Chapter IV

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CHAPTER IV

PREPARATION OF THE PACKAGE

4.0 Techniques to develop Creativity

"Imagination is more important than knowledge, for knowledge is limited while imagination embraces the entire world," says Albert Einstein. "If imagination is truly more important than knowledge, then the means by which imagination can be applied to the development of creative products should need special attention." (Arthur Vangundy).

To enhance imagination and nurture creativity certain methods and procedures can be followed. These methods or procedures are called the techniques to develop creative thinking.

Following are some of the techniques to foster creative thinking.

4.1 Observations, checklists and question checklists

According to John Arnold, in any educational process four key words are important namely question, observe, associate and predict. The same words are important for the creative process too. Questioning is basic and fundamental. The creative process starts with the question. According to Arnold, one should follow certain steps in observation "To be properly educated for innovation then we must be aware of some of the problems associated with observing and we must try to avoid the pitfalls
of preconception, projection and rigidity improved by past experiences. We should take a number of different looks at things, observe in the broadest context possible and always be on the lookout for the unexpected. Our observation must be combined to form the new unity that we call invention."

An observation must be accurate, minute, significant, relevant, comprehensive and should stimulate other processes of thinking, inquiry, inference, imagination and also action.

Following strategies should be used while observing an incident, event or phenomenon:

1) All the senses should be used.
2) All the possible aids should be used.
3) Many angles should be taken into consideration.
4) In certain other observations the background should also be considered.

There are also eleven aspects of observation process which are useful for making an observation.

**Checklist of goals of observation process**

i) Components, parts, organs, divisions, aspects
ii) Properties, attributes, characteristics
   - Interrelationships among components - properties
   - Construction, composition, pattern arrangement
   - Functions, working mechanism
- Processes, interaction with stages phases
- Changes, transplantation taking place
- Reactions to different conditions factors, variables
- Significance, role principle implication
- Class type group, community to which it belongs
- Deviations from the type normal, the common, the conventional, the unexpected

Socrates, (469 -399 BC) the great philosopher, encouraged the method of questioning to seek knowledge among the people of Greece.

Arthur Careen² (1985) has described 4 classification systems for questions of which the first one is more important in the field of training in creativity.

1) Convergent and divergent
2) Bloom’s taxonomy
3) Critical thinking
4) Multiple talents

Alex Osborn³ has given the question checklist in his book "Applied Imagination" which is famous and intensively used in the field of creativity.

Osborn proposes seventyfive idea spurring questions which are useful in individual ideation or brainstorming sessions. The checklist containing these questions is given below.
Checklist for new ideas (also known as scamper technique)

1) Put to other uses?
   New ways to use as is? Other uses if modified?

2) Adapt? What else is like this? What other ideas does this suggest? Does past offer a parallel? What could I copy? What could I emulate?

3) Modify? New twist? Change meaning colour, motion, sound, odour form, shape? Other changes?


9) Combine? How about a blend, an alloy, an assortment, an ensemble? Combine units? Combine purposes? Combine appeals? Combine ideas?

George T. Land\(^1\) has added two more categories to it.

1) Benefit - Safety, faster power, longer life more accurate easier maintenance convenience, appearance, cheaper specifications, wearability, lubrication, breakage, transprotability, rigidity, adaptability, reliability, legality, shipping stability, adhesion cohesion looking.

Robert Eberle \(^1\)(1972) describes the scamper model based on this check list and explains its uses.

As a form of intellectual calisthenics the scamper technique is capable of

1) Developing group spirit
2) arousing curiosity
3) stimulating involvement and
4) providing strategies for creative listing and the development of imagination
Richard Suchmann (1962, 66) developed an inquiry training model, to train children to inquire scientifically. The major goal of the method was to help students to develop intellectual discipline necessary to search out data, process it and apply logic to it and thereby determine casual relationship among phenomena.

The inquiry session begins with the presentation of discrepant event. This is achieved by showing a silent film of the discrepant event. When the discrepancy is clear to the pupils, they gather information about the event by asking questions for verification. When students become aware of the properties of the data, hypothesis is formed. The students test it with the experimentary questions. This helps them to see relationships between different variables and thereby arrive at simple cause effect - relationship.
4.2 Attribute listing

This is a useful technique for designing or redesigning a specific product or service or activity. The technique was developed by Robert Crawford (1954) of the University of Nebraska. According to Crawford, magic inspiration is not the only or even major source of creativity. Much creativity arises from changing the attribute of an object or an activity or from grafting on to the object or an activity an attribute or attributes of some other object or activity.

Crawford has summarised the principles of all attribute listing as follows-

1) Creation is not Inspiration alone. It is largely the adaptation and experimentation.

2) Creation is not just mechanically combining different products or ideas. It is a useful modification of an attribute or assimilation of the attribute of other things.

3) In trying to modify the current attribute of an object, it is desirable to search for concrete alterations.

4) Creativity can be systematically studied by looking first for closely related substitutes of the current attributes and then progressively going in for more and more far out alternatives.
5) Creation is not just stealing of ideas. It is a continuing stream of modifications suggested by ideas in use which result overtime into greatly changed products or objects.

Attribute listing is a technique that promotes a clearer view of qualities, specification, characteristics, limitations and attributes of a problem, to allow for an easy change and development of new ideas through the change. Attribute listing can be done by an individual, children or combined with informal brainstorming in group work.

In attribute listing an attempt is first made to list the basic but modifiable attributes or properties or specifications of a particular object or activity. Then an attempt is made to generate alternatives to the current attribute or specification. Very often it may be useful to list abstract attributes of a concrete object or activity. This may help in generating more ideas than of concrete attributes are listed.

4.3 **Morphological analysis**

This technique was developed by the famous physicist and astronomer Prof. Fritz Zwicky (1969). It is a creative adaptation of what mathematicians describe as Matrix Analysis. It involves stating two or more components of a problem, whereas attribute listing or check list techniques focus on combination. In morphological analysis focus is on the principles of combination. The existing data on parts of a problem is combined in new ways to discover original ideas or solutions.
Steps in the morphological analysis

1) The problem to be solved must be very concisely formulated.

2) All of the parameters i.e. the basic dimensions or components of the problem that might be of importance for the solution of the problem given, must be localised and analysed. The attributes of each parameter are listed.

3) The morphological box or multidimensional matrix which contains all of the potential solution of the given problem is constructed.

4) All the solutions contained in the morphological box are closely scrutinized and evaluated with respect to the purposes that are to be achieved.

5) The optimally suitable solutions are selected and are practically applied.

An agenda, part of which can be represented as a morphological matrix

a) Usual representation of the agenda

Minutes
1) Matters arising
2) Use of the gas/liquid chromatography apparatus
3) Use of the infra-red spectrometry systems
4) Use of the ultra-violet spectrometry systems
5) Use of the atomic absorption (AA) spectrometer
6) any other business

b) Two dimensional representation of the idea generation stages of the agenda

**Existing analytical services**

<table>
<thead>
<tr>
<th>Matters arising</th>
<th>GLC</th>
<th>IR</th>
<th>UV</th>
<th>AA</th>
<th>Others</th>
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<td>Uses Faster service - modified/better service computerised results</td>
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<td>Upgrade operations</td>
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<td>Other suggestion</td>
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The more sophisticated the matrix the more important it becomes to derive the dimensions rigourously. In these cases the intuitive process may be replaced by a synthesis described by M. S. Allen who uses matrices as methods for stimulating creative thought.

Allen suggests the following steps in a systematic procedure for developing a morphological analysis.

1) Break down the problem into smaller aspects, each written on a card.
2) Leave the problem for a while giving the subconscious mind an opportunity to work on it. (Invention period)
3) Return to the problem and add any extra ideas that may arise on to additional cards.
4) Examine the cards and build up groups of them which are related.

5) Continue synthesizing the groups into a small number (no greater than 7) until important and distinct elements are obtained (dimensions).

6) Set out each dimension in a representation as in the given figure.

7) Examine the various combinations by moving the strips relative to one another.

Optional representation of four dimensional matrix

Allen's morphologizer for representing a four dimensional matrix

<table>
<thead>
<tr>
<th>D1</th>
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<th>D4</th>
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</table>

4.4 Brainstorming Technique

Brainstorming was developed as a method of generating ideas by an advertising executive Alex Osborn in the late 1930's. He described his methods in an important and definitive book called "Applied Imagination" in which he quoted the following dictionary
definition of the verb ‘brainstorm’ to “practise a conference technique in which a group attempts to find a solution for a specific problem by amassing all the ideas spontaneously contributed by its members.”

Brainstorming technique concerns with creative problem solving process which consists of three phases -
1) Fact finding
2) Idea finding
3) Solution finding

Osborn recommended brainstorming for the second idea finding phases of creative problem solving. The two major principles of brainstorming are -

1) Deferment of judgement
2) Quantity breeds quality

The four major rules are -

1) Criticism is ruled out.
2) Freewheeling is welcomed.
3) Quantity is wanted.
4) Combinations and improvements are sought.

1) **Deferment of judgement** - Thinking, according to Osborn, involves both a judicial mind and a creative mind. The former, analyses compares and chooses whereas the latter
visualises, forsees and generates ideas. The judicial mind puts the brakes on the creative mind and these brakes need to be removed so that ideas can be generated. Instead of literally deferring judgement, we are in reality, using limited criteria thinking, dependent on the way we state the problem.

2) **Quantity breeds quality** - The rationale for this dictum originates in associationistic psychology which assumes that our thought or associations are structured hierarchically. The most dominant thoughts in this hierarchy are those which are most habitual, common or usual, hence safest and most acceptable to others. It is necessary to get through these conventional ideas if we have to arrive at original ones.

4.5 **Selecting A Brainstorming Group**

Osborn recommended a group of approximately ten people, half of whom are experienced 'core' participants. The group is conducted by two leaders.

The group should represent as many disciplines as possible who will be able to understand the problem and contribute to it. The total time available for brainstorming should be organised so as to permit at least an hour and a half warm up leading up to the actual generation. A period of problem redefinition can be included at the end of the warm-up.
At some stage of the warm-up procedure the leader explains how the group will be expected to behave while generating ideas. The essentials of each idea should be captured, more convenient way being to write down, while generating the ideas, on a flipchart. Trigger sessions form an important aspect of the brainstorming session. A trigger session is a group idea generation process in which members work independently for a period producing a list of ideas. At the end of a given time each person reads out his list generating stimuli for the rest of the group to produce some ideas. A strict time schedule has to be set.

There are a few variations of Osborn method which can be introduced according to the nature of the problem and capabilities of the group. The variations are:

1) Wildest idea technique
2) Reverse brainstorming

Once the idea generation session is over, the evaluation procedure starts, where careful consideration should be given to each idea.

46 Synectics

It is a term which has come to mean the practice of a set of procedures introduced and developed primarily by Synectics One, an American consultancy organization. The name was coined by W J J Gordon, a co-founder of the company to describe a process leading to new insight through bringing together elements that are normally unrelated.
‘Synectics’ is a complex rapidly changing body of knowledge and their account in no way be considered a definite one. Gordon, after an intensive research, suggested that individual creativity was associated with certain psychological states, which, if they could be induced, could increase the probability of creative breakthrough.

Synectics as a method of group thinking requires five or seven members from different disciplines anticipating collectively to think over and find the solution to a problem. In this method founders have devised systematic ways of accessing and harnessing the preconcious. The preconcious mind does not think logically but it thinks analogically, associatively and visually. The principle mechanisms used in synectics are the use of several different kinds of mind stretching analogies and a good deal of fantasizing.

Synectics in operation depends heavily on two mechanisms namely, making the strange familiar and making the familiar strange by using analogies.

**Direct Analogy** - A direct analogy is a straightforward comparison of two parallel facts or concepts from different environments. Thinking in terms of direct analogies has led to important technical and scientific discoveries.

**Group Fantasy Analogy** - (G.P.) One method of producing material during the excursion is for the group to
build up a single fantasy picture that is possible but not necessarily related to an aspect of the problem. The fantasy in which everyday constraints are broken and thus new ideas are produced.

**Personal Analogy (P)** - In the personal analogy stage of an excursion, members of the group try to imagine what it feels like to be the object under consideration. When a high level of identification takes place, the results are evocative and prove to be useful stimuli for deeper understanding of the concept. The exercise also seems to have a cohesive effect on group interactions. Most successful demonstrations of personal analogy steps have arisen when the problems are of engineering or design nature.

**Synectic Analogy Or Book Title** - The symbolic analogy stage is one sub routine which can be included as part of the excursion of a synectics session. The group members attempt to search the concept under discussion in an evocative way. The phrase preferably expresses the essence of the problem in an original way often containing an element of paradox.

The whole problem solving process including the uses of analogies and metaphor and then force-fitting them to the problem to obtain the view point of the solution is described by both Gorden and Prince.
The synectics approach has been utilized successfully in business and industry.

4.7 **Forced Relationships**

This technique is explained by Feldhusen and Treffinger (1985). The technique of forcing relationship is an associative thinking activity, which helps to develop the ability to see unusual uses for things and the combination of ideas from different viewpoints. The technique has four major approaches which are summarised below. These are, listing techniques, catalogue techniques, focussed relationships and arbitrary forced relationships.

i) **Listing Techniques** - In this technique the problem statement is presented to the students. A list of unrelated objects is then presented or generated by the teacher or children. This list has no relationship to the problem stated and may in fact be produced before the introduction of the problem in order to lessen the tendency to choose the related objects. The children take each object on the list in turn and associate it with the problem statement. The objects do not need to be related. The relationship should be driven by a free association method. They have to state the first relationship that comes to mind. By doing this, judgement of the relationship is initially deferred. After all the relationships have been recorded the students go back through the list and evaluate the ideas for possible modification, development and implementation. Evaluation of the responses should be recorded with a positive or
negative sign. A third run through the responses serves as a planning stage to begin development of the ideas.

ii) **Catalogue Techniques** - This technique is much like the listing technique. The problem is stated first. However, objects to be used in association with problem solutions are drawn randomly from a catalogue. The catalogue is opened at random and the students can use any object, as seen there, in creating a solution. The objects are then forced to fit the problem statement. The same steps of evaluation development and implementation are then followed as in the listing technique.

iii) **Focussed Relationships** - Focussing relationships follow the same line as the catalogue or listing techniques. However, the relationship of the objects to the problem statement is not completely random or arbitrary. The objects which will be forced to the problem statement should be preselected and in some way be relevant to the problem.

iv) **Arbitrary Forced Relationships** - Arbitrary forced relationships do not involve the use of a problem statement. All that is needed is a growth of arbitrary words, objects or ideas. Two objects are selected at random and forced together. Ideas that are produced using this technique, can then be developed.

These techniques can be used in almost any problem situation, whether it is related to the subject matter or to other classroom
activities. They provide excellent experience in associative thinking and help children become better creative thinkers and problem solvers.

4.8 **Lateral thinking**

While distinguishing between different types of thinking Edward de Bono\(^*\) coined the term “lateral thinking” (1967) It means, seeking solutions to some problems by unorthodox or apparently illogical methods.” The key word is ‘apparently’. The methods may seem “illogical” in terms of normal logic but are derived from the logic of patterning systems where for example provocation is a necessity. This outlook emphasizes the searching for different approaches and different ways of looking at things.

With vertical thinking one takes a position and one seeks to build on that basis. The next step has to be related and logically derived from where you are at this moment. With “lateral thinking” we move “sideways” to try different points of entry. We can use various methods including provocation, to get us out of the usual line of thought.

**Diagram** - Vertical Thinking  
**Diagram** - lateral thinking

![Diagram - Vertical Thinking](image-url)  
![Diagram - lateral thinking](image-url)
Lateral thinking has very much to do with perception. In lateral thinking we seek to put forward different views. All are correct and all can co-exist. The different views are not derived from each other but are independently produced ‘Lateral thinking,’ like perception, is very much concerned with ‘possibilities’ and what might be.”

So the term ‘lateral thinking’ can be used in two senses, one of which is specific and the other more general. ‘Specific’ indicates a set of systematic techniques used for changing concepts and perceptions and generating new ones.

The term ‘general’ indicates exploring multiple possibilities and approaches instead of pursuing a single approach.

It is obvious that there is a strong overlap between the general definition and perceptional thinking. In a sense lateral thinking is perceptional thinking.

The principles of lateral thinking are:

1) Recognition of dominant polarizing ideas.
2) The search for different ways of looking at things.
3) A relaxation of the rigid control of vertical thinking.
4) The use of chance.

Edward de bono describes various ways or methods to practise the skill of lateral thinking e. g. -
1) The intermediate impossible.
2) Random juxtaposition.
3) The reverse method.
4) Analogies.
5) Reliable generation of alternatives.
6) Different ways of looking at things.
7) Practice in design.
8) Challenging assumptions etc.

4.9 **Creative Problem Solving - (CPS)**

Several models of problem solving have been developed under the name creative problem solving. CPS is not a single technique but a complex process which involves various techniques mentioned and described earlier.

Earlier attempts to develop concepts of CPS were done by Osborn, Parnes etc. According to Osborn (1961) CPS consists of three phases -

1) Fact finding
2) Idea finding
3) Solution finding

He recommended brainstorming for the second phase.

Parnes (1967) in his creative behaviour workbook describes a training programme for CPS which contains 16 sessions. According to Parnes, there are five steps of CPS, namely
1) Fact finding
2) Problem finding
3) Idea finding
4) Solution finding
and
5) Acceptance finding

The 16 sessions involve practice in various techniques and processes like

1) Sensitivity to problem
2) Redefining the problem
3) Brainstorming
4) Forced relationships
5) Evaluation of ideas
6) Acceptance of solutions
7) Demonstrations of total CPS processes
8) Improving observations by using visual patterns and describing category
9) Practice of total process
10) Use of manipulation category involving Osborn’s checklist of questions
11) Solution finding
12) Practice of total process
13) Acceptance finding
14) Own problem working
15) Practice of above procedures
and
16) Review of the whole programme
Angelo M Biondi (1975) in his article 'Creative Problem Solving from Holding to Free Flight' explains five steps of CPS in detail and analyses the problems as analytical problems, judgement problems, and creative problems. To evaluate the ideas for the selection of the best solution, he describes various criteria like effect on:

1) Objectives
2) People
3) Costs
4) Tangible values
and
5) Time

Torrance and Myers (1970) presented another model in their book 'Creative Learning and Teaching.' According to them, the steps of CPS are:

1) Sensing problems and challenge
2) Recognising the real problem
3) Producing alternative solutions
4) Evaluating ideas
and
5) Preparing to put ideas into use

The third step above involves use of other techniques mentioned earlier.
Many developments were made in defining and teaching CPS. The latest development was done by Isken & Treffinger\(^8\) (1985). It involves six steps:

1) Mess finding
2) Data finding
3) Problem finding
4) Idea finding
5) Solution finding
and
6) Acceptance finding

Guilford\(^9\) (1977) explains the close relation between problem solving and creative thinking. He proposes a structure of intellect problem solving model (SIPS model) and prepares SIPS model. It is an information processing model involving the fine mental operations - Cognition, memory, divergent production, convergent production and evaluation.'

Carl Gregory (1967) in his book ‘Management of Intelligence’ describes nine steps of scientific problem solving (SPS) along with the creative aspects. These steps are:

1) Deciding an objective
2) Analysing problems
3) Gathering data
4) Organizing data
5) Inducting
6) Planning
7) Prechecking
8) Activating plans
and
9) Evaluating

Step 1, 2 and 3 are related to the preparation stage. Steps 4 and 5 are related to incubation, insight or illumination and steps 6, 7, 8, are related to the verification stage of the creative process.

4.9.1 Little Known Creative Problem Solving Techniques

Stanley S. Gryskiewicz (1976, 1978, 1980) and others developed a model of CPS at the Centre for creative Leadership which is called ‘Funneling Applied creativity’. It contains three funnels or phases

1) Cultural constructions stifling creativity
2) Idea generation
and
3) Evaluation of ideas resulting in a stronger solution

Arthur Vangundy (1980) has described little known CPS techniques which are just listed here

1) Split main comparisons
2) Rational algorithms
3) Bionics
4) Brain writing
5) Brain sketching
6) Trigger sessions

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The following variations are given by Horst Geschka
Baltttle Institute Germany (1979)

1) Method 6 - 3 - 8 also called as Recorded Round
Robin
2) Brain writing pool
3) Pincard technique
4) Gallery method
5) Collective notebook method
and
6) Idea Delphi

Common to all these methods is that ideas are written down
on a sheet of paper rather than expressed verbally. The
group members receive the sheets by certain prescribed
mechanisms and use previously written ideas to stimulate
even more.

Horst Geschka¹ (1979) lists some more techniques like

1) Synetics excursion
2) visual synetics
3) Scanner technique, which are methods of creative
confrontation. Gotz Schande lists the techniques like
i) Semantic intuition
ii) Tilmag method and
iii) Stimulus analysis
In addition to these techniques hundreds of books, instructional materials, articles are published for developing creative abilities, e.g.

1) Feldhusen and Traffinger have published the list giving a brief information of these books in their book “Creative Thinking and Problem Solving” (1985)
2) Gary Davis and Houtman S. G. Thinking Creatively (1968)
3) Joseph Mason (1957) - How to develop ideas (article)
4) Tree Kagan (1962) Methods of furthering new ideas and
5) O. R. Seitz (1974) Training for creativity


4.9.2 Models of creative learning and enrichment

Following are the four models which reflect creative learning.

The models are
1) Feldhusen and Kolloffs 7(1978) The purdue three stage model for enrichment
2) Renzullis 8(1977, 78) Enrichment Triad Model
3) Treffingers 9(1980) creative learning model and

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4.10.1) The Perdue Model -

Stage I - Developing basic divergent and convergent thinking skills and affective responses, teacher leads short term articles e.g. fluency, flexibility originality, elaboration logic, critical thinking, values classification, self understanding.

Stage II - Developing higher level cognitive strategies work study production skills. Students take more initiative e.g. creative problem solving, research method, library skills, time management, interviewing, ‘enquiry techniques, writing.’

Stage III - Developing independence in research and creative production. Students take initiative, teacher service as resource person and guide e.g. experimental research, writing reports, formal presentation, extended synthesis projects creative performance.

II) Enrichment Triad Model by Renzulli (1977-78)

The study of eminent persons suggested that an interaction exists among the three basic trials

1) Above average ability
2) Task commitment
   and
3) Creativity
It is this interaction rather than any single trait or additive factor that results in superior performance.

This model represents an attempt to integrate the findings on the characteristics of eminent persons into an overall design of programming for gifted and talented students.

**Type 1 enrichment - General exploratory experiences**

Type 1 enrichment consists of those experiences and activities that are designed to bring the learner into touch with the kinds of topics or areas of study in which he or she may have a sincere interest.

**Type 2 enrichment - Group training activities**

Type 2 enrichment consists of methods, material and instructional techniques and are mainly concerned with the development of thinking and feeling processes such as critical thinking, problem solving, reflective thinking, enquiry training, divergent thinking, sensitivity training, awareness development and creative or productive thinking.

**Type 3 enrichment - Individual and small group investigations of real problems**

Type 3 enrichment consists of activities in which the youngster becomes an actual investigator of a real problem or topic by using appropriate methods of enquiry.
4.10.2 Treffinger Creative Learning Model (1980)

**Cognitive**
- Independent Inquiry, Self Direction.
- Resource Management, Product Development, "The Practising Professional".

**Cognitive**

**Cognitive**
- Fluency, Flexibility, Originality. Elaboration, Cognition and Memory.

**Level III**
- Involvement in Real Changes

**Affective**
- Internalization of Values, Commitment to Productive Living Towards self-actualisation.

**Affective**

**Affective**

**Level I Activities** - Include many enjoyable and popular activities for students such as brainstorming, attribute listing and the scamper technique.

**Level II Activities** - Students learn and practise more complex methods and systems for creative thinking and problem-solving e.g. problems in such programme as olympics of the mind or future problem solving with such group exercises as CPS for kids (Eberle and Stanish in 1980) problem solver.

**Level III activities** - Students develop confidence and competence in dealing with real problems and challenges.

4.10.4 An Instructional Model For Enhancing Incubation By E.Paul Torrance (1979, 90)

This three stage model provides for an introductory phase
which arouses anticipation and heightens expectation. A second phase which deepens involvement and commitment and goes beyond the superficial and a third phase which keeps the thought processes going and results in increased chances of successful incubation.

The fundamental purpose of the first stage of the model of instruction is to heighten anticipation and expectation and to motivate learners to try to see connections between what they are being asked to learn and something meaningful to their lives. Fifteen activities are suggested for implementing the first stage.

In the second stage, heightened anticipation must turn into deepended expectations. Several different patterns of processing information have been found to be facilitative during this stage. These are

1) Digging deeper
2) Looking twice
3) Listening for smells
4) Listening / talking to a cat or crossing out mistakes
5) Cutting holes to see through
6) Cutting corners
7) Getting into deeper water
8) Getting out of locked doors

Fourteen learning activities are suggested for listing, about the kinds of information processing described above. The
information processing strategies for the third stage are -

1) Having a ball
2) Singing in one's own key
3) Building sand castles
4) Plugging in the sun
5) Shaking hands with tomorrow

Twenty four learning activities which facilitate the achievements of the goals of the third stage are listed. Torrance concludes that no longer incubation be regarded as a regressive thought process or as a chance matter. It should be regarded as a higher level thought process that goes beyond logical rational processes and that can be enhanced through practice and instruction that encourages higher states of consciousness.

The above discussed, are various techniques. Some of which are followed in carrying out the training programme.

4.11 Importance of Training

The process of educating children is evolving from teacher determined instruction to the development of alternative forms of education. Training is one of such activities. The objective of training is to bring about the desired change in the pupil. The objective is achieved by following various paths.
4.11.1 **Significance of the Package**

Instructions in creative thinking and problem solving have long been characterized by a group or total class of activities. But in carefully planning participatory activities students are able to exercise their own creative and problem solving abilities. The high quality instructional material involves carefully planned instructions and planned activities.

Use of media and computers in preparation and development of learning packages have been given various names. Instructional material, contract packages, self learning or for training by an instructor etc. Researches have already established that these learning packages are quite useful in teaching basic concepts of the subject. It is also important to recognize that they can be used to teach creativity and problem solving. (E. P. Torrance 1976).

During the past decade, enormous amount of instructional material has been prepared for use of creative and gifted children.

Feldhusen and Treffinger\(^{15}\) (1980) Canes and Collins\(^{16}\) (1980) evaluated a great quantity of these materials for the purpose of developing creative thinking and problem solving skills among gifted students.

Feldhusen & Treffinger (1977) suggested a criterion for selecting instructional material and offered guidelines for creating “Teacher Planned” instructional material. Torrance E. P. and some of his associates, Black and Torrance,
Torrance and Torrance have advocated the use of different models for creativity and problem solving process as a basis for instructional material.

On the Indian scene there is some effort being done in the development of such material. The subject areas are science and mathematics. The field of the languages is so far neglected as compared to these subjects.

Educators and researchers have tried to search for the model in order to prepare instructional material. Most frequently used and successful model for creative learning was A. S. Osborn's (1963) brainstorming model which was then refined by Barnes and others.

4.12 Glaser's Model and its adaption in the present research

Glaser\(^\text{17}\) (1962) has restitured a model for preparing instructional material. In the present study for the frame work, the same model has been modified a little and used.

The flowchart for the modified model is as below:

- Drawing Conclusions
- Assessment of Response
- Implementation of training program
- Assessing Entree behaviour
- Construction of the problem
- Planning Instructional Objectives

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4.12.1 *Explanation of the steps in the Flow chart*

i) **Planning Instructional Objectives**

The rationale behind constructing the package was to give training to the students in convergent and divergent productions.

ii) **Construction of writing the items**

Various items were constructed to make an integrated package. The construction of these items was not an easy task. Each item required a lot of thinking and consideration. Items were thought of and discussed with the guide and the subject experts in Marathi language. Some items were retained and some omitted. Thus every item was thoroughly dealt with. The whole package was shown to the subject experts and was carefully scrutinized. Thus the final package was made.

iii) **Assessing the Entree Behavior**

While the training programme was on, there was continuous monitoring of the student behavior. After each item was explained, it was seen that the students had a clear idea about their involvement and action. The students were asked to express their doubts and they were cleared with proper explanation.
iv) **Implementation of the Training Programme**

As explained in Chapter III the programme proceeded the same way. Some minor adjustments were made. But as such the rigidity of the routine was followed.

v) **Assessment of the responses**

In each training period some specific time was marked for discussions regarding the responses. Unusual responses were read and the students were shown appreciation for their behavior.

vi) **Drawing Conclusion**

Once the programme was over, the data was analyzed and the conclusions drawn.

4.13 **Theoretical Basis Behind Making Of A Package**

Cuillford\(^{(24)}\) (1956, 1959, 1966) has conceptualized creativity in terms of mental abilities involved in creative achievement in his well-known structure of the intellect. He saw creative thinking as clearly what he categorized as divergent production. He defines divergent production as the generation of the information where the emphasis is upon variety of output from the same source. (Innovation, Originality, Unusual Synthesis or Perspective) Included in the divergent thinking category are the factors of
fluency, flexibility, originality and elaboration. He has concluded that creative thinking cannot be equated with convergent thinking. He asserted that the redefinition abilities and sensitivity to problems are also important in creative thinking. He has also included the idea of convergent production as a part and parcel of creativity. Convergent production is the other kind of productive thinking. Like divergent production, it is also concerned with retrieval of items of information from memory storage for use in answering questions and solving problems. Where as in divergent production a number of alternative answers are wanted, in convergent production one answer is adequate and will ordinarily satisfy the requirements of a question or a problem. Here only one answer is considered correct. Convergent production is the area of logic tight deductions. It is true that one may encourage oneself in much divergent production en route to the right answer in a convergent production task.

4.14 Guilford’s S. I. Model

Guilford’s structure included 120 abilities but it was modified and now includes 180 abilities. These abilities are outcomes of 6 contents x 6 operations x 6 products. The model is a three way classification of intellectual abilities designed to encompass and organize intellectual aptitude factors. The three dimensions of the model specify

1. The Content
2. The operation of a given kind of intellectual activities
3. The Product
While following these two modes of thinking the brain stores information. Guilford has divided the information or contents into four types.

One of the important facts about the information is that it is constructed by the brain. It is easy to believe that the idea 'tree' is a product of one's brain activity. The idea does not exist in the object alone although it is assumed that there is an object out there that calls forth the idea when the eye and brain are exposed to it. The truth of the matter is that the figural information that one gets from the object is also manufactured by one's brain, coupled with activity of the eyes and optic nerves. The brain decides the incoming nervous impulses. There is re-structuring in a new language and some kind of facsimile of the original source object.
This is the visual figural information, it has not only shape and texture, but has also boundary lines and internal organization.

The "Behavioral" abilities are important for the people who have to deal effectively with others. The third kind of information is "Symbolic". Symbols represent something else, they are signs and tokens. Most common symbols are composed of letters or numbers. A letter or number (for e.g A, B, 4, 5) that is seen in print is first of all some visual figural information. It has shape and sign as well as orientation. But when a number, letter or printed word is recognized as a standing for something else, or when numbers or letter's are manipulated like in mathematics, they become symbols.

The Semantic information is different from visual - figural information. Visual - figural information is translated into semantic information which enables a person to do much more with the object.

The term "Semantic" comes from the field of semantics which is concerned with meanings connected with words. This kind of information could have been called "Verbal" since most of the meanings have words attached to them. But many meanings exist without word labels, for e.g a young child who cannot still communicate with the family members. This action of his, certainly contains some semantic information. Even some speechless animals like
dogs, monkeys appear to have semantic information. Thus the semantic information may not be verbalized but it has some meaning into it.

Semantic information becomes an important attribute in any creative activity. Mapping of the world too is done with the help of semantic information and from this mapping a course of action is designed. Symbolic information also, is transferred into semantic forms and then into verbal symbolic form and the process of communication starts. This process is very vital in any creative activity.

The present research is regarding verbal creativity and therefore, the training package involves semantic content.

2. **Operations**

There are six kinds of intellectual operations regarding each content.

1. Cognition
2. Memory
3. Divergent Production
4. Convergent Production
5. Comparing and Judging Information
6. Evaluation
- **Cognition**

Discovering, knowing and understanding are all instances of the cognition operation.

- **Memory**

Various forms of information are stored in the brain. Remembering and recall are two functions of memory.

- **Divergent Production Abilities**

Once information has been cognized and stored by the organisms it must be retrievable under many different conditions that require its usage during performance of a future task. When a task is one that requires many alternative retained bits of information which confirm to task specifications, the production of information retrieved to satisfy the many alternate specifications is called divergent production abilities. In transformation category, divergent production abilities are more easily recognized as flexibility factors i.e. ability to produce alternative changes.

Generation of information from given information where the emphasis is given upon variety and quantity of output from the same source, this operation is most clearly involved in aptitudes of creative potential. It is obvious that this is the rationale behind choosing divergent production for the preparation of the verbal package.
- **Convergent Production Abilities**

Convergent production is the other kind of productive thinking. It is also concerned with retrieval of items/information from memory storage for use in answering questions and solving problems. Where as in divergent production a number of alternative answers are wanted, in convergent production only one answer will ordinarily satisfy the requirements of the question or a problem. Here only one answer is considered correct. Convergent production is the area of logic-tight deductions.

3. **Product**

The kind of structures that information takes are called “products”. The “products” are constructed by brain, where the different kinds of content are regarded as codes or languages. The products are something like parts of speech within a language. The products are outcome of some content using the specific operation. It means when the solution is found out by the subject it fits in either of the products given below.

There are six kinds of products (Units)

1. Unit
2. Class
3. Relation
4. System
5. Transformation
6. Implication

All these six units were chosen for writing the items in verbal package.

A diagramatic representation of the above discussed concept is given below.

Following are some of operations which were used while the preparation of the verbal package.

i. **Cognition of Semantic Transformation (CMT)**

Definition - It is the ability of being aware of changes of various kinds, such as movements or other changes in objects, in interpretations of
THE STRUCTURE OF INTELLECT MODEL

Figural
- Symbolic
- Semantic
- Behavioral
- Contents

Products
- Units
- Classes
- Relations
- Systems
- Transformations
- Implications

Operations
- Evaluation
- Convergent Production
- Divergent Production
- Cognition
- Memory

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someone's behaviour in the spelling of words in the familiar objects.

In the literature some words have different meanings in different context. It is called pun.

The Sample Item - In the verbal package some words are stated which have more than one meaning e.g. पत्रे, करे.

ii. **Convergent production of semantic transformation (NMT)**

Definition - 1) It is an ability to recognise the elements of a structure in such a way that they will have new functions.

2) It is also an ability to choose the right kind of object to fulfill the need. It is also an ability to name or point out the object for the particular use.

The sample item - वाचक एवं विद्याश्रेष्ठी शोधयासाठी —

iii. **Convergent production of Semantic units (CMU)**

Definitions - It is the ability to recognise the elements of a structure in such a way that they will have new functions
1. The sample item - Fill in the Blanks

2. Divergent production of Symbolic units (DSU)

To measure this ability Guilford has suggested a test called as "Word Fluency" in which the students are asked to write as many words as possible containing the specified letter as suffix or as prefix.

The sample item - the words starting with Marathi alphabet "क" words ending with "क".

v. Divergent production of Semantic Units (DSU)

Definition - It is the ability to state many things in a particular class.

The sample item - "Write as many blue objects in nature as you can"

vi. Divergent Production of Semantic Classes (DMC)

Definition - The content of any information can be classified or grouped in different ways.

The Sample item - Some words are given below
which can be grouped in more than way.

e.g. Boat, airplane, rabbit, fly, fox

i. airplane, fly (Fly in the air)
ii. Rabbit, fox (Animals)
iii. Boat, Airplane, (Manmade)

Another example of a test for DMC is of different nature, e.g. List all the uses of a plastic bag.

DMC makes significant contributions to inventions and creative thinking in general.

vii. **Divergent Production of Semantic Relations (DMR).**

**Definition** - It is an ability to complete a relationship between two units.

*The sample item* अफ़िलिमाणे — गार वारसकिं जुळा

viii. **Divergent Production of Semantic Systems (DMS)**

**Definition** - It is an ability to plan and organize various complex things
DMS tests have been in the form of composing sentences.

e.g. राजा, घोर  
रामने मेहराना पकड़े  
राजा अ चौर ह्याची ताजीं झाले.

ix. **Divergent Production of Semantic transformation** *(DMT)*

**Definition** - It is an ability to transform the content in an unusual way.

*The sample item*  Here are some sentences with blanks are given. The blanks can be filled with various different types of words.

i. फादामन अपां चुटगा.
ii. फादामन पशी पउता.
iii. फादामन मुखा पउता.

Giving titles to the paragraphs

x. **Divergent Production of Semantic Implications** *(DMI)*

**Definition** - It is an ability to state or suggest more from the given information. It is also an ability to extend more.
The sample item - A word is given e.g. Teacher

Obe has to note down many words connected to it.

The developed verbal package consisted of the following operations and the number of items thereof as below.

<table>
<thead>
<tr>
<th>Operation</th>
<th>No. of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMT</td>
<td>1</td>
</tr>
<tr>
<td>NMT</td>
<td>1</td>
</tr>
<tr>
<td>CMU</td>
<td>2</td>
</tr>
<tr>
<td>DSV</td>
<td>2</td>
</tr>
<tr>
<td>DMU</td>
<td>3</td>
</tr>
<tr>
<td>DMC</td>
<td>1</td>
</tr>
<tr>
<td>DMC</td>
<td>1</td>
</tr>
<tr>
<td>DMC</td>
<td>1</td>
</tr>
<tr>
<td>DMR</td>
<td>5</td>
</tr>
<tr>
<td>DMS</td>
<td>5</td>
</tr>
<tr>
<td>DMT</td>
<td>2</td>
</tr>
<tr>
<td>DMT</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total No. of Items</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

Thus the verbal package was built and given its final shape.

The detailed package appears in Appendix "A"
1) Vangundy  
Comparing little known creative problem solving techniques in creativity week III proceedings, NC Centre for Creative leadership.

2) Arnold John  

3) Arthur Carin and Sind R. B.  
Teaching Science through discovery Charles E. Merril Publishing Company, Columbus.

4) Osborn  

5) George T. Land  

6) Robert Eberle  

7) Richard Suchman  
The elementary school training programmes in scientific inquiry University of Illioins press.

8) Edward De Bono  
Lateral Thinking Pelican Penguin, N.Y.
9) Angelo M. Biondi
Creative problem solving in “Trends and perspectives for the professional manager.

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Creativity Retrospect and prospect Journal of Creative behaviour.

11) Gryskiewiz S.

12) Renzulli
The "Enrichment trid model", Mansfield Centre, CT. Creative learning press.

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Encouraging Creative learning for the gifted and the talented Ventura CA LII Publications.

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An instructional model for enhancing incubation, Journal of Creative behaviour.

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Developing Creative Thinking, The Purdue Creativity Programme, Journal of Creative behaviour.

16) Canes and Collins
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18) Guilford’s S. I. Model

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