Chapter II

Development and Description of the Tools
CHAPTER II
DEVELOPMENT AND DESCRIPTION OF THE TOOLS

The preceding chapter dealt with the theoretical basis of the problem, review of the related studies, significance and delimitations of the problem, objectives of the study and the hypotheses. Research calls for adequate and relevant data which should be collected objectively and which should give very dependable and valid information. Each tool is appropriate for the collection of certain type of evidence or information. The researcher has to select from the available tools that provide him the data he seeks for testing hypotheses. The researcher should familiarize with the nature, merits and limitations of the existing research tool and should also develop skill in the construction and use of these research tools. The present chapter is devoted to the development and description of the tools required for collection of data. The tools used in the study have been listed below:

- Environment Awareness Ability Measure (EAAM) (Developed and validated by Jha, 1998)
- Concept Maps as Instructional Material (Developed by the investigator)
- An opinionnaire developed by the investigator to know teacher's opinions regarding concept mapping as an instructional strategy.
- Deo-Mohan Achievement Motivation (n-Ach) Scale (Developed and standardized by Deo and Mohan, 1985)
- The Joyce-Hudson scale of convergence and divergence cognitive style (Developed by Hudson and validated by Child and Smithers, 1971).

Each one of the above mentioned tool is discussed as under:

ENVIRONMENT AWARENESS ABILITY MEASURE (EAAM)

The present tool ‘Environmental Awareness Ability Scale’ purports to measure the extent and degree of awareness of people about environmental
pollution and its protection. The scale explores the understanding of people about the importance of environment in which they live. And how far the efforts of Government through various legislations, mass-awakening programmes of N.G.O. and other agencies through mass-media, electronic media and print-media could achieve their goals. Thus, the present tool may prove itself very useful in assessing the knowledge of people and at the same time promoting their awareness; if they need so, about the environmental dimension of sustainable human development.

DEVELOPMENT OF SCALE

It was thus decided to construct an environmental awareness ability scale based on the following dimensions of environment as a whole:

(a) Causes of pollution,
(b) Conservation of soil forest, air etc.,
(c) Energy conservation,
(d) Conservation of human health,
(e) Conservation of wild-life and animal husbandry.

Seventy one statements, based on the above five dimensions were prepared. They were subjected to expert judgement where every item was required to be passed on its relevance to the content and criterion of Environmental Awareness. Experts were requested to content validate the scale items. On the basis of their opinion and comments 10 items had to be reframed and 20 were deleted for over all ambiguity. A list of 51 items (including 43 positively and 8 negatively worded) were then finalized. In order to make the test widely usable, items were prepared in Hindi and English both. For doing item analysis 100 Ss were randomly selected from High Schools and Inter Colleges of Saharsa town of Bihar. Their responses were scored by using Agree/Disagree categories. A numerical weightage of 1(one) was assigned to the response category of Agree in the case of positive items and Disagree in the case of negative items. Item analysis was done by using extreme group
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Comparison method. Response frequencies along with assigned values for the items were tabulated on a master sheet. Then total scores of the respondents were examined carefully. After that these scores were arranged in descending order (the highest score was placed on the top and lowest score was placed in the bottom). Then from the total cases, top 27% and bottom 27% cases were taken to form two groups. The percentage of the scores of two groups were calculated item-wise. After that biserial correlation coefficients between the scores of two groups were calculated on the basis of Flanagan's table. These correlations were carefully examined and items showing Zero or below .20 value were deleted for being unsatisfactory. Thus, the final form contains 51 items.

RELIABILITY

Three indices of reliability were determined, split-half reliability was found 0.61; secondly it was calculated by K-R method and was found 0.84 and thirdly, it was determined by test-retest method. Two test-retest reliabilities were determined; one after an interval of three months and other of six months and the values were found 0.74 and 0.71 respectively. Thus, the Environment Awareness Ability Scale bears an adequate degree of reliability. Reliabilities are shown in the following table.

<table>
<thead>
<tr>
<th>RELIABILITIES</th>
<th>K-R Method</th>
<th>Test-Retest Method</th>
<th>Split-Half Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=100</td>
<td>N=50</td>
<td>N=50</td>
<td>N=50</td>
</tr>
<tr>
<td>Time gap of 3 months</td>
<td>0.84</td>
<td>0.74</td>
<td>0.61</td>
</tr>
<tr>
<td>Time gap of 6 months</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2.1 : Reliabilities for EAAS
Development and Description of the Tools

VALIDITY

To determine validity of the Environment Awareness Ability Measure coefficients of correlation between the scores of the present scale and Environment Awareness Scale of Tarniji was computed. The coefficient of correlation was found to be 0.83. The scale also possesses face and content validity since each item was judged by experts.

SCORING

There are 51 items in EAAM. Each agreed item carries the value of "1" mark and each disagree item of "zero" mark but the negative items are scored inversely. Thus, on the total scale the scores ranged between 0-51. The scale gives a composite scores of environment awareness ability of the subject. Negative items were indicated by the star-mark.

STANDARDISATION

The scale was standardised on 300 boys and 300 girls randomly drawn from 101213 classes of different schools and colleges of Saharsa and Katihar towns of the Koshi Division of Bihar. The range of age was between 14 and 21 years.

NORMS

Norms have been prepared for the EAAM which are as follows:-

<table>
<thead>
<tr>
<th>Awareness level</th>
<th>Range of Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>37-51</td>
</tr>
<tr>
<td>Average</td>
<td>16-36</td>
</tr>
<tr>
<td>Low</td>
<td>0-15</td>
</tr>
</tbody>
</table>
CONCEPT MAP AS INSTRUCTIONAL MATERIAL

Concept maps were developed in this chapter as instructional material for providing exposure to students in the selected topics of environment for acquisition of environmental awareness. Instructional materials are developed to facilitate the teaching-learning process in classroom situations.

SELECTION OF TOPIC

For the present study, following topics of IX class environmental awareness were chosen by the investigator for preparing instructional materials (concept maps):-

- Classification of natural resources
- Natural resources management
- Components and layers of atmosphere
- Causes of pollution
- Air pollution (green house effect, global warming and ozone layer depletion)
- Water pollution (pollutants, sources, effects)
- Soil pollution (sources, effects)
- Soil erosion (causes, effects, prevention)
- Noise pollution
- Energy flow in an ecosystem

APPROACH TO CONCEPT MAPPING

Concept map is described repeatedly in literature, as a tool that can enhance student's learning in environment education classroom. The relevance, steps and the terminology used in the formation of concept maps are given below:
RELEVANCE OF CONCEPT MAPPING

In almost all the educational institutions, it is observed that enormous information is delivered out directly from text books to students. The success depends upon the abilities to memorize the materials by rote learning. It requires more time and energy. So, educational technology has emerged out with an innovative instructional strategy in order to make learning meaningful. The new instructional strategy is called as concept mapping. A concept map is a schematic diagram or semantic network that includes concepts arranged in a hierarchical order linked by words that form proposition. Concept maps are the graphic representation of information. Concept mapping has been shown to help learners learn, researchers create new knowledge, administrators to better structure and manage organizations and evaluators to assess learning. So, concept maps are graphical tools for organizing and representing knowledge.

STRATEGIES FOR MAKING CONCEPT MAPS

• To construct a concept map, it is important to begin with a domain of knowledge that is very familiar to the person constructing the map. Since concept map structures are dependent on the context in which they will be used, it is best to identify a segment of a text, a particular problem or question that one is trying to understand. This creates a context that will help to determine the hierarchical structure of the concept map.

• A good way to define the context for a concept map is to construct a focus question, that is, a question that clearly specifies the problem or issue the concept map should help to resolve.

• Given a selected domain and a defined question or problem in this domain, the next step is to identify the key concepts that apply to this domain.

• The next step is to construct a preliminary concept map. After a preliminary map is constructed, it is always necessary to revise this map.
• Cross-links should be sought after preliminary map to show that the learner understands the relationships between the sub-domains in the map.

• Concepts are usually enclosed in circles or boxes and relationships between concepts are indicated by making links between two concepts.

• Propositions are the statements about some object or event in the universe, either naturally occurring or constructed. Propositions contain two or more concepts connected with other words to form a meaningful statement.

• Concepts are represented in a hierarchical manner with the most inclusive, most general concepts at the top of map and more specific, less general concepts are arranged below.

CONSTRUCTING A GOOD CONCEPT MAP

➢ Write down major terms or concepts about a topic
➢ Identify the most general, intermediate and specific concepts
➢ Draw the concept map. While drawing the concept maps the following points should be taken into consideration.
  • Concepts should be circled
  • The general concepts should be placed at the top
  • The intermediate concepts should be placed below the general concepts
  • The specific concepts should be placed at the bottom.
  • Draw lines between related concepts
  • Label the lines with 'linking words' to indicate the relationship between the concepts
  • Revise the map in order to provide holistic learning.

Thus, concept maps are not only a powerful tool for capturing, representing, and archiving knowledge of individuals, but also a powerful tool to create new knowledge.
The hierarchical concept maps on topics mentioned earlier in this chapter were developed by the investigator and are appended at the end (Annexure-II).

VALIDATION

The concept maps made by the investigator on the topics mentioned above were subjected to two types of evaluation—self evaluation and expert appraisal.

In the self-evaluation, the content portion of the instructional materials had been checked about their factual correctness and relevancy with objectives.

In the expert appraisal, comments and suggestions had been taken from ten Science teachers/environmental education teachers by administering the opinionnaire about the presentation of the material and existence of the essential characteristics needed for an instructional material.

OPINIONNAIRE

The investigator gathered the opinion of teachers by developing the likert type scale in regard to the instructional strategies in teaching-learning process. The scale was divided into five point scale ranging from strongly agree to strongly disagree (Annexure III).

FORMATION OF STATEMENTS

Various survey type questions were designed to prepare the opinionnaire for administering on the teachers to gather opinion regarding instructional strategies. The questions/items in the section were open-ended and were aimed at eliciting descriptive comments from the teachers. The following points were considered while framing the items:

- Content and level of instructional materials
- Positive attitude towards learning
- Development of cognitive structure
- Integrating new and old knowledge
- Understanding of the concepts
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- Principle of self-learning
- Generating ideas from general to specific
- Designing of complex structures
- According to psychological level of the students

CRITERIA FOR SELECTING THE ITEMS OF THE SCALE

The following criteria has been adopted for the selection of items:

a. selected items should be relevant to the attributes to be measured
b. items should be stated in simple, clear and precise words

FORMAT OF THE OPINIONNAIRE

All the items in statement form were to be rated on a five point scale starting from:

- strongly agree
- undecided
- strongly disagree
- agree
- disagree

In this scale it was required by the subjects to opt for one of the response from five alternatives.

FIRST TRYOUT

The opinionnaire was given to the experts and teachers for suggestions, modifications and to find out any ambiguity, level of difficulty and inadequacy of the language of the items. In this opinionnaire of concept mapping 16 statements were made out of which five statements were rejected and 11 statements/items were retained after slight modifications by the experts.

FINAL TRYOUT OF THE OPINIONNAIRE

The opinionnaire was administered to the teachers by following the instructions carefully. There was no time limit and no right or wrong responses.
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The percentage response of each statement/item in regard to instructional strategy was calculated.

**OPINIONNAIRE SCALE PERCENTAGE**

Opinionnaire scale was analysed and interpreted to get opinion of teachers regarding concept mapping as instructional strategy.

1. The concept maps help in generating new ideas in understanding environmental awareness concepts.

<table>
<thead>
<tr>
<th>Percentage response</th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>53.33</td>
<td>33.33</td>
<td>13.33</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

2. The concept maps do not help in developing complex structures.

<table>
<thead>
<tr>
<th>Percentage response</th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>03.33</td>
<td>33.33</td>
<td>63.33</td>
</tr>
</tbody>
</table>

3. The concept mapping as instructional strategy involves meaningful learning and acquiring new environmental awareness concepts.

<table>
<thead>
<tr>
<th>Percentage response</th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>55.66</td>
<td>26.65</td>
<td>13.33</td>
<td>3.36</td>
<td>-</td>
</tr>
</tbody>
</table>

4. It helps to provide more clear meaning of the concepts.

<table>
<thead>
<tr>
<th>Percentage response</th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>41.92</td>
<td>48.39</td>
<td>3.22</td>
<td>6.45</td>
<td>-</td>
</tr>
</tbody>
</table>

5. Concept maps do not help in increasing concentration among the students during learning of environmental concepts.

<table>
<thead>
<tr>
<th>Percentage response</th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.33</td>
<td>3.32</td>
<td>10</td>
<td>33.37</td>
<td>43.33</td>
</tr>
</tbody>
</table>
The concept maps help to integrate new and old knowledge.

<table>
<thead>
<tr>
<th>Percentage response</th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>54.45</td>
<td>34.33</td>
<td>1.30</td>
<td>3.60</td>
<td>-</td>
</tr>
</tbody>
</table>

The concept map is time consuming instructional strategy.

<table>
<thead>
<tr>
<th>Percentage response</th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-</td>
<td>36.66</td>
<td>20</td>
<td>36.64</td>
<td>5.68</td>
</tr>
</tbody>
</table>

The concept maps are related with achievement and style of learning.

<table>
<thead>
<tr>
<th>Percentage response</th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>23.13</td>
<td>47.27</td>
<td>18.25</td>
<td>5.66</td>
<td>4.44</td>
</tr>
</tbody>
</table>

The concept maps help in development of higher order conceptualization.

<table>
<thead>
<tr>
<th>Percentage response</th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>23.32</td>
<td>40</td>
<td>20.23</td>
<td>8</td>
<td>5.77</td>
</tr>
</tbody>
</table>

The concept mapping would develop creativity and cognitive abilities.

<table>
<thead>
<tr>
<th>Percentage response</th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50.5</td>
<td>29.5</td>
<td>15.66</td>
<td>-</td>
<td>3.32</td>
</tr>
</tbody>
</table>

The concept mapping would help in self-learning of general and specific concepts.

<table>
<thead>
<tr>
<th>Percentage response</th>
<th>SA</th>
<th>A</th>
<th>UD</th>
<th>DA</th>
<th>SDA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>42.37</td>
<td>41</td>
<td>10</td>
<td>6.67</td>
<td>-</td>
</tr>
</tbody>
</table>

The opinionnaire revealed that majority of teachers agreed that concept maps help in generating ideas, assimilation of new concept, integrating new
and old knowledge, help in increasing concentration related with style of learning, development of complex structure and higher order of conceptualization in acquisition of environmental awareness concepts.

**NEED IDENTIFICATION**

In order to facilitate teaching learning process it is very important to develop an instructional strategy which can make education highly interactive individualized so that the learners can learn at their own pace.

![Diagram](image.png)  

*Fig. 2.1 Format showing different steps involved in the development of instructional material (Kochhar, 2007)*
IDENTIFICATION OF INSTRUCTIONAL OBJECTIVES

According to Abedor (1978) "An objective is precise statement of learning outcomes. A behavioural objective describes what the learner will be able to do at the end of the instruction."

In writing the objectives for these instructional materials, a Gronlund approach viz general and specific objective is followed. For the selected 10 topics in environmental education, the general objectives and specific objectives have been detailed in table 2.3.

**Table 2.3 : General and specific objectives**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Topic</th>
<th>General objectives</th>
<th>Specific objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Natural resources</td>
<td>• To know about natural resources in environment.</td>
<td>• To recognize different types of natural resources.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• To understand common natural resources such as air, water, land, minerals, energy, plants and animals.</td>
<td>• To classify natural resources according to chemical nature, abundance, availability and distribution.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• To apply the knowledge of natural resources to solve environmental problems.</td>
<td>• To give explanation about different natural resources.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• To develop the observations, preservation and conservation skills.</td>
<td>• To describe the important and harmful effects of natural resources.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• To give measures of conserving these natural resources.</td>
</tr>
</tbody>
</table>
### Development and Description of the Tools

#### 2. Natural resources management
- To know about natural resources management.
- To understand the different ecosystems in natural resources.
- To apply the knowledge of natural resources management to solve various environmental problems of pollution.
- To develop the preservation skill.
- To recall different types of natural resources and their management.
- To classify various factors of natural resources management.
- To describe environmental resistance with different examples.
- To explain fisheries management practices as a part of natural resources management which include selection, laws, artificial propagation, habitat improvement.

#### 3. Components and layers of atmosphere
- To know about atmosphere and its layers.
- To understand the components and different layers of atmosphere.
- To apply the knowledge of different layers in understanding the functions of atmosphere.
- To recall the different components of atmosphere.
- To describe different layers with their formation, distance form earth and functions.
- To explain importance of atmosphere in climate control.
### Development and Description of the Tools

#### 4. Causes of pollution
- To know the term pollution.
- To understand various causes of pollution.
- To apply the knowledge in protecting the environment.
- To develop the skill of protecting the environment from pollution.
- To define the term pollution.
- To understand the different causes like population, industry and technology.
- To explain the reasons of imbalance in the environment.
- To identify the causes of environmental problems related to air, water and soil pollution.

#### 5. Air pollution
- To acquire knowledge about air pollution.
- To understand different sources of air pollution.
- To apply the knowledge to find harmful effects of air pollution.
- To develop observation and preservation skill.
- To know about different air pollutants.
- To understand different changes which occur in air.
- To classify different sources of air pollution.
- To explain harmful effect of air pollution i.e. respiratory problems, acid rain, green house effect, global warming, depletion of ozone layer etc.
### Development and Description of the Tools

<table>
<thead>
<tr>
<th>6. Water pollution</th>
<th>7. Soil pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td>• To know about water pollution.</td>
<td>• To know about soil pollution.</td>
</tr>
<tr>
<td>• To understand causes of water pollution.</td>
<td>• To understand different sources of soil pollution.</td>
</tr>
<tr>
<td>• To apply the knowledge to identify the sources of water pollution.</td>
<td>• To apply the knowledge to find harmful effects of soil pollution.</td>
</tr>
<tr>
<td>• To find measures to control water pollution.</td>
<td>• To develop observation and prevention skill.</td>
</tr>
<tr>
<td></td>
<td>• To know different types of changes occur due to water pollutions.</td>
</tr>
<tr>
<td></td>
<td>• To classify different types of water pollutants.</td>
</tr>
<tr>
<td></td>
<td>• To understand main sources of water pollution, point and non-point sources of water pollution.</td>
</tr>
<tr>
<td></td>
<td>• To describe harmful effects of water pollution i.e. diseases, eutrophication, biomagnification etc.</td>
</tr>
</tbody>
</table>
Development and Description of the Tools

| 8. | Soil erosion | • To know about soil erosion.  
• To understand the different causes of soil erosion.  
• To find effects of soil erosion.  
• To develop prevention skill. | • To understand human and natural causes of soil erosion.  
• To find effects of soil erosion on fertile soil, hilly areas, rivers.  
• To apply preventive measures to control soil erosion such as cropping, proper drainage, sowing grasses, terrace farming. |
| 9. | Noise pollution | • To know about noise pollution.  
• To understand the sources of noise pollution.  
• To find effects of noise pollution.  
• To develop preventive skills. | • To define noise pollution.  
• To understand natural and man made sources of noise pollution such as domestic gadgets, loud speakers, vehicles, air craft etc.  
• To find harmful effects of it on ear, heart, brain, eye, liver etc.  
• To explain remedial measures to control noise pollution. |
Development and Description of the Tools

10. Energy flow in an ecosystem
- To make aware about ecosystem
- To understand flow of energy in an ecosystem.
- To find out the relationship among different trophic levels.
- To develop skill of conservation of energy.

- To define ecosystem, trophic levels, energy processes.
- To understand the process of energy consumption and energy production.
- To get information about different food chains.
- To develop measurements to conserve energy at different levels.

ACHIEVEMENT MOTIVATION (n-Ach) SCALE

Achievement motivation scale constructed and standardized by Deo and Mohan (1985) is a standard verbal measure of achievement motivation in general. Achievement motivation is a variable which is used in many studies in education either as a main or secondary variable or a moderator variable. The following factors were classified as cues of achievement imagery. All these factors were accepted for providing the basis to prepare the items in the scale of achievement motivation.

FACTORS

1. ACADEMIC FACTORS
(i) Academic motivation, (ii) Need achievement, (iii) Academic challenge, (iv) Achievement anxiety, (v) Importance of grades or marks (vi) Meaningfulness of daily school/college tasks, (vii) Relevance of school/college to students future goals, (viii) Attitude towards education (ix) work methods, (x) Attitude towards teachers (xi) Warmth of interpersonal relation (xii) College concern for the individual, and (xiii) Implementation of educational objectives.
2. FACTORS OF GENERAL FIELD OF INTEREST:
COMPETITION IN CURRICULAR AND CO-CURRICULAR ACTIVITIES.
(i) Sports and athletics (curricular and professional),
(ii) Fine arts and dramatics,
(iii) Dancing,
(iv) Music,
(v) Painting,
(vi) Debates and orations etc,
(vii) Boating,
(viii) Mountaineering or hiking,
(ix) Cross-country races,
(x) Sports,
(xi) Domestic crafts for girls like cooking, embroidery etc,
(xii) Reading and writing and,
(xiii) Experimentation or any act of creation,

3. SOCIAL INTERESTS
(i) Organizing and participating in social activities
(ii) Arranging exhibitions, social functions etc.

To sum up items for the scale were based on (i) Academic factors, (ii) Factors of general interest, and (iii) Factors of social interest.

CRITERIA FOR THE CHOICE OF ITEMS IN THE SCALE
1. The selected item should evolve the achievement imagery in the respondents.
2. It should be related to their achievement experiences based on situations known to them.
3. The item should be comprehensible to the respondents.
4. The language of the item should be such that the respondent can immediately identify with the situations expressed in the item.
The preliminary draft was prepared which consisted of 115 items. This draft with separate verbal instructions was a 5 points self-rating questionnaire having both positive and negative items. The items in the scale were arranged and distributed factor wise in the following order (Table 2.4).

Table 2.4: Distribution of items

<table>
<thead>
<tr>
<th>Factor</th>
<th>No. of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Academic motivation</td>
<td>9</td>
</tr>
<tr>
<td>2. Need for achievement</td>
<td>11</td>
</tr>
<tr>
<td>3. Academic challenge</td>
<td>5</td>
</tr>
<tr>
<td>4. Achievement anxiety</td>
<td>4</td>
</tr>
<tr>
<td>5. Importance of grades/marks</td>
<td>5</td>
</tr>
<tr>
<td>6. Meaningfulness of task</td>
<td>6</td>
</tr>
<tr>
<td>7. Relevance of school/College to future goals</td>
<td>5</td>
</tr>
<tr>
<td>8. Attitude towards education</td>
<td>6</td>
</tr>
<tr>
<td>9. Work methods</td>
<td>10</td>
</tr>
<tr>
<td>10. Attitude towards teachers</td>
<td>6</td>
</tr>
<tr>
<td>11. Warmth of inter personal relations</td>
<td>4</td>
</tr>
<tr>
<td>12. Individual concern</td>
<td>6</td>
</tr>
<tr>
<td>13. General and social interests</td>
<td>9</td>
</tr>
<tr>
<td>14. Mountaineering</td>
<td>3</td>
</tr>
<tr>
<td>15. Boating</td>
<td>3</td>
</tr>
<tr>
<td>16. Dramatics</td>
<td>5</td>
</tr>
<tr>
<td>17. Music</td>
<td>3</td>
</tr>
<tr>
<td>18. Sports</td>
<td>12</td>
</tr>
<tr>
<td>19. Miscellaneous</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>115</td>
</tr>
</tbody>
</table>
Development and Description of the Tools

This questionnaire is of the self-rating type and can be administered in a group with 5 points to rate viz. Always, Frequently, Sometimes, Rarely and Never. It has no time limit. The scoring device was simple stencil type having a numerical weight-age from 4 to 0 for positive in the above order of rating scale and the reverse of it for the negative items.

ITEM ANALYSIS

Johnson's U.L.I. method was applied for item analysis and item discrimination values, taking 27% upper-lower achievers out of a group of 46 boys and girls. A slightly modified version of the same technique was applied to obtain items-indices on the basis of highest limits of the scale. Accordingly the sum total of the two highest weights of the scale 4 and 3 was taken and analysis was done with the same formula. Values obtained by both these method were subjected to correlation to see consistency of the two methods. The correlation coefficient obtained was 0.92 which was highly significant.

SELECTION OF ITEMS

Out of the 115 items, those which yielded negative or zero values were rejected out right. Rest of the items were selected on the basis of the high correspondence between item indices obtained through the two above-methods and secondly on the basis of content, so that each factor should be represented in the scale, at least by 2 or 3 items. Finally 50 items were chosen after careful scrutiny.

FINAL FORM OF THE SCALE

After the item analysis some changes were made in the scale. The questions were changed to statements form to avoid the feeling of irritation and monotony to the respondents. Hindi version of the scale was also prepared. In the final scale, out of 50 items, 13 are negative and 37 are positive items.

RELIABILITY OF THE SCALE

Test-retest method was applied to obtain the reliability coefficient of the scale. Taking different sets of sample; the administration of the scale was repeated on several occasions. The results are given below in (Table 2.5).
Table 2.5: Showing reliability coefficient

<table>
<thead>
<tr>
<th>Sample</th>
<th>N</th>
<th>Interval</th>
<th>r</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed group</td>
<td>51</td>
<td>4 Weeks</td>
<td>.69</td>
<td>.01</td>
</tr>
<tr>
<td>Males</td>
<td>33</td>
<td>5-6 Weeks</td>
<td>.67</td>
<td>.01</td>
</tr>
<tr>
<td>Females</td>
<td>50</td>
<td>5-6 Weeks</td>
<td>.78</td>
<td>.01</td>
</tr>
</tbody>
</table>

These coefficients of reliability are sufficiently high and the scale can be considered as reliable for use.

VALIDITY OF THE SCALE

As far as the validity of the scale is concerned, in the first instance the item validity established by the high-low discrimination method was accepted as the validity of the whole measure. Besides, this scale was also used for validating the projective test of Achievement motivation. The coefficient of correlation between the scale and the projective test was observed to be .54 which speaks for the validity of the scale also, the validity being of the concurrent nature. Finally the scale scores were also correlated with the scores obtained by administering the Aberdeen Academic Motivation Inventory of Entwistle (1968) yielding a coefficient of correlation as .75 for a mixed sample of 93, this correlation is high enough to establish the validity of the scale. These explanations support the results of present scale of achievement motivation to be sufficiently valid for use for measuring achievement motivation.

ADMINISTRATION OF THE SCALE

The scale can be administered individually as well as in a group of about 25-30 subjects. The subjects should be seated comfortably, at some distance from each other and all with in such distance that every subject can clearly hear
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the tester's voice. The tester should make sure that each subject has a pen for marking responses. First the answer sheets should be distributed to each subject and the subject should be asked to write down their particulars. Then the tester should distribute the scale booklets giving one to each subject.

The directions printed in the test booklet should read loudly and properly explained verbally. The subjects should be told that there is no time-limit but they are expected to work fast and give their honest response to each item. Every item is to be answered by every subject. After the subjects finish marking their responses, the test booklets should be collected along with the answer sheets.

SCORING

Two stencil keys are to be used for scoring, one for positive items and one for negative items. A positive item carries the weights of 4, 3, 2, 1 and 0 respectively for the categories of Always, Frequently, Sometimes, Rarely and Never. The negative item is to be scored 0, 1, 2, 3 and 4 for the same categories respectively that are given above. Separate keys for positive and negative items are provided. The total score is the summation of all the positive and negative items scores. The minimum score obtained can be 0 (zero) and the maximum can be 200, other scores ranging in between. This is a quick scoring administered scale which is also quick in administration and very easy for use in administration as well as scoring.

NORMS AND INTERPRETATION OF THE OBTAINED SCORES

The scores can theoretically range from 0 to 200. For the interpretation of the score, norms are presented in three forms frequency distribution with mean and standard deviation, percentile norms and T-scores. Norms can be applied according to the need and purpose of the investigation. This scale is applicable for 13 to 20 years and above age groups also (Annexure IV).
THE JOYCE-HUDSON SCALE OF CONVERGENCE AND DIVERGENCE COGNITIVE STYLE

DESCRIPTION OF THE TOOL

The Joyce and Hudson scale has been designed to measure convergence and divergence cognitive style. It contains a 20-item questionnaire. In most studies, 'convergers' and 'divergers' have usually been identified from their relative performance on intelligence and open-ended tests. Convergent thinkers have been defined and distinguished by their comparatively high scores in problems requiring one conventionally accepted solution clearly obtainable from the information available, whilst at the same time obtaining low scores in problems requiring the generation of several equally acceptable solutions. The reverse arrangement defines the divergent thinker. This scale studies the cognitive characteristics of students (Child and Smithers, 1971).

TEST DEVELOPMENT

The scale was refined from data using factor analysis. To validate the scale, scores on intelligence and open-ended tests were obtained from the sample and used to define three groups consisting of convergers, divergers and all-rounders. The scale had following steps:

Step I A sample of 306 first year university students from various science and non-science disciplines were given the questionnaire. Of those who did not complete the questionnaires 55 percent were from non-science subjects. The sample contained 156 science students (N=123 men, N=33 women) and 150 non-science students (N=90 men, N=60 women). The sciences represented were chemistry, biology, material sciences, physics, textiles, maths, statistics and pharmacy. Non-science subjects included languages, applied social studies, management and social science.

Step II The tests used for this analysis were AH5 test of high-grade intelligence, two divergent thinking tests and the Joyce-Hudson
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self-rating scale of convergence and divergence. Joyce-Hudson's scale of convergence and divergence is shown in an appendix at the end and a glance at the items will reveal that they have selected topics frequently associated with the personal, social and intellectual style of science and non-science specialists.

Step III

To examine the internal consistency of the questionnaire (the Joyce-Hudson) the two-way response pattern, tetrachoric correlations were obtained for the responses to the 20 items. The correlations were factor analysed using a Birmingham programme (Hallworth and Brebner, 1965). All but six of the 20 items loaded significantly on the first factor which accounted for 20 percent of the total variance. The loadings are shown in the appendix against each item. The 14 items were taken as the basis of a refined scale of convergence and divergence.

Step IV

The AH5 provides a measure of verbal + numerical and spatial skills as separate entities which can, if required, be summed to give an overall score. Convergers and divergers were identified from their relative performances on the AH5 and divergent thinking tests following Hudson (1966). The students' fluency scores on the 'Uses' and 'Consequences' tests were ranked and the ranks combined, there being a highly significant correlation of +0.51 between the scores. The combined ranks and the total AH5 scores were each graded on five-point scales running from +2 to −2 in the proportion 1:2:4:2:1 and a cross-tabulation carried out to give differential scores. Students with differential scores of ±2 or greater were classed as either divergers or convergers according to the bias of their performance.

ADMINISTRATION OF THE TOOL

Stop-watch, test booklets, and pencils were used for administration of tests. Test administrator distributed the test booklets and pencils. As soon as the
identifying information on the cover page had been filled in, test administrator said now start reading the directions, completed all the items in the questionnaire. After completion of tests in the given time (20-25 minutes), administrator collected all the tests and signed them.

SCORING PROCEDURE

After collecting the questionnaires, the scoring was done. Each agree and disagree item was scored according to the instructions. The scores were ranked and the ranks were combined. The combined ranks and the scores were then graded on five-point scale running from +2 to -2 and a cross tabulation gave the differential scores.

RELIABILITY

Ranked scores showed highly significant correlation of +0.51. A cross-tabulation gave differential scores. A student falling in the top 10 percent of the combined divergent thinking ranks (+2) and at the same time falling in the bottom 10 percent of the ranks (+2) obtained an overall differential score of +4. Tetra choric correlations were obtained for the responses. The correlations were factor analysed using a Birmingham programme.

VALIDITY

There are several ways. Since this test was intended to examine the validity of the scale by drawing on data from a study by the authors of some cognitive characteristics of university students. To estimate the validity of cognitive style scale, content validity was established. The mean scores of convergers, divergers and all rounder on the Joyce-Hudson scale were respectively 5.87 ± 2.53, 7.94 ± 2.87 and 6.67± 2.77. All the differences were significant beyond the 5 percent level and appeared at first sight to validate the scale. All the differences between science and non-science specialists were significant beyond the 1 percent level whilst with in these categories only the difference between non-science divergers and non-science convergers reached significance (P<.05). The two items showed the highest correlations with the factor. The internal consistency demonstrated by factor analysis and inspection.
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of the items confirmed that the scale was largely a self-rating of subject bias. This scale had featured one aspect that subject attitudes and interests distinguish science from non-science students.

ITEM ANALYSIS

Item analysis was done by using extreme group comparison method. Response frequencies along with assigned values for the items were tabulated on a master sheet. Then total scores of the respondents were examined carefully. After that these scores were arranged in descending order (the highest score was placed on the top and lowest score was placed in the bottom). Then from the total cases, top 27% and bottom 27% cases were taken to form two groups. The percentage of the scores of two groups were calculated item-wise. After that biserial correlation coefficients between the scores of two groups were calculated. These correlations were carefully examined and items showing 0 or below 0.20 value were deleted for being unsatisfactory. Thus, the final form contains 20 items.

RELIABILITY

Test-retest method was applied to obtain the reliability coefficient of the scale. Most tests of 50-called reliability are merely tests of internal consistency. Thus, Cronbach's alpha and split half analyses only indicate internal consistency-not important here. In fact, not desireable at all. Reliability (in the test-retest sense which is important) is usually assured by having very good samples and sensible test conditions. The divergency test was used numerous times-always work well and gives consistent data. Where as new convergency test was used twice (with very large samples) in two different countries. The same result patterns occurred both times, with remarkable consistency (Reid, 2008). In present investigation, the scale was administered to a group of 50 students of age group 15+ from IX grade (Chandigarh school). Test-retest method was used. The coefficient of reliability was sufficiently high (0.74) and the scale was considered as reliable for use.
VALIDITY

As far as the validity of the scale is concerned, in the first instance the items validity was established by face validity. This supported high confidence in test validity and the outcomes from the test seemed highly consistent with other measurements (Reid, 2008).

Hence, the tool was finally approved for being used in the present investigation. A copy of Joyce-Hudson scale of convergence and divergence cognitive style is appended at the end (Annexure V).