CHAPTER 4

DEVELOPMENT OF TOOLS

This chapter is devoted to discuss the development and standardization of tools used in the present study. There were two categories of tools- one were instructional tools and others were measuring tools. Whereas the purpose of a measuring tool is to measure the existing capability of a person, the instructional tools are prepared in order to impart some instructions so as to produce a particular ability in a person. Instructional tool in the present study, included a training module on lateral thinking. The measuring tools were: the test of lateral thinking, reaction scale and willingness scale. The process of tools construction has been described under the heading- instructional tools and measuring tools.

4.1.0 INSTRUCTIONAL TOOLS

These tools were used to impart training to the student-teachers in PO method to develop lateral thinking. Keeping in view the objectives and design of the study, one subsidiary objective that emerged was the development and standardization of this training module.

4.1.1 TRAINING MODULE

The module here means a specific, small unit, self instructional, self paced, employing specific steps ranging from objectives to evaluation. It is in form of a small booklet which carried instructions, rationale, behavioural objectives, pre-requisites, stepwise content with sectional recapitulation followed by exercise sheet. Different researchers like Mukhopadhyay (1982), Mullick (1985) and Dhamija (1985) have given different ways of developing module. Most of them have confined themselves to the way programmed learning material is developed. This connotation of the module has been more of a semi-programmed material (more comprehensive and less structured than a common text book).

One prerequisite for development of such type of material, a training module, is ‘Task analysis’. Though the content of the module required higher mental abilities, still every possible effort was made to keep the focus by performing the task analysis.

(a) Task Analysis

The Task analysis was done in three parts. In the first part the selection of the subject matter that was used for the task analysis was done. The second part deals with the theoretical aspects of
the task analysis as applied to the designs of instructional strategies and to the development of
the material for the different instructional approaches. The third part deals with the steps
followed for writing the task analysis.

i. Selection of Subject matter

First step for handling the task analysis was the selection of the subject matter. As the module
revolved around the PO method, the content was chosen from various De Bono books besides
various thinking and lateral thinking books. The language was kept as simple as possible.
Whenever possible, the examples were framed in teaching learning situation. Illustrations in
form of diagrams and flow charts were used to make the content more comprehensive.

ii. Theoretical aspects of Task Analysis

One of the initial steps in developing the training module is to analyse the nature of the actual
task involved. It means breaking down the task into constituent parts and then to determine how
these constituent parts are related and organized. The aims of the task analysis are thus:

1) To develop the task which the learner has to learn
2) To identify the behaviours compatible with the task
3) To identify the condition under which the behavior occurs
4) To determine the criterion of acceptable performance

In the task analysis, one has to make adequate statement of instructional objectives (or task
description). Gagne (1963) proposed that we need to conduct a careful analysis of each learning
situation for determining what kind of tasks was involved. Gagne (1963) proposed to educators,
different type of learning arranged in a classification or taxonomic system. Such conclusions
were drawn not only by Gagne, but also by Glaser, Melton and many others. Theoretical aspects
of task analysis are based on five important factors. These are:

a. Teaching structure
b. Task description
c. Task analysis
d. Types of task analysis
e. Sources of task analysis

a. Teaching Structure: It plays an important role in task analysis. As per Davis (1971)
   “Every task by its very definition must possess a unique structure or organization”. The few
   basic classes of learning structures are:
• Signal structures
• Chain structures
• Multiple discrimination structures
• Concept structures
• Principle structures

However the nature of the task is a useful and meaningful criterion, no single method is applicable for all situations. That is why the actual choice of appropriate strategy is often extremely difficult to make.

- Some tasks are essentially procedural (chains) and others are diagnostic (multiple discrimination) in character.
- Some tasks are relatively simple while others are more complex.
- Some tasks contain risks that can be accepted in the sense that while an error should be avoided, the error would not be regarded catastrophic.

In the present task all the factors were properly taken care of.

b. Task description: It means the full description of terminal behavior or performance (Miller 1962 and De Cecco 1970). It is thus regarded as a systematic way of identifying and sequencing the salient features of the task. It is important to write task description for three reasons namely,

- It helps in ensuring that all essential material will be taught without giving any necessary information in the instructional sequence.
- It helps the designer to identify the types of learning involved and the order in which the tasks and sub-tasks are to be taught.
- It also helps in planning and sequence of the work instruction.

This view was supported by many technologist like Glaser (1963) and Gagne (1963). They are of the view that type of learning involved helps in presenting the content in a hierarchical manner. For the module relevant method was adopted. Self-instructed learning units were supported with question-answers as well as discussions. Various idea-generating techniques were used accordingly. Here the module required no special apparatus aids to be given along with. On the basis of these seven steps, the task analysis of the module was prepared by the investigator. It consisted of seven columns built upon seven steps discussed above. But as the nature of task is totally different, major differences from a usual task analysis were

1) Terminal Behaviour: Along with action verbs, it was also given in form of mental abilities.
2) Task Designation: It was designed according to expected behavioral outcomes, so it also included mental abilities.

3) Types of Learning: Whereas different types of learning like signal learning-(e.g. while learning meaning of “PO”, “PO-I” and “PO-II”), chain learning, multiple discrimination learning, concept learning and principle learning were used. Some techniques that evoked or provoked the thinking of student-teachers even required a reverse behavior, we may say de-learning, for example of concept learning.

c. Task analysis: After giving the task description or a set of objectives, the designer analyses the type of learning involved. This is called task analysis. Gagne (1965) says that in the task analysis, the designer identifies classes of behaviour which can go with the conditions necessary for their learning. The ultimate aim of the Task Analysis is:

- To describe the task which the student has to learn.
- To isolate the required behaviour.
- To identify the conditions under which the behaviour occurs.
- To determine criterion for acceptable performance.

Types of Task Analysis

In order to fulfill the entirely different needs of the contents or subject matter, three different types of task analysis are recognized.

1. Task Analysis: This involves a detailed analysis of intellectual tasks
2. Job Analysis: This involves a detailed analysis of tasks involving physical or psychomotor skills. The technique concentrates on what is to be done, when the task is carried out.
3. Skill Analysis: This involves further analysis of psychomotor tasks and concentrates on how the job will be accomplished. Skill analysis will need to be carried out in addition to job analysis, when either the whole task or part of the task involves complex, intricate and subtle hand-eye coordination.

Most teachers and trainees hold that the task analysis is applicable to all types of task whether the task is of cognitive nature or of psychomotor nature. But an essential component of teacher’s and trainee’s role is to recognize the circumstances in which the strategy of analysis is likely to be more efficient than another for successful performance.

Sources of information for Task Analysis
In carrying out a task analysis which involves topic, job or skill analysis, a number of sources of relevant information must be tapped, so as to ensure that a complete picture has been obtained; obviously, the most important source of information must always be the master or in other words, the man who can do the job at the required level of mastery. He must always be selected with the great care and it should be ensured that he is inevitably proficient at the level which all the learners will be expected to attain to. If the master’s level of proficiency is too high, the task analysis will set needlessly high levels of performance with all the resultant dangers of over training. If the master’s level of proficiency is too low, the resulting task analysis will be invalid with the consequent danger of under training. Once the master’s behavior has been analyzed, it is important to check his performance for accuracy and completeness. Also important is the necessity of checking the task analysis under different operating conditions and environment, for these can sometimes affect the way task is accomplished. In preparing task analysis, teachers and instructors must be consulted; course material studied and the student-teachers who are either learning or have just finished learning the task should be interviewed. All types of procedures like observations, interviews, questionnaires and activity analysis can be used in consulting these sources.

Steps followed in Task Analysis:

The following steps were taken into consideration while performing Task Analysis:

i. Writing terminal objectives in behavioral terms.
ii. Defining pre-requisite knowledge and skills in behavioral terms.
iii. Writing task description.
iv. Analyzing the task.
v. Writing the types of learning involved in task analysis.
vi. Methodology used and
vii. Apparatus used.

i. Writing terminal objectives in behavioural terms: objectives refer to what is commonly designated as mastery of a given subject matter. Getting a clear statement of the terminal objective is the first step to design the instruction. There are many ways of writing objectives, but two schemes have been found especially helpful. One was developed by Mager( 1962), whose main interest was in the cognitive and affective area. The other was developed by Miller(1962) whose main interest was in psychomotor skills. Although both the schemes have been found to be very effective, in this study, Mager’s approach was
preferred. Mager’s criteria of writing objectives can also be described in terms of A, B, C and D

• A denotes audience, one who is to do the learning.
• B denotes behaviour, a verb or an object which clearly describes an observable action the learner will be doing as a result of the learning experience.
• C denotes conditions, limitations or restrictions placed on the learner, or material or aids given to the learner, when he is being evaluated to determine whether or not the objective has been attained.
• D denotes degree, the decision point or acceptable performance at which the learner proves that he has mastered the objective which is achievement that is say 8 marks out of 10 with less than four errors.

ii. Keeping in mind, Mager’s criteria of writing behavioural objectives were framed by the investigator for the experimental work.

iii. Defining pre-requisite knowledge (entry behavior) and skills in behavioural terms: Entry level behavior is that behavior which the learner must have acquired before he can acquire new terminal behavior. Different intellectual skills require different entry behavior for different types of learning. Consequently, the investigator has made an attempt to identify the entry level behavior for each terminal behavior in her experimentation. On the basis of which the entry behavior for the module was described.

iv. Writing task description: After developing the terminal objectives in behavioural terms task description for each objective was written. In this study higher cognitive and affective tasks were taken by the investigator.

v. Analysis of task: After the terminal objectives were broken into tasks and task description for each objective had been developed, the next step in the process was to analyze the tasks for determining the types of learning involved in the attainment of objectives.

vi. Writing the types of learning involved: While analyzing the task it was also necessary to determine the types of learning involved.

vii. Methodology used: While analyzing the task, it was also necessary to reflect over the different methods of teaching that will be used by the teacher. For every sub-task or activity, in this self instructional module, every care was taken to keep the instructions interactive and thought provoking.

viii. Apparatus used while teaching: The last step for writing a task analysis was to determine the apparatus and aids required during teaching. No special aid was required in this method except a work-sheet that was a part of the module.

4.1.2 Development of Module
A module is specific, self instructional, self paced and having small units and specific steps ranging from objectives to evaluation. It is generally in form of small booklet which carries instructions, rationale, behavioural objectives, pre-requisite, stepwise content with sectional recapitulation followed by practice-sheet. In this study, a module means a self contained unit with a definite set of expected behavioral outcomes providing experience or set of experiences. Different researchers have given different ways of developing a module. In the present study steps suggested by Mukhopadhyay (1982) were followed. These steps are

a) Writing a module
b) Editing and reviewing
c) Try out phase
d) Evaluation

a) Writing a module: This stage means the presentation of the material in small frames. The student-teachers were supposed to be trained by the module itself, without any external help, therefore, the Thematic development of the module contained following parts

i. Information for indication: - On the front page of module, introductory information regarding the name of module has been given. The various information of this page helped the reader to locate the desirable information from the module.

ii. Content: - Information about different captions of the module was given under the heading Module. It included names and details of all the activities.

iii. Writing of Instructions for the learner: - Instructions for the learner were given at the next page of the booklet. These instructions were guidelines for making the use of module. These were concerned with how to open the booklet, how to read the booklet, when to stop while reading, how to look at the visual material, how to answer the questions following a frame in the module, when to go to the next frame and when to test the information that is grasped. Such instructions help in keeping the learner focused and avoid any confusion.

iv. Rationale: - After reading the material, the reader must possess the information given in form of activities. Achievement of the reader over the material has been termed as the rational.

v. Expected behavioral outcomes: - During development of the module, the type of expected behavioral outcomes of the target group was kept in mind. These expected behavioral outcomes have actually helped in deciding the appropriate learning experience. In order to acquaint the readers with the type of expected behavioral outcomes of the module, expected behavioral outcomes were stated in the beginning of the module.

**Procedure for writing the Frame:**
This module was prepared for the trainee teachers with an objective of developing their thinking abilities; therefore the modular frames were very comprehensive. One activity consisted of only one frame which further contained two components. The first component dealt with the content or teaching point presented in details with the help of flow diagrams, pictures and examples etc. The second component of the frame contained the questions that were related to the content taught in the frame. The questions were not only objective type in nature but there were some open ended questions also there. In the end of the module, the answers to the exercises were given in detail to provide feedback to the student-teachers.

While writing the module, following parts were specially considered:

a) Frame size
b) Linking information
c) Response mode

i. Frame size: While writing the frame, the teaching point was taken into consideration. It was done so because the size of the frame has to confirm the length of the teaching point. Because of this, the frames were of different size. The total number of frames written in module was equal to the total number of teaching points.

ii. Linking information: In order to link the content of a frame with that of a preceding frame, relevant information was incorporated after every sub unit of the content. Such information was included with certain specific purposes. The first purpose was to provide help to the learner in recapitulating the point done in previous frame. The second purpose was to bring continuity in the sequence of frames and to relate the information with the entering behavior.

iii. Response mode: The response mode was of overt nature in the module. For each frame, whether the question in it was of completion type, multiple choice type, filling the blanks type, the student-teachers were supposed to write the answers in the response sheet. After that they are required to compare their answers with the correct answers provided in the answer sheet. They could proceed to the next frame if the answers were correct, but if the answers were incorrect, they were instructed to read the previous frame again, understand the point and then proceed further.

Editing and reviewing

After the first draft of the module was ready, editing was done. Editing was considered good as it helped in knocking the rough edges off and polishing the material. The draft frames were edited thrice. The first editing was done by a subject matter expert to ensure the information accuracy of the module. The second editing was done by a module writer, who attempted to
simplify the material and discover the errors, if any. This editing also included editing of illustration and figures to suit the need of the learner. The third editing was done by the language expert for avoiding literary discrepancies. The first draft was reviewed in the light of the editor’s suggestion and then put into the tryout phase. The third phase tryout also included three stages.

a) Individual tryout
b) Small group tryout
c) Field tryout

Individual Tryout: In individual tryout, the module was tried on one individual. This tryout was carried out to know the student’s reaction towards general instructions given in the module, pre-requisites, expected behavioral outcomes, the language, and appropriateness of the questions and the diagrams and the illustrations used in the module etc. In the individual tryout, three student-teachers from G.V.M.C.O.E, Sonepat were selected. These student-teachers belonged to different teaching subjects and different sections. Each student was required to read the module carefully. The module was given to these student-teachers separately on different time. Reactions of these student-teachers were observed. Special attention was given where ever the student-teachers got struck during reading. The complaints or suggestions for improvement of activities or questions were given due considerations and required improvements were made in the module.

Small group try-out: After the individual try-out and modifications made thereafter, the module was tried out on a small group of twenty student-teachers. These student-teachers were randomly selected again from G.V.M.C.O.E, Sonepat. This college is located in urban area. The selected sample constituted sample for a group try-out. So the sample included girl student-teachers only. During the group-tryout, the student-teachers of this sample were given an orientation i.e. a talk about the use of the module as well as about lateral thinking. Each one of them was given a copy of the module. After they had read the instructions, it was made sure that each one of them had understood the instructions about the way they had to read the module. They were instructed not to see the correct answers given on the reverse page while writing their answers on the response sheet. The reactions of this group were noted. After that the investigator held a discussion session with these student-teachers and on the basis of this discussion, improvements were made in the module. The module was then taken for the field try out.
Field tryout: For the final tryout the module was administered on the target population of 51 student-teachers of G.V.M.C.O.E, Sonepat. Each one of these student-teachers who were teacher-trainees, a copy of module was given. While the student-teachers were working through the module, no individual help was provided. Unlike the case of individual and the small group try out, no revisions and corrections in the module were made because this time the purpose was to assess the effectiveness of the module and to study the reactions and willingness of the trainee-teachers. As the module was divided in five activities and a work-sheet, the student-teachers were given different activities on different days. So on the first day the student-teachers were given only the orientation. The next day they were provided the first activity. The next day they were given activity 2. After that they were given lateral thinking test on the next day. The process was repeated in the same manner. They were given lateral thinking test after second activity, third activity, fourth activity and finally after the work-sheet. Every time the student-teachers were given an activity, after they had gone through the activity and had given their answers to the questions on the response sheet, the module sheet and the response sheet was collected.

Evaluation: After the editing, the module was analyzed and evaluated in terms of a) Error rate b) Density c) Gain ratio

a) Error rate: The concept of error rate is applicable to this module as the material is presented in a linear form. It is calculated on the basis of response obtained to questions after each frame. If on any frame, the learner doesn’t respond as expected, it is termed as an error. In calculation of error rate, the objective type questions were marked in the same manner. Whereas in case of open-ended questions (thinking exercises), every answer was marked right and error was considered only in no answer situation. Error rate is calculated in percentage.

\[
ER \text{ in percentage} = \frac{N_e \times 100}{N_r \times N_i}
\]

\(N_e = \text{Total Number of errors made by all the individuals on an activity of module}\)

\(N_i = \text{Total number of individuals handling the module}\)

\(N_r = \text{Total number of required responses in the frames}\)
According to this specified procedure, the error rate was calculated separately for each of the five activities and exercise sheet so obtained is less than five as shown in table 4.1. So it can be concluded that all the activities in the module were comprehensible to the student-teachers.
Table 4.1

Respective Errors rates for activities and exercise of module

<table>
<thead>
<tr>
<th>Activities</th>
<th>( N_r )</th>
<th>( N_c )</th>
<th>( N_i )</th>
<th>Error Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity-I</td>
<td>9</td>
<td>3</td>
<td>51</td>
<td>0.65</td>
</tr>
<tr>
<td>Activity-II</td>
<td>8</td>
<td>8</td>
<td>51</td>
<td>1.96</td>
</tr>
<tr>
<td>Activity-III</td>
<td>7</td>
<td>4</td>
<td>51</td>
<td>1.12</td>
</tr>
<tr>
<td>Activity-IV</td>
<td>12</td>
<td>8</td>
<td>51</td>
<td>1.30</td>
</tr>
<tr>
<td>Activity-V</td>
<td>8</td>
<td>4</td>
<td>51</td>
<td>1.96</td>
</tr>
<tr>
<td>Activity-VI</td>
<td>6</td>
<td>3</td>
<td>51</td>
<td>0.98</td>
</tr>
<tr>
<td>Exercise Sheet</td>
<td>47</td>
<td>27</td>
<td>51</td>
<td>3.41</td>
</tr>
</tbody>
</table>

b) Density: It is an independent measure of difficulty of a module. Density function is an indirect measure of the rate at which material is introduced. In this study, Type Token Ratio (TTR) as a measure of the density of a module was used. For evaluating the difficulty value of the module a tally was made of the number of different responses required of the student-teachers in the module. This number was thus divided by the total number of responses required. A program would have density of 1.00, if every response required in the program was different. The same maxim applies to the module. It means that the module would have minimal density, if all the responses required of the student-teachers were similar. Thus the formula applied to find out the density is,

\[
TTR = \left( \frac{N_d}{N_t} \right)
\]

Where \( N_i \) is the total number of responses required in the module and \( N_d \) is the total number of different responses.
Table 4.2

Table showing Type Token Ratio for the Density of Module

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>Nt</th>
<th>Nd</th>
<th>TTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>97</td>
<td>94</td>
<td>0.969</td>
</tr>
</tbody>
</table>

So the module has a high density (near to 1)

C) Gain ratio: Module effectiveness can be measured through the gain ratio between the amount of learned material and the amount of that could possibly be learned. The gain ratio is found by dividing mean gain between pre-test and post-test scores by the mean possible gain scores, which is defined as the difference between the mean pre-test scores and the full scores on the post-test. Gain ratio for the module is

\[
Gain\ Ratio = \frac{Mean\ of\ post\ test\ scores - Mean\ of\ pre\ test\ scores}{Full\ Scores - Mean\ of\ pre\ test\ scores}
\]

Table 4.3

Table showing Gain Ratio for Module

<table>
<thead>
<tr>
<th>FULL SCORE</th>
<th>MEAN OF PRE-TEST</th>
<th>MEAN OF POST-TEST</th>
<th>GAIN RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td>96</td>
<td>33.193</td>
<td>47.53</td>
<td>0.4382</td>
</tr>
</tbody>
</table>

After the above steps, from all the considerations derived by computing the various module elements- the error rate, gain ratio, density etc. it was concluded that the module is satisfactory and ready for administration as well as experimentation.
4.2.0 Measuring tools

As already specified the measuring tools included the lateral thinking test, Raven’s Progressive Matrices, the socio-economic status scale, willingness scale and General reaction scale.

4.2.1 Lateral Thinking Test

General Description

The lateral thinking test has been devised to measure lateral thinking of student teachers as well as children above age twelve. The test permits freedom of responses along with the given responses. So the question types are open ended although the three most probable answers are also given. The instructions are provided before the actual administration of test. The subjects are supposed to either tick any of the given answer or write their responses on the blank space provided as option four in the test booklet. There are twenty four test items in all. The researcher has kept the test and testing time small to avoid fatigue and boredom to influence the results. All the test items are verbal in nature and can be administered in a group or individually. Though there is no time limit for the test, researcher found (as observed by the researcher during various trials and experiment) that the maximum time taken by the subjects was twenty-five minutes. With no previous studies to make a lead, the researchers centered the scoring on four elements.

So the elements considered necessary for lateral thinking in the present study are:

1. Vertical thinking- In the present study the vertical thinking term was used for the way of thinking where a person tends to think logically and if the logical answers are already given as optional choices, he tends to select the best suited answer according to his thinking out of these given answers. Therefore, the most obvious answers selected by the student-teachers out of the given three choices were marked under vertical thinking score.

2. Escape- The right brain is mostly overpowered by left brain in most of the people. That is why most of us think by logic, reasoning and details. Our previous information, knowledge and experiences leave some impression in our brain giving birth to traps and patterns. So the first element for lateral thinking is escape from the usual i.e. the ability to avoid the obvious ideas that our logics and reasoning mostly points towards. To test the same, investigator presented three most obvious answers to choose from. Marks for escape is given only if someone avoids these answers and gives some other answer.

3. Novelty- or originality of the thoughts is also given the weightage as in the creativity tests. Here also novelty is calculated by marking those answers novel that are given by less than 3% of population.
4. Outrageousness- To move from the routine track to provocation and then on side track is called movement by De Bono. The movement is different from judgment. The logical thinking forces us to pass the judgment immediately. So withholding the judgment and accepting the unusual is the third element. It includes provocation / outrageousness of idea. The ideas that are totally different or in opposite direction to the conventional thought process, are considered as outrageous ideas. An extra score is given for such an idea.

The two components, novelty and outrageousness have a very small yet clear difference. Whereas any idea which is not a common idea or an idea that is proposed by less than five percent of the population is an original idea, an outrageous idea carries some provocation. It is definitely novel or original, but also takes thinking in a new dimension that is usually ignored.

The test has been devised in such a way that each question is followed by four options. Three alternatives are most prevalent answers of the questions which were initially selected by researcher’s own imagination as well as from most common answers given by the examinees during trials. Fourth alternative is left blank. The examinees can choose his/her answer from the given alternatives or can use his/her own thought pattern to generate the answers. All the answers are right so one mark is given for vertical thinking. The answers chosen from given options are given one mark only. Escape from the obvious /usual is given two marks. So any answer that is different from the given answer is given two marks. The answers that are new or novel are given three marks. Criterion for the novel answers is again the same as in creativity tests. Answer given by a population size of less than 5% is considered novel. An outrageous idea is given four marks. Outrageousness of the idea was decided on the basis of thinking in a provocative way.

To find the effectiveness of training module, the investigator prepared and standardized a lateral thinking test. The following steps were followed while developing and standardizing the test.

1. Preparation of a preliminary draft
2. Standardization of the lateral thinking test

Preparation of preliminary draft: to prepare the first draft was one of the most cumbersome processes of the study. A blue print was prepared after going through various studies based on hemispherical specialization as well as many lateral thinking exercises and literature available. The addition and omission of the items literally depended on the researcher’s own discretion. To prepare the first draft of the test following steps were taken

- Item formulation
• Item selection
• Item analysis

Description of these stages is given below:

Item Formulation: The items were formulated from different sources like relevant literature, internet and discussion with the experts in the field of creativity and lateral thinking, research scholars. Some help was also taken through internet. A list of these items was prepared which included 45 items initially. All these items were framed in such a way that the different items may provoke the thinking structure of the examinee holistically.

Item selection: The list of items so prepared was reviewed. The items which were overlapping or repeated were dropped. Then the items with ambiguous or wrong language were modified or dropped altogether. Then the items were given to a panel of five experts with a request to mark or drop any item that was found unsuitable. In this procedure five more items were dropped subsequently, the items were administered on a small group of student-teachers to know if the items were understandable to them or not. The items which were not understandable or creating confusions were dropped altogether. Ultimately the final draft of the scale was left with only 24 items.

Item Analysis- Another important aspect in the construction of the test was item analysis. It is concerned with item difficulty and item discrimination. Item difficulty is taken in terms of proportions and item discrimination of individual, completing the items successfully. Discrimination index refers to the degree by which it differentiates between those obtaining high and low scores. But in the test of lateral thinking like the present one, item difficulty cannot be measured exactly in a conventional manner as truly speaking there is no pass or fail on any item and in the test of lateral thinking, the items were of divergent nature. Of course an idea of productivity of an item i.e. its capability of generating adequate responses was taken into consideration. So the items were analyzed adequately in pre-tryout stage. Items were modified and substituted a number of times till they were found to be sufficiently productive and capable of generating adequate response. It was more based upon the judgment of the researchers as well as the related competent persons. Viewpoints of the examinees during initial and tryout stage were also duly considered.

Still two different types of analyses were done for each item of the lateral thinking test. The first type involved calculations of mean and SD and their level of significance with a view to ensure that each item could adequately elicit responses and demonstrate individual differences. The
second type of analysis was concerned with calculation of item discrimination in terms of t-ratio by taking upper (U) and lower (L) 27 percent of cases for both of the colleges. It was found that CR of all the items in the test came out to be highly significant (at 0.01 and 0.05 level of significance) for both of the colleges. Thus, all the items included in the preliminary draft of lateral thinking test were retained. The final draft was further subjected to the process of validity and reliability.

**Reliability & Validity**

The reliability and validity of the test was established in order to determine its utility and efficiency. The sample for both the tests was same and consisted of 200 student-teachers from two education colleges. The sex-wise and college-wise distribution of the sample is given in Table 4.4. The size of the sample selected from different colleges was considered appropriate in the light of research evidences that support the reliability and validity studies in the area of thinking test construction.

**Table 4.4**

<table>
<thead>
<tr>
<th>Sex</th>
<th>Hindu C.O.E., Sonepat</th>
<th>G.V.M.C.O.E., Sonepat</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>50</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>Boys</td>
<td>50</td>
<td>--</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>200</td>
</tr>
</tbody>
</table>

**Reliability** - Reliability of lateral thinking test was established through test-retest method as well as parallel form technique, which was found to be the most suitable way for lateral thinking. The test-retest reliability for the test was established on a sample of 200 student-teachers belonging to two different education colleges as shown in table 4.4. The gap between the first administration and second administration was one month. The stability of the test was determined through t-test of significance between the mean scores on first administration and second administration. The result of t-test for difference between the mean scores on first administration and second administration (t=0.74) showed that the t-ratio was not significant,
thereby implying that the test was stable. This insignificant t-ratio is justified as people are trained to think nearly in a similar manner due to the sequence traps.

Parallel form method was also used to test the reliability of the lateral thinking test. The result was obtained by employing the Spearman Brown formula. The K-R formula could not be used for the simple reason that the nature of responses on the lateral thinking test items was divergent in nature. However, the reliability results are given in table 4.5

<table>
<thead>
<tr>
<th>Table 4.5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test-retest Reliability Coefficient and Parallel Form Reliability coefficients of Lateral thinking Test</strong></td>
</tr>
<tr>
<td><strong>S. No.</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

There being no direct reference to lateral thinking test, direct references from literature is taken for creative test. Wodkta (1914) reported reliability coefficient ranging from 0.28 to 0.75 for verbal creativity battery. Test retest reliability for Torrance Test of creative thinking ranged from 0.71 to 0.93 whereas Passi reported reliability for Test of creativity 0.68 to 0.91. The reliability coefficient for lateral thinking test being highly positive implies that the test is stable.

Validity- The validity of the test is concerned with what the test measures and how well it does that. As we know that validity is a relative term but there were found no other related tests. The ‘face’ validity is employed in selection of items. As a test is said to have face validity when it appears to measure whatever the author had in mind, namely what he thought he was measuring. Further, the discussions with the experts in the field of lateral thinking and creativity were held and the items were considered valid only after their unanimous suggestions and approval.

4.2.2 Development and Standardization of willingness scale

Feasibility of any method depends upon the willingness of the participants trained in that particular model/ method to implement this method in classroom situation because if the teachers are not willing to implement the method in actual classroom, the method will become inappropriate. So to see the effectiveness of the module, one of the objectives of the study was to construct the willingness scale. The scale was constructed to check the willingness of the
examinees towards the module. It consisted of three parts. Part one included questions regarding the identifying data of the examinee. It included columns like name, age, qualifications etc. The second part deals with the instructions regarding the use of the scale. It also informs the examinees about the response mode. Part three contains questions regarding the module. There are 14 questions in form of statements, the answers of which can be given by ticking any of the options like strongly agree, agree undecided, disagree and strongly disagree. The last three questions (Q. No. 12, 13, 14) are subjective questions regarding suggestions to improve the module and its shortcomings.

Preparation of preliminary draft: The blueprint of the scale was prepared, which after passing through the stages underneath, formed the first draft of the scale. These stages are:

a) Item formulation
b) Item selection
c) Item analysis

Description of these stages is given below:

a) Item Formulation: Firstly a chunk of 25 statements was selected after consulting with different sources like relevant literature, discussion with teacher educators, research scholars working in the field. All these statements were framed to access the willingness of student teachers towards the module. In this way 24 items were prepared initially out of which five items were open ended which were kept to bring qualitative improvements in the scale.

b) Item selection: The list of items so prepared was reviewed and the items which were overlapping or repeated were dropped. Then the draft was given to a language expert and the items with ambiguous or wrong language were modified or dropped altogether. Then the items were given to a panel of five experts with a request to mark or drop any item that was found unsuitable. The experts, so consulted were Senior Professors from education as well as Psychology from Kurukshetra University (K.U.) and Punjab University (P.U.). In this procedure five more items were dropped, subsequently, the items were administered on a small group of student-teachers to know if the items were understandable to them or not. The items which were not understandable or creating confusions were dropped altogether. Ultimately the final draft of the scale was left with only 14 items.

c) Item Analysis- One important aspect in the construction of the scale is item analysis. It is concerned with item difficulty. Item difficulty is taken in terms of proportions and item
discrimination of individual, completing the items successfully. But in this scale, the items were analyzed adequately in pre-tryout stage. Items were modified and substituted a number of times till they were found to be sufficiently productive and capable of generating adequate response. It was more based upon the judgment of the researchers as well as the related competent persons. Viewpoints of the examinees during initial and tryout stage were also duly considered. The final draft was further subjected to the process of validity and reliability.

Reliability & Validity

The reliability and validity of the scale was established in order to determine its utility and efficiency. The sample of 25 student-teachers was selected from a training college.

Reliability - It was established through test-retest method. The trainees who were given the module during the try out stage were subsequently given the willingness scale. The gap between the first administration and second administration was only a week. The trainees were expected to rate the statements on five point scale. The stability of the scale was determined through Pearson correlation between the means of scores for pre test and post test i.e. the correlation between the mean scores of first and second administration. The correlation was significant (0.81). The reliability coefficient for the scale implies that the scale is stable.

Validity- The validity of the test is concerned with what the test measures and how well it does that. The ‘face’ validity is employed in selection of items. As a test is said to have face validity when it appears to measure whatever the author had in mind, namely what he thought he was measuring. The face validity of the scale was determined through discussing the statements with the experts in the field. On the basis of their unanimous suggestions and agreement, the face validity of the scale was established.

4.2.3 Development and Standardization of Reaction scale

The feasibility of any model or method depends upon how the participants trained in that particular model/method react towards it. An unfavourable reaction would mean that that it is difficult to introduce that method. So it is very important to know what the reaction of the participants is towards the method. For this purpose Passi and Sansanwal (1987) prepared reaction scale for various models. On the basis of this the reaction scale towards the lateral thinking module was developed and standardized. The scale was constructed to see the reactions of the examinees towards the module. It consisted of three parts. Part one included questions regarding the identifying data of the examinee. It included columns like name, age,
qualifications etc. The second part deals with the instructions regarding the use of the scale. It also informs the examinees about the response mode. Part three contains questions regarding the module. There are 19 questions in form of statements, the answers of which can be given by ticking any of the options like strongly agree, agree, undecided, disagree and strongly disagree. Procedure and standardization of the scale is given in the preceding paragraph.

Preparation of preliminary draft: First the blue print of the scale was prepared, which after passing through the stages underneath, formed the first draft of the scale. These stages are:

a) Item formulation
b) Item selection
c) Item analysis

Description of these stages is given below:

a) Item Formulation: The items were formulated from different sources like relevant literature, discussion with teacher educators, research scholars working in the field. All these statements were framed to access the reactions of student teachers towards the module. In this way 29 items were prepared initially.

b) Item selection: The list of items so prepared was reviewed and the items which were overlapping or repeated were dropped. The draft was given to a language expert and the items with ambiguous or wrong language were modified or dropped altogether. Then the items were given to a panel of five experts with a request to mark or drop any item that was found unsuitable. In this procedure five more items were dropped, subsequently, the items were administered on a small group of student-teachers to know if the items were understandable to them or not. The items which were not understandable or creating confusions were dropped altogether. Ultimately the final draft of the scale was left with only 19 items.

c) Item Analysis- One important aspect in the construction of the test is item analysis. It is concerned with item difficulty. Item difficulty is taken in terms of proportions and item discrimination of individual, completing the items successfully. But in this scale, the items were analyzed adequately in pre-tryout stage. Items were modified and substituted a number of times till they were found to be sufficiently productive and capable of generating adequate response. It was more based upon the judgment of the researchers as well as the related competent persons. Viewpoints of the examinees during initial and tryout stage were also duly considered. The final draft was further subjected to the process of validity and reliability.
Reliability & Validity

The reliability and validity of the scale was established in order to determine its utility and efficiency. The sample of 25 student-teachers was selected from a training college.

Reliability – The test-retest method was considered to be most suitable with the reaction scale. The trainees who were given the module during the try out stage were subsequently given the reaction scale. The gap between the first administration and second administration was fifteen days. The trainees were expected to rate the statements on five point scale. The stability of the test was determined through Spearman Brown formula between the means of test scores for pre test and post test i.e. the correlation between the mean scores of first and second administration. The correlation was significant (0.81). This much high reliability coefficient for the scale implies that the scale is stable.

Keeping in views the factors of incidence, behavior, maturity and mortality of the sample, the split half technique was not used because 1) The statements were not arranged according to the difficulty level. 2) The number of statements in the scale was not too many.

Validity- The ‘face’ validity method was employed to validate the reaction scale. As a scale is said to have face validity when it appears to measure whatever the author had in mind, namely what he thought he was measuring. The face validity of the scale was determined through discussing the statements with the experts in the field. On the basis of their unanimous suggestions and agreement, the face validity of the scale was established.

4.2.4 Interview

Qualitative evaluation of the module required some face to face interaction with the student-teachers. To do the same interviews of six student-teachers were held. These student-teachers were selected on the basis of their post test scores. Two student-teachers who scored highest marks in lateral thinking test and two student-teachers who scored lowest marks were chosen for the interview. Two student-teachers who gained highest i.e. the difference between post-test scores and pre-test scores of them was maximum, were also selected. Standardized open ended interview was held. The exact wording and the sequence of questions were pre-decided. But the questions were worded in a completely open ended format. To keep the interview effective, great care was taken in developing the rapport. The initial task of securing the confidence and cooperation of subject was done with great sensitivity.
**Interview Structure:** The interview was framed in a structured form and the questions and their sequence was predefined. Still every care was taken in bringing comfort and flexibility for the interviewee. The subjects were separated in a way that they get no chance of interaction with already interviewed candidate. They were convinced that the answers were quite confidential and will have no aftereffects on them, whatsoever. The observations were manually recorded. But main focus was kept on their emotions, reactions, anxiety or enthusiasm. The directions of their answers decided the further course of the interview. The views about the module were confirmed in the end again.

Validity: To make the interview valid, the content validity was used. The critical judgment of the experts in the field of education and thinking was taken to select the essential questions.

Reliability: The reliability or the consistency of the response was evaluated by restating a question in slightly different form at a later time in the interview. The questions of the interview were found to be sufficiently reliable and valid.

**Case-studies:** To analyze the responses of the interviewees, complete case studies were prepared. For the same, data was collected from the teachers, friends along with the responses from interviews and the direct observations.