CHAPTER-III

DESCRIPTION & DEVELOPMENT OF TOOLS

This chapter is dealing with the development of tools mainly Achievement tests (self constructed), Raven's Progressive Matrices, Witkin's group embedded test at Piaget's two developmental stages concrete operations and formal operations respectively.

This chapter contains the details about the concepts included in lessons taught to Class Vth & Class IXth.

3.1.1 GROUP EMBEDDED FIGURE TESTS DEVELOPED BY WITKIN

This test was developed by Witkin, Oltman and Raskin and published by consulting Psychological Press Inc.

The Witkin's Group Embedded Figure Test (GEFT) was applied to identify the cognitive style when it is hidden within a complex pattern.

The items selected for the GEFT were based on an item analysis. The author prepared the preliminary draft contained of 32 items. These 32 items were arranged in two parallel forms of 16 each.

The GEFT consists of three sections. The first section contains seven very simple items, and is primarily for practice and each of the second and third sections, contains nine more difficult items.

The co-relations between the a-item first section stores and the a-item second section scores were computed, to producing a reliability
estimate of 82 for both males (No. 80) and females (No.= 97). The validity of Test was analysed by administration the second section of test of test in its group form and third section as an individually administered test using the items in their original coloured form to one group. Another group was given the second section individually and the third section as a group test. Thus the correlations corrected for reduced test length and combined for the two groups.

The test was administered strictly in accordance with the instructions given in the manual. The obtained scores were used to classify the students into two groups, which are Field Independent and Field Dependent groups.

3.1.2 STANDARD PROGRESSIVE MATRICES DEVELOPED BY RAVEN (1958)

This test was designed by Raven and published by H.K. Lewis and Co., Ltd.,

The progressive matrices have been standardized for representative samples of British people, 6 to 65 years of age. Thereby it was found that, the Progressive Matrices Scale were analysed by administration of scale to samples of 735 cholchester Children and 1,407 children and 3,665 Militia Men and 2,197 civilians.

The scale consists of sixty problems divided into five sets of twelve each. In each set the first problem is an nearly as possible self-evident. The problems which follows become progressively more difficult. As the order of the problem provides the standard training in the method of working the scale can be given either as
an individual, a self-administered or as a group test. A person's total score provides an index of his intellectual capacity.

The test was administered strictly in accordance with the instructions given in the manual. The raw scores were used to classify the students to each group into two levels that are high level intelligence and low level intelligence.

3.2 DEVELOPMENT OF ACHIEVEMENT TEST

Achievement test measures an individual's knowledge or skill in a given area or subject (Fraenkel and Wallen 1993). The investigator could not get any appropriate standardized achievement test to evaluate the V-Class and IX-Class student's knowledge of the selected concepts in science subject. Therefore, the investigator herself has developed and standardized two achievement tests for the pupils of above said classes.

3.2.1 Planning Stage

The Planning was done in respect of class, subject content and the time for which experiment was to be performed. The subject content pertained to the science subject of Vth and IXth class students respectively. The time was restricted to eleven teaching periods of forty-five minutes each intact class in respect of teaching through the Reception strategy of Bruner's Model and equal numbers of teaching periods through selection strategy and lecture method to the other intact class of the same school at piagets concrete operations stage (Class V).
For Formal operations stage i.e. 9th class fifteen periods of forty five minutes each were taken for teaching through reception strategy of Brunner's concept attainment model and eleven periods were taken for teaching through selection strategy and traditional method i.e. lecture method.

The test-items were multiple choice type items with four responses for each item. The blue print was prepared for showing taxonomy of objectives (knowledge, comprehension and application) on the one dimension and the weightage given to science concepts on the other dimension at piagete's two developmental stages i.e. concrete operations (V Class) and formal operations (IX Class). The blue prints are given in table.

**Table 3.1**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Concepts</th>
<th>Objectives</th>
<th>No. of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Knowledge</td>
<td>Application</td>
</tr>
<tr>
<td>1.</td>
<td>Vitamins</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>Deficiency Diseases</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3.</td>
<td>Living things</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>4.</td>
<td>Communicable diseases</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>5.</td>
<td>Force</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6.</td>
<td>Energy</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>Ambhilians</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>8.</td>
<td>Vegetative propagation</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>9.</td>
<td>Respiratory system.</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>10.</td>
<td>Pollution</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>11.</td>
<td>Oviparous</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Total :</td>
<td>19</td>
<td>4</td>
</tr>
</tbody>
</table>
Table 3.2
Blue Print of Achievement Test for IX Class
(Concrete operations stage)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Concepts</th>
<th>Objectives</th>
<th>No. of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Knowledge</td>
<td>Application</td>
</tr>
<tr>
<td>1.</td>
<td>Habitat</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>parts of Eye</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3.</td>
<td>Reptiles</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>4.</td>
<td>Vegetative Propagation.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>Mammals</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>6.</td>
<td>Digestive system</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>7.</td>
<td>Colour of Rainbow</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>8.</td>
<td>Oviparous</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>9.</td>
<td>Types of Plants</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>10.</td>
<td>Vitamins</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>11.</td>
<td>Metals &amp; Non-metals</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>12.</td>
<td>Elements compounds &amp; mixtures</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>13.</td>
<td>Parts of flower</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>14.</td>
<td>Cells</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>15.</td>
<td>Physical &amp; Chemical changes.</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>24</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

3.2.2 Preparation Stage

Following concepts of Science from Class-Vth text book were selected for the study as under:-

- Vitamins
- Deficiency diseases
- Living Things
- Respiratory System
- Ambhibians
Vegetative propagation
Oviparous
Pollution
Communicable Diseases
Force
Energy

For IXth class the concepts were as under:-
- Parts of Eye
- Habitat
- Reptiles
- Vegetative Propagation
- Mammals
- Digestive System
- Colours of Rainbow
- Oviparous
- Types of Plants
- Vitamins
- Metals & Non-metals
- Parts of Flower
- Elements, compounds & mixtures
- Cells
- Physical & Chemical changes.

Then the test items were prepared according to context of items.
Therefore, a preliminary draft was prepared with 50 and forty items for Class IXth and Vth respectively.
Then the achievement test, before it was used, was sent to subject teachers to elicit their views on the following points:-

- To suggest any other question.
- To add any other areas of relevance.
- To correct the ambiguities, poor phrasing etc.
- To omit irrelevant questions.

By considering the suggestions of subject teachers. He preliminary draft was re-framed and five items from achievement test of Vth class and 7 items were cut from IXth Class achievement test. Scoring keys were prepared for the same.

3.2.3 First Draft of Achievement Test

The preliminary draft was administered to a sample of 60 and 60 students of Class-Vth and Vth respectively. On the basis of students' performance, discussions were held with subject teachers and students individually. In the light of the views of the subject teachers nine items and six items of Class IXth & Vth respectively were properly reviewed as shown in the table. The perusal of the table reveals the percentage of responses of the first draft of achievement test. The distracters showing the percentage of responses indicated by star (*) marks were modified for the second draft. As a result of discussion and modification of items finally thirtytwo and 40 items for Class Vth and IXth respectively were retained which formed the first draft of achievement test.
3.2.4 **Final Draft of the Achievement Test**

A sample of eighty students each of grade Vth and IXth respectively were selected randomly as sample and the first draft was administered to them. The answer scripts were evaluated and then selected items of first draft were taken for the final draft. The difficulty value (D.V.) and Discriminative Power (D.P.) of each item was computed.

For calculating the Difficulty Value (D.V.) and Discriminating Power (D.P.) the following formulae were used:

\[
\begin{align*}
\text{D.V.} &= \frac{RU + RL}{n} \\
\text{D.P.} &= \frac{RU - RL}{n / 2}
\end{align*}
\]

Where:

- **R.U.** = No. of correct responses in the upper group.
- **R.L.** = No. of correct response in the lower group
- **N** = Size of the sample in upper and lower group.

From the sample size, two sub groups of twenty seven percent students each falling in upper and lower categories, were selected. In case of Eighty students (.27x80=21.60) we had twenty one students on each category and therefore, forty students were considered for applying the formula for IXth Class as well as for Vth class.

3.2.5 **Reliability of Achievement Test**

Reliability is essential to the effectiveness of any data gathering procedure (Best, Kahan 1989). Guilford (1954) defines as the
proportion of the true variance in the observed test scores. Anastasi (1995) regards reliability as a consistency with which a set of test scores measures whatever they do measure. Frankel and Wallen (1993) say that reliability refers to the consistency of the scores obtained.

Frankel and Wallen (1993) believe that the Kuder-Richardson strategy is the most frequently employed method for determining of consistency of tools. Therefore, on this study Kuder-Richardson formula was found to be the most suitable method to calculate reliability. The achievement test was administered to a group of hundred students studying in Class-Vth & IVth respectively which do not form the experimental sample of population. The table presents the results (See Appendix) -

3.2.6 VALIDITY OF TEST

Validity is the most important idea to consider when preparing or selecting on instalment for use. It refers to the degree to which it intends to measure. Frankel and Wallen (1993) mention that in recent years, validity has been defined as referring to the appropriateness, meaningfulness and usefulness of the specific inference researchers make based on the data they collect.

Validation of an instrument is the process of collecting evidence to support such inferences. This has to be realized that validity refers to the degree to which evidence supports any inferences a researcher makes to use on the data he collects using a particular instrument.
At the most elementary level, it is necessary for all the tests to have context validity i.e. each question be released to the topic. Frankel and Wallen (1993) mention that context validity refers to the context and format of the instrument. The context and format must be consistent with the definition of the variable and sample of subjects to be measured. There must be an adequate coverage of the overall topic, the question must be clear and unambiguous.

A more adequate approach to validation consists of checking the agreement between the responses elicited by the questionnaire against the criterion. In some cases, it is possible to validate questionnaire responses against the actual behaviour of the respondent. The test was validated against the criterion of content validity.

Thorndike and Hagen (1986) suggest that the problem of context validity is parallel to the problem of preparing a blue print for test and then building a test to match the blue print.

The following procedure was followed by the investigator to determine context validity of the achievement test. The test items and a list of an outcome were given to the panel of five experts in the subject matter and five experts in test items. Context of item, clarity, its correspondence to the outcomes along with the validity and objectivity data were used to make modifications in some items. The experts have also had an agreement over the answers so that the scoring key could be verified. The experts agreed with the investigator on the assignment of test item 96 percent of the cases. The correspondence was taken as evidence at context validity.