beginning to the end. A person’s total score provides an idea of his intellectual capacity. To record the answers a score card is available with matrices. It can be quickly and accurately marked by super imposing a stencil marking key (scoring key) which is also given with the matrices. A copy of the score card and the scoring key of Raven’s Standard Progressive Matrices is given as Appendices VIII (A) and VIII (B) respectively.

4.4 SELECTION OF THE SAMPLE

The quality of a piece of research not only stands or falls by the appropriateness of methodology and instrumentation but also by the suitability of the sampling strategy that he has been adopted (Morrison, 1993). In any form of research, sampling is fundamental. A sample is a small portion of a population selected for observation and analysis. By observing the characteristics of the sample, one can make certain inferences about the characteristics of the population from which it is drawn (Best, 1996). According to Koul (1984), sampling stands for the process by which a relatively small number of individuals or measures of individuals, objects or events selected and analyzed in order to find out something about the entire population from which it was selected.

A detailed description of the selection of the school, class and groups are given below.
Table 4.9.  
Break up of the Sample

<table>
<thead>
<tr>
<th>District</th>
<th>ERNAKULAM</th>
<th>KOTTAYAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of school</td>
<td>GOVT.</td>
<td>AIDED</td>
</tr>
<tr>
<td>Group</td>
<td>EXP.</td>
<td>CONT</td>
</tr>
<tr>
<td>Std/division</td>
<td>VII A</td>
<td>VII B</td>
</tr>
<tr>
<td>No. of students</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

4.4.1 Selection of the School

The investigator selected the samples from Government Upper Primary School, Koothaattukulam, St. Ignatius H.S.S., Kanjiramattom, Government H.S.S., Kula Seghara Mangalam and SMSN H.S.S., Vaikom. One Aided and one Government school were selected from each Ernakulam District and Kottayam District. The authorities and students were very co-operative and were ready to provide ample help at any time to conduct the study.

4.4.2 Selection of the Class

The investigator decided to conduct the study on VIIth standard students. So, eight VIIth standard classes were selected from four schools of Ernakulam and Kottayam district in Kerala, for the present study.

4.4.3 Selection of the Groups

The investigator selected two non-equivalent groups, with the help of the concerned teacher of the selected schools because it is very difficult to select two equivalent groups in the present school set up. Then one of the
groups was randomly selected as the experimental group and the other as control group. Thus, from each school one division was selected as experimental group and the other as control group. Thus, the final sample was reduced to 300 students (150 in each group) from the four selected schools.

4.5 PROCEDURE ADOPTED IN EXPERIMENTATION

The experiment was conducted to study the effectiveness of Drawing Skill Oriented Instructional Approach on achievement in Basic Science of students at Primary level. After the selection of the two parallel groups, the investigator started the experiment to collect the data. The tools used were lesson transcripts based on Drawing Skill Oriented Instructional Approach and present Activity Oriented Approach, an achievement test prepared on the chapters of VII standard Basic Science (Malayalam medium) under Kerala state syllabus, a Drawing Skill test, a Drawing Attitude Scale and a Drawing Interest Inventory. The steps followed in the experimentation are as follows.

4.5.1 Pre-test conducted.

4.5.2 Learning by the experimental group.

4.5.3 Learning by control group.

4.5.4 Post-test administered.

4.5.5 Administration of delayed memory Achievement test and Drawing Skill test.

4.5.1 Pre-test Conducted

The experiment was conducted on a final sample of 300 students at primary level. After matching the students on the marks of previous year achievement and scores of Raven’s Progressive Matrices, the investigator
assigned one division as experimental group and the other as control group from each school. After getting permission from the heads of the schools, the investigator administered the Achievement test, Drawing Skill test, Drawing Attitude Scale and Drawing Interest Inventory as pre-test to the two groups. Proper instructions were given to the students before the administration of each test. The responses were collected back for scoring and tabulation.

4.5.2 Learning by Experimental Group

After administering the Pre-test, the experimental group was taught using Drawing Skill Oriented Instructional Approach by the investigator. There were 20 lessons and the duration of each lesson is 40 minutes. The teacher gave a clear explanation of basic elements and principles in drawing and how to make drawings on concepts, themes, imaginations, objects etc. which the students practice collectively and individually and eventually master the skill. The investigator guided them through proper channels as and when needed.

4.5.3 Learning by the Control Group

After administering the Pre-test to control group, they were taught the content using the lesson transcripts based on present Activity Oriented Approach. The investigator explained the facts, concepts, principles etc. connected with the topic and conducted activities like discussion and demonstration. Equal time and effort was taken to the control group also. The investigator took 20 periods of 40 minutes duration to complete the whole topics selected.

4.5.4 Administration of Post-test

After the completion of the lessons to the experimental and control groups, the investigator administered the same tools as post test. Separate
question papers were given to each student. The investigator also gave additional instructions to the students. The responses were collected back and the test was scored with the help of the scoring key and the scores were gathered and subjected to statistical analysis.

4.5.5 Administration of delayed memory Achievement test and Drawing Skill test

The items in the Achievement test and Drawing Skill test were rearranged and given to the experimental and control groups after one month in order to check the retention capacity of the students under study. The delayed memory Achievement test and delayed memory Drawing Skill test were almost same to the Achievement test and Drawing Skill test with respect to the weightage given to objectives and contents. The number of questions in delayed memory Achievement test and Drawing Skill test are the same as in the Achievement test and Drawing Skill test. There is a slight change in the order and the wordings of the questions. The scores obtained after administering the delayed memory Achievement test and Drawing Skill test were collected and subjected a statistical analysis. A copy of delayed memory Achievement test and Drawing Skill test in Malayalam and English are given as Appendices VIII A, VIII B, VIII D and VIII E. The scoring keys for delayed memory Achievement test and Drawing Skill test are given as Appendices VIII C and VIII F.

4.6. STATISTICAL TECHNIQUES EMPLOYED

To draw a general picture of pupil’s performance in the experimental and control groups the major statistical measure used was t-test and ANCOVA.
4.6.1 The t-test

The t-test assesses whether the means of two groups are statistically different from each other. It is one type of inferential statistics. It is used to determine whether there is a significant difference between the means of two groups. So, when the difference between two population averages is being investigated, a t-test is used. In other words, a t-test is used when we wish to compare two means.

In the present study, the responses given by the students were tabulated systematically. The critical ratio was found out for academic achievement, drawing skill improvement, drawing attitude development, and drawing interest enhancement and retention of students at primary level.

4.6.2. Analysis of Covariance

Since the aim of the study was to determine the Effectiveness of Drawing Skill Oriented Instructional approach on achievement in Basic Science, it was necessary to find out whether there is significant difference between two mean scores. Analysis of Covariance was used to find out the effectiveness of new instructional approach. All the pre-test and post-test scores of both the groups were consolidated for statistical analysis. This technique was also applied to test the effectiveness of Drawing Skill Oriented Instructional approach on achievement in Basic Science as a whole and under different categories of objectives, drawing skill improvement as a whole and under different levels, drawing attitude development and drawing interest enhancement. Analysis of Covariance represents an extension of analysis of Variance to allow for the correlation between initial and final scores.
In applying this statistical technique, the procedure suggested and illustrated by Garret (1981) was followed. It includes nine major steps as follows.

**Step 1**

Determine the correction terms $C_x$, $C_y$ and $C_{xy}$ being correction of ‘$X$’ scores, ‘$Y$’ scores and ‘$XY$’ scores respectively which are required to make adjustments of the standard deviation calculated from original measures, taking zero as the assumed mean. These are calculated using the formula:

$$C_x = \frac{\left(\sum x\right)^2}{N}; C_y = \frac{\left(\sum y\right)^2}{N}; C_{xy} = \frac{\left(\sum xy\right)}{N}$$

Where $N =$ Number of scores of both the groups.

**Step 2**

Calculation of total sum of squares (SS) for ‘$X$’, ‘$y$’ and ‘$xy$’.

These are calculated using the formulae:

Total (SS) for $X = \Sigma X^2 - C_x$

Total (SS) for $Y = \Sigma Y^2 - C_y$

Total (SS) for $XY = \Sigma XY - C_{xy}$

**Step 3**

Calculation of Sum of Squares (SS) Among group means. These are calculated using the formulae:

For $X = \frac{\left(\sum X_1\right)^2 + \left(\sum X_2\right)^2}{n} = C_x$

For $Y = \frac{\left(\sum Y_1\right)^2 + \left(\sum Y_2\right)^2}{n} = C_x$

For $XY = \frac{\left(\sum X_1\left(\sum Y_1\right) + \left(\sum X_2\right)\left(\sum Y_2\right)\right)}{n} = C_{xy}$
Where \( n = \text{No. of scores in one group} \)

\[ X_1, X_2 = \text{The \( X \) scores of two groups} \]

\[ Y_1, Y_2 = \text{The \( Y \) scores of two groups} \]

**Step 4.**

Calculation of Sum of Squares within groups. These are calculated by using the formulae

For \( X = \text{Total SS for } X - \text{Among Group mean SS for } X \)

For \( Y = \text{Total SS for } Y - \text{Among Group mean SS for } Y \)

For \( XY = \text{Total SS for } XY - \text{Among Group mean SS for } XY \)

**Step 5**

Calculation of Variance of ‘\( X \)’ and ‘\( Y \)’ scores are taken respectively. The F-test is applied to the two sets of scores of scores. This is a preliminary analysis of Variance to decide whether the scores approach close significance.

**Step 6**

Computation of \( Y \) (\( SS_{yx} \))

\[
SS_{yx} = SS_Y - \frac{(SS_x)^2}{SS_x}
\]

This is meant for correcting the final \( Y \)-scores for difference in initial \( X \)-scores. This is calculated for the Total ‘\( SS \)’ and within ‘\( SS \)’. Then among mean ‘\( SS \)’ determined by subtracting Within ‘\( SS \)’ from Total ‘\( SS \)’.

From the adjusted sum of Squares thus calculated, the Variance can be computed by dividing each ‘\( SS \)’ for its degree of freedom.

Then F-test is applied to the adjusted, among and within variance to determine whether the adjusted means differ significantly.
Step 7

From the Sum of Squares (SS) in ‘X’, ‘Y’ and ‘XY’, it is possible to compute several co-efficient of correlation. These are helpful in the interpretation of results obtained in step-6. The general formula used is

\[ \gamma = \frac{\sum XY}{\sqrt{\sum X^2 \cdot \sum Y^2}} \]

It may be applied to the appropriate SS’s for Total, Among Means and Within Groups. The correlation among scores and the correlation among means may be used in preliminary way to decide Analysis of Covariance is worthwhile.

Step 8

Calculation of adjusted ‘Y’ means by using the formula

\[ M_{xy} = M_y - b_{Within} (M_x - G_m) \]

This step is to find whether the mean difference noticed in step-6 is significant.

Step 9

Testing the significance difference among adjusted Y means. For this the standard error of difference between two means is calculated using the formula \( SE_D = SD_{yx} \sqrt{1/N_1 + 1/N_2} \). Then the ‘t’ value is found from Table ‘D’ and by substituting in the equation \( t = D/SE_D \). Thus the level of significance of difference at 0.05 or 0.01 level is obtained.

The details of analysis and interpretation of data using the above mentioned statistical techniques are given in the next chapter.