CHAPTER III

DESIGN OF THE STUDY

Personality Variables and Their Tools for Measurement

Intellectual Ability Variables and Their Tools for Measurement

Treatment Modes

Method of Analysis - Statistical

References
A review of previous researches presented in Chapter II has shown that while some studies give sufficient evidence of interaction between personality and mental ability variables and different treatment modes, other have failed to do so. The failure to obtain evidence of interaction may be due to inclusion of those personality and mental ability variables that do not seem to require different treatment modes or the treatment modes employed differ only in minor details so as to provide unsatisfactory evidence of interaction. Tobias (1976) is also of this view. After a review of all researches, he writes about the studies which have failed to provide any evidence of interaction.

...in such studies, both the attribute dimensions and the treatments have not been as carefully thought out as they might be. For example, the alternative instructional treatments, the inputs, have often differed from one another in only minor details ..... the input differences may not have engaged different abilities and hence are unlikely to interact with the aptitude dimension".

The present study has attempted to include those personality and mental ability variables which seem to require different treatment modes. The treatment modes have also been selected keeping in view the fact that they seem to require sufficiently different personality and mental ability variables for success through them. The review has also shown that lack of the evidence of interaction may also be due to non-employment of suitable control
variables. Therefore, suitable control variables have also been incorporated in the design of this study. The present study thus seeks to investigate the interaction between personality variables (Anxiety and Extroversion) and mental ability variables (Intelligence and Creativity) and three treatment modes namely, linear and branching styles of programming and expository method of teaching. Intelligence and previous achievement in the subject (Mathematics) have been employed as control variables. The rationale for including these variables has been presented in the following pages.

**Personality Variables:**

There is both theoretical and empirical support for the position that learning effectiveness is a function of the interaction of treatment modes and personality (Greer, 1977). Leith (1968) while emphasizing the importance of personality variables for assigning treatment modes write, "Learning and personality are inter-related. Whether one method or another of arranging and presenting task will help or hinder depends on the pupil's personality". Accordingly, the incorporation of personality variables seems important for determining the treatment mode best suited for an individual. The review of related researches (Chapter II) has shown that personality variable such as anxiety, extroversion-introversion, neuroticism, confidence,
self sufficiency, achievement motivation, have been studied for interaction effects. Sufficient evidence of interaction has, however, been obtained for the personality variables: anxiety, extroversion-introversion, neuroticism and achievement motivation etc. Obviously, it is not possible to employ all these variables in a single research study. Ordinarily, it becomes very difficult to cope with data, if more than three or four variables are employed. Since the present investigation proposes to study the interaction effects of personality as well as mental ability variables and also to include intelligence and previous achievement in the subject as control variables, it was not considered feasible to include more than two personality variables in the present design. Extroversion-introversion and anxiety have been found to be fairly important for assigning treatment modes. Therefore, these personality variables have been employed in the present study. The rationale of inclusion of these personality variables is presented below.

(1) Anxiety:

Anxiety has emerged (Chapt. II) as an important variable determining achievement. Different levels of anxiety call for different treatment modes for optimal achievement. Primes and Allinsmith (1964), Traweek (1964), Leith (1969), Brown and Leith (1975), Patel (1978) and
others after exhaustive investigations concluded that anxious students performed better through structured or supportive methods of teaching like programmed instructions and teacher centred methods than unstructured or exploratory method of teaching. erhartzte comparative case with which the linear programme can be attempted and constant rein-
forcesents incorporated in it, make it suitable for high anxiety students. his view is also supported by Tobias (1973). he writes,

The reduced difficulty of programs, their tighter organization and the reduction of students uncertainty while studying a programme would suggest that these instructional modes ought to be especially benefici-
for the performance of high anxiety individuals.

jarr (1962) also quotes sorber who says, "learners who are quite anxious..... seems to be one who profit a great deal from the instruction (programmed instruction)." According to him,

It seems reasonable to suppose that since the machine instruction (programmed instruction) provides for many reinforcaments, the learner's degree of anxiety might be reduced...... The result should be an increase in rate of learning.

harc it can be safely inferred that structured learning situation like programmed instruction is suited to the highly anxious students whereas the unstructured learning situation like expository method is more suited to low anxiety students.
(ii) Extroversion/Introversion:

The review of related studies (Chapter II) shows that extroversion/introversion seems to play an important role in assigning treatment modes for optimal achievement. Leith and Brown (1970) after a study of extroversion/introversion and treatment modes also concluded that these children require different treatment modes for optimal achievement. The research studies by Davis and Leith (1968), Leith (1969) and others show that introverts are likely to be profit from a structured learning situation which programmed instruction provides whereas extroverts profit more from an unstructured learning situation like expository method of instruction. After a review of a number of A/I studies, Leith (1973) concludes, "introverts are likely to be more successful when they follow a carefully sequenced, high prompted structure of learning" and extroverts, "appear to learn better in less formal discovery situation". This according to him seems due to the fact that extroverts have a greater tolerance for ambiguity and lack of structure in the teaching situation, whereas introverts are more inclined to be responsive to unambiguous and clearly structured situation.

Reer (1978) also points out the fact, "Studies in personality have indicated that the extroverted child, who is outgoing and social, would learn best through contact with other people, his teacher, his peer group; and that the
introverted child, the withdrawn, the emotionally disturbed, would be happiest with the individualised learning situation which programmed learning sets up. So perhaps programmed learning is more suitable learning situation for children who display traits of introversion than for those who are extroverted. Thus it seems logical that structured and unstructured teaching modes should be assigned for introverts and extroverts respectively for maximum achievement.

The linear programme employed in the present study provides a structured, carefully sequenced and highly prompted learning situation and as such it is likely to suit the high anxiety and introverted students. This is also supported by Leith (1964). He pointed out, "we might suppose that introverted and perhaps anxious pupil will do well with linear programme." Expository method as proposed in the present study is a unstructured and unprompted learning situation, therefore, it is likely to suit the low anxiety and extroverted students. The branching programme provides a fairly structured but comparatively less prompted learning situation as compared to linear programme and thus it may suited the average persons on the introversion-extroversion and high and low anxiety dimension. Therefore, these personality dimensions were considered fairly important for assigning the treatment modes employed in the present study.
TOOLS FOR MEASUREMENT:

(1) Indian Adaptation of Eysenck's 'Eysenck's Personality Inventory:

Eysenck's 'Eysenck's Personality Inventory has been adopted by Kapoor and Jalota for Indian students. It is a questionnaire designed to measure the two factors of personality which have been found to account for most of the variance in the personality domain - extroversion and neuroticism. The extroversion (E) scale represents the continuum of social extroversion-introversion. High scores on the scale reflect sociability, outgoingness and care-freeness. The neuroticism scale reflects emotional instability, anxiety proneness and the tendency to develop neurotic symptoms under stress. This 'E.P.I. is suitable for normal and abnormal persons. This inventory can be used as a group or an individual test for persons of ages 15+. The M.P.I. consists of two scales - long scale and short scale. Items from serial number 1 to 12 given on the front page of the test booklet make the short scale, while all the 48 items of the booklet constitute the long scale. Although no time limit is enforced in the testing, the short scale takes about 3 to 5 minutes. The long scale takes about 15 to 20 minutes. Each of these items is answerable by a tick mark ' ' in one of the boxes.

The test gives a maximum score of 48 on Extroversion
and also 48 on neuroticism. The 48 items of the test booklet are distributed among the two personality dimensions and scored as shown in the following Table No. 1.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Item No. in the booklet</th>
<th>No. of items</th>
<th>Max. Raw Score</th>
<th>Correct Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introversion Long Scale</td>
<td>1, 4, 5, 8, 9, 12, 20, 26, 28, 32, 34, 38, 42, 44, 46, 48.</td>
<td>16</td>
<td>32</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>14, 16, 18, 22, 24, 30, 36, 40</td>
<td>8</td>
<td>16</td>
<td>No</td>
</tr>
<tr>
<td>Short Scale</td>
<td>1, 4, 5, 8, 9, 12</td>
<td>6</td>
<td>12</td>
<td>Yes</td>
</tr>
<tr>
<td>Neuroticism Long Scale</td>
<td>2, 3, 6, 7, 10, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47.</td>
<td>24</td>
<td>48</td>
<td>Yes</td>
</tr>
<tr>
<td>Short Scale</td>
<td>2, 3, 6, 7, 10, 11.</td>
<td>6</td>
<td>12</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Thus, there are 24 items for the assessment of introversion/extroversion and 24 items for neuroticism on the long scale. Each item is either an exclusive measure of introversion/extroversion or neuroticism. Each item is designed to elucidate three alternative responses namely,
Yes, No and Undecided. Each item yields a score of either 0, 1 or 2. A scoring key has been provided for this purpose. The total composite extroversion or neuroticism score is simply the sum of raw scores on all the 24 items in the two dimensions. For the full scale the mean neuroticism score for the male and female groups combined was 23.2 with a S.D. of 10; this corresponds with English norms of 19.9, S.D. 11 (Syserock, 1959). For the extroversion scale the mean combined score was 27.8, S.D. 6.2, this compares with English norms of 24.9, S.D. 9.7. There were no difference of any significance between males and females. The correlation between N and E for the long scale was -0.223 which is in good agreement with the English norms. The data suggest that this Indian version of the N.E.I. gives results no essentially different from those obtained with original version in England.

In the present study the extroversion/introversion items of Syserock's Rodsley Personality Inventory (Hindi adaptation by Kapoor and Jalota) have been employed as a measure of extroversion/introversion dimension of personality.

(11) Sarason's General Anxiety Scale for Children (GASC):

Sarason's general anxiety scale for children (GASC) is a questionnaire designed to measure the anxiety level of school going children. The whole questionnaire has fourty
five items in all relating to general anxiety of the children. Various areas from which the items have, generally, been chosen for the scale are the following:

(1) Health, physical appearance and injury.
(2) Afraid from animals and strange things.
(3) Success or failure in work.
(4) Worries regarding family members.
(5) Social relations and social approval.
(6) Worries regarding the future.
(7) Afraid in loneliness.

The response 'Yes' to any question is the indication for the presence of anxiety whereas the 'No' is the indication for the absence of anxiety.

The split-half reliability of the scale was found to be 0.79. Validity data was obtained by correlating the scores obtained on this scale with Minha's anxiety scale. The validity coefficient comes out to be 0.73.

MENTAL ABILITY VARIABLES:

Since different individuals manifest different profiles of learning ability, the success of a given treatment mode depends on the extent to which it is accommodated to mental abilities of the learner. Torrance (1965) after a review of his own and few other important studies concluded that students with differing mental abilities profit
differently with different treatment modes. He writes,

> There are now many convergent lines of research that make it clear that when a teacher changes methods of instruction or the nature of instructional materials that children with different kinds of mental abilities become the star learners and non-learners.

Thus mental ability variables seem to be important for assigning treatment modes for optimal learning. The review of related researches (Chapter II) shows that intelligence and creativity have emerged as important mental ability variables for interaction effects. Therefore, these mental ability variables have been employed in the present study. The rationale for including these mental ability variables is given in the following pages.

(1) Intelligence:

Intelligence has been found to play prominent role in learning through different treatment modes (Chapter II). Feisler and Stern (1967) writes, "Mental maturity (Intelligence) should be considered in deciding what types of differential instruction to use in teaching certain skills". Hartley (1965), Singh (1977) and others have concluded that linear programme is most suitable for low intelligence pupils in comparison to branching programme, which is best suited for high intelligence ones. This seems quite logical because for low intelligence pupils, as Leith (1968) points out, "Learning is facilitated by small steps, careful sequencing, cueing, immediate confirmation, low error rate
and so on which linear programme provides. The average intelligence pupils achieved higher with expository method of teaching in comparison to linear and branching styles of programming (Singh, 1977). Thus it can be concluded that high intelligent pupils require a less structured and open situation whereas low intelligence pupils require a thoroughly structured one.

(ii) Creativity:

Creativity has been found to play a significant role in achievement through different treatment modes. Torrance (1965) after critically evaluating the MacDonald and Raths (1964) study pointed out, "Pupils of varying levels of creative thinking ability... are possibly best taught by varying procedures". Gotkin and Nassa (1963) reported that for highly intelligent pupils who had worked through programme (linear), it was less creative students who made significantly greater achievement in comparison to high creative. Torrance quotes a personal communication from Gotkin and Nassa which says that in interviews conducted with the children they found that the highly creative children expressed a strong dislike to linear programme while low creative children liked linear programme. This seems fairly logical. Torrance (1965) also writes,

*Highly creative children dislike this way of learning (linear programme) and failed to learn very much from it because it was contrary to their preferred or best way of learning. They dislike being forced...*
to make only tiny leaps because they are accustomed to making longer mental leaps and checking, testing and correcting their errors. The less creative children, however, prefer the safety of the tiny mental leaps and the authoritative feedback of their errors."

linear programme as compared to branching places stringent restrictions on independent and creative thinking and has been accused of curving original thinking and creativity (Torrance, 1965). The highly creative learners have been found to profit more from branching style of programming (Kapadia, 1972) whereas average ones achieve higher from expository method. Thus, it can be safely concluded that high creative pupils requires a less structured and open situation whereas low creatives requires a rigid and structured situation.

It can, therefore, inferred that highly structured and rigidly followed sequence situation like linear programme employed in the present study is more suitable for low intelligence and low creativity pupils. The branching programme, which is less structured and provide fairly independent learning sequence is more suitable for high intelligence and high creativity pupils. The expository method, a less independent than branching programme, employed in the present study may suit the average pupils on both intelligence and creativity dimensions of mental ability.
Therefore, these mental ability variables were considered fairly important for assigning the treatment modes employed in the present study.

**Tools for Measurement:**

(1) 

Wechsler's Mixed Type Group Test of Intelligence:

This is a standard tool for measurement of intelligence of school going children of age ranging from 11 to 17 years. This test has been prepared in a spiral-pumibus form providing selective form of items for both parts of the test - verbal and non-verbal on the lines of Wechsler-Bellevue scale of Intelligence. Each of the verbal and non-verbal parts consisted of 5 sub-tests each. They are as follows:

<table>
<thead>
<tr>
<th>Verbal Test</th>
<th>Non-Verbal Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Analogy Test</td>
<td>1. Analogy Test</td>
</tr>
<tr>
<td>2. Number Series Test</td>
<td>2. Arrangement Test</td>
</tr>
<tr>
<td>3. Classification Test</td>
<td>3. Classification Test</td>
</tr>
<tr>
<td>4. Vocabulary Test</td>
<td>4. Digit Symbol Test</td>
</tr>
<tr>
<td>5. Reasoning Test</td>
<td>5. Part Fitting Test</td>
</tr>
</tbody>
</table>

All these sub-tests are mostly saturated with 'g' factor. Test consists of items of varying difficulty levels, high discrimination power and with positive and high correlation with the total test scores. In each test only one correct answer is to be selected for one question from the
five alternatives given under each question. A score of one is awarded for each correct answer. No marks are deducted for wrong answer. Reliability of test was computed through various methods. They are presented below:

<table>
<thead>
<tr>
<th>Methods</th>
<th>Verbal</th>
<th>Non-Verbal</th>
<th>Full</th>
</tr>
</thead>
<tbody>
<tr>
<td>Split-half</td>
<td>0.91</td>
<td>0.81</td>
<td>0.88</td>
</tr>
<tr>
<td>Test-.test</td>
<td>0.89</td>
<td>0.82</td>
<td>0.86</td>
</tr>
<tr>
<td>Kuder-Richardson</td>
<td>0.90</td>
<td>0.80</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Validity of the test was obtained by correlating the scores obtained on the test and teacher's ratings. It was found to be 0.87 for full test, 0.86 for verbal test and 0.72 for non-verbal test. Correlation between the scores on this test and examination marks were also obtained. These correlations were 0.39, 0.36 and 0.3, respectively.

(ii) Jecar 'ehdi's Verbal Test of Creative Thinking:

This test battery is meant to identify creative talent at all stages of education except pre-primary and primary. The test is based on the Guilford's concept of divergent thinking ability. The divergent thinking abilities included are fluency, flexibility and originality. The whole test consists of the following four sub-tests:

1. Consequence Test
2. Unusual uses Test
3. Similarity Test - Relationship Test
4. Product Improvement Test.
The test-retest reliabilities of the factor scores on the total creativity scores are as below:

<table>
<thead>
<tr>
<th>Fluency</th>
<th>Flexibility</th>
<th>Originality</th>
<th>Total Creativity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.945</td>
<td>0.321</td>
<td>0.896</td>
<td>0.959</td>
</tr>
</tbody>
</table>

Inter-scorer reliabilities for the factor scores were found to range from 0.653 to 0.981.

The validity coefficient against the teacher ratings for each factor are given in the following manner:

<table>
<thead>
<tr>
<th>Fluency</th>
<th>Flexibility</th>
<th>Originality</th>
<th>Total Creativity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.40</td>
<td>0.32</td>
<td>0.34</td>
<td>0.39</td>
</tr>
</tbody>
</table>

All correlations are significant beyond 0.01 level.

CONTROL VARIABLES:

The review of researches presented in Chapter II shows that although some researchers have employed fairly important personality and mental ability variables but have failed to establish any interaction with treatment modes employed by them. This may partly be attributed to the lack of controls in their research designs. Variables other than those under study may have affected post-achievement, which should be controlled for dependable and reliable conclusion.

It is, therefore, necessary to employ controls in the study. The present study employs previous achievement in the
subject under study i.e. mathematics and intelligence as two control variables. The rationale for inclusion of these variables is given in the following pages.

(i) Previous Achievement in the Subject:

The ultimate objective of a well designed study is to control all the factors, other than those under study which are likely to affect the post-test scores. Thus, the variables like different aspects of personality, mental ability, i.e. achievement motivation should be controlled for dependable conclusions. Obviously all the measures cannot be controlled in a study like the present one. Previous achievement in the subject is not only due to learners’ mental ability but is also influenced by his personality, study habits, achievement motivation etc. Therefore, it was considered justified that this measure if employed as a control would perhaps take care of all the variables other than those under study. Therefore, previous achievement has been employed for this purpose in the present study. Flynn and organ (1965), Desai (1966), Noble (1967), Nai (1967), Khushdil (1968) and Patel (1978) have also employed previous achievement as a control variable in their studies. It was also considered that for more meaningful and dependable results, previous achievement in the subject matter area under study should be controlled because achievement in
different subject matter areas is affected by quite a
different sets of personality and motivational factors.
For example, achievement in language is largely influenced
by the socio-economic status of the family of the
learners whereas the achievement in subjects like math-
ematics is influenced by such personality variables as
persistence, study habits etc. Most of the research
workers who have employed this variable as a control in
their studies have used previous achievement in the subject
matter area under investigation for this purpose. Lessi
(1966) while investigating the relative merits of progra-
med learning and traditional approach in the teaching of
Gujarati compared the two sections on previous achievement
in Gujarati language. Khushdil (1968) while comparing the
integrated and traditional method in teaching of social
science to class VII, matched the groups on the scores of
previous achievement in social sciences. Dari (1967) also
matched the control and experimental groups on the basis
of previous achievement in general science for comparing
two different methods in general science. In the present
study, therefore, previous achievement in mathematics has
been employed as a control variable.

(ii) Intelligence:

Intelligence is considered as a single most
important factor determining academic achievement.
enroe (1950) while emphasising the fact, writes,

.....it is a truism to say that intelligence is of significance in most school situations.

Chaliwal (1971) is also of the same view. He says,

Intelligence is the single important factor accounting for variation in academic achievement, that it plays a major role in causing difference among individuals regarding their academic achievement.

Banreti - Fuchs (1978) very recently conducted a fairly exhaustive study to find out the relationship between intelligence and achievement in reading and mathematics of 275 boys and 263 girls. He obtains the value of coefficient of correlation for boys 0.82 and that for girls as 0.85. This shows that achievement is highly predictable on the basis of intelligence. Chaliwal (1971) also obtained a coefficient product moment correlation of 0.523 between intelligence and academic achievement. Hatch and Flint (1962) also found intelligence as the most important variable for prediction of attainment. Other investigators, Vidhu, 1968; Utcher, 1968; Srivastava, 1969; Jha, 1970; Arora and Shair, 1970; Sinha, 1970; Kessi et al., 1970; Sinha, 1972; Ohan et al., 1975; Contractor, 1975; Bhushan and Sharma, 1976; Singh, 1977; Seth, 1978 and many others have also obtained significant and positive relationship between intelligence and academic achievement. Therefore, this variable has also been employed as control variable.
TREATMENT MODES:

Quite a few researches reviewed (Chapter II) have employed single treatment mode for the purpose of establishing the interaction. Evidence of a negative or positive relationship in such studies does show that the treatment mode employed may be more suited for persons scoring high or low on the trait studied, but does not provide any evidence for assigning alternative treatment mode for the students who have failed to achieve high through that treatment. Tobiss (1969) also writes,

Studies of this kind are most seriously weakened by the fact that the instructional treatment is not varied. Then only one instructional mode has been employed little can be inferred about ATI's since the relationship might well differ with another instructional method.

So there is a need to employ more than one treatment mode in order to assign treatment modes to students of differing personality and mental abilities. Some investigators have employed more than one treatment modes and have mostly obtained significant interactions with them. The insignificant interaction obtained by some of them may be attributed to the fact that the treatments employed by them differed in such minor details so as not to warrant any interaction. Therefore, the treatment modes employed in any study should differ sufficient for any interaction to occur. Sheehan and Hambleton (1977) also
point out, "To substantiate interactions, future ATI studies will have to utilize treatments which are known to require different psychological processes". They further add, "Until an approach such as this is taken, teachers will not be provided with empirical guidelines for matching instructional alternatives to student aptitudes".

The present study, therefore, proposes to employ such treatment modes which are known to require different psychological processes and different aptitude pattern. The discussion presented in the preceding pages clearly shows that linear and branching style of programming and expository method of teaching require quite different personality and mental ability variables for success through them. In the present study, therefore, linear and branching styles of programming and expository method of teaching have been employed. Measures of central tendencies, a topic of high school statistics formed the subject matter of these instructional, treatment modes. The rationale for selecting this topic has already been presented in Chapter I (Introduction). A brief description of these treatment modes has been presented in the following pages.

(i) Linear Programme:

The linear method of programming was developed by Skinner, B.F. on the basis of 'Operant conditioning Theory
of learning'. The learner possesses a repertoire of responses - some of which are more likely to be made in a given situation than others - and these are of different degrees of complexity. In teaching something new to the learner it is possible, by reinforcing successive approximations to the response to be acquired, to lead him from a response already possessed, through a sequence of small progressive steps, to the new response. Only those approximations which lead to this goal are reinforced. With a human learner an immediate knowledge of results or an informative after effect is satisfying enough. Immediate feedback of information after a response has been made is an important feature of linear programming. The linear matter are designed to cause the student to emit the behaviours defined as the subject matter to be learned, piece by piece, rewarding each instance where in the student emits the desired behaviour. Linear programme by using various prompts make no explicit provision for errors by the student, since errors are, by linear theory, simply irrelevant to the learning process.

The format of linear programme is simple. A linear programme consists in presenting the subject matter in small segments called frames. Each frame provides a very short preparation of new materials. Following a frame, the student is desired to emit a response. He then compares
his written response to the correct response given. If
his written response matches the correct response, he
feels, thereby rewarded, the act is thus 'learned'. A
linear programme is a single path sequence in which all
students read and respond to the same material. Figure 1
shows a diagramatic representation of a linear programme.
The large circle is a frame which includes stimulus or
context, enrichment materials, prompt to facilitate
correct response and response. The small circle represents
the correct response. The learner after reading the frame
responds to the question and compares it with the correct
response. In this way the student proceeds from one frame
to the next and thus completes the programme.

Frame 1 — \( x \) — Frame 2 — \( x \) — Frame 3 — \( x \) — Frame 4

Fig. 1: Diagramatical representation of a linear
programme.

A linear programme on measures of central tendency
was developed and validated by the present investigator.
The development of this programme has been described in
Chapter IV.

(ii) Branching Programme:

The branching method of programming was developed
by Crowder. This method of programming makes no assump-
tion about the nature of learning theory or process. It is
not a theory about how education should be conducted rather it is a technique for preparing a written materials that will allow teaching to be more effectively and efficiently implemented.

The branching or intrinsic programming may be explained in this way: the student is given the material to be learned in small logical units. Each unit explain a concept, giving as many examples as possible. Immediately after he has read and digested one of these units he is given a short multiple choice test on it. The results of the tests are used to determine what next unit of information shall be presented to the student. The learner chooses one of the response. If he is wrong, he will be so informed, given a reason and offered further choices or presented with the original frame. Thus, theoretically a programme could be prepared which diagnosis errors and provides remedial instruction. If a pupil chooses correctly he may bypass all these frames or 'branches' and proceed quickly through the programme. In branching programme, the short test or questions serve primarily a diagnostic purpose and appropriate remedies are provided in the different branches. Figure 2 shows a diagramatic representation of a branching programme. The circle is a frame. In this diagram the main sequence is if no errors were made, is frame 1, 2 and 3. Depending upon the errors in answering the multiple choice question, branched along various
branching frames, such as frame No. 24, 25, 26 and 27. In this way the student proceeds from one frame to the next and thus completes the whole programme.

Fig. 2: Diagramatic representation of a branching programme.

A branching programme on measures of central tendencies was developed and validated by the present investigator. The development of this programme has been described in Chapter IV.

EXPOSITORY METHOD:

The expository method involves the presentation of the matter in such a way as to be intelligible to the pupil. The facts and the explanation of the facts are for the teacher the data of exposition. As a expositor, the business of a teacher is so to present his facts that they shall carry with them the explanation that appeals to him as satisfactory. The expository method as employed in the present study consisted a presentation of a concept verbally
to the students at the first instance. It was elaborated further by the help of suitable examples i.e. an inductive deductive approach was adopted. The teacher employed no audio-visual aid, only chalk and black-board was employed pertaining to a concept. The students were allowed to put questions freely if they failed to understand a particular concept. The whole sequence was presented in the form of an expository text which has been presented in Appendix B.

**Method of Analysis: Statistical**

A review of related researches presented in Chapter II reveals that a variety of 'statistical techniques' have been employed for investigating the interaction between learner characteristics and various treatment modes. In several studies the interaction has been studied by correlational and/or regressional analyses (Kapadia, 1972; Agarwal, 1976; Porter, 1962; Agarwal, 1978; Sheehan and Hambleton, 1977). They have computed simple Pearson's Product Moment Coefficient of correlation when investigating relationship between a single personological variable and two or more treatment modes. Sometimes other personological variables were considered important to influence the relationship between the variables under study and two treatment modes. For example, while studying the interaction of intelligence and two treatment modes, 'study habit' could be an important variable influencing
criterion scores. The influence of such variable should be controlled or partialled out. Some researchers have, therefore, employed coefficient of partial correlation for this purpose. If the regression lines, based on the coefficient of correlation, between the measures of the personological variable and criterion test scores for the different treatment modes do not cross, the interaction is called ordinal and if these lines cross, the interaction has been termed as disordinal. Ordinal interaction is of little value for assigning treatment modes to students of differing levels of ability and a disordinal interaction help in assigning alternative treatment modes to such students. To determine the utility of significant interaction (disordinal interaction), Johnson—Seyman Analysis (Johnson and Seyman, 1956; Johnson and Jackson, 1959) has been performed on each pair of treatment groups within each interaction. This technique helps to determine points within the range of observed scores on either sides of interacting score (or point) on the aptitude scale, where the predicted criterion scores are significantly different. The region between these two points is called 'region of non-significance'. On the basis of this region of non-significance the student can be assigned to either of the two treatment modes. However, an experience with this technique showed that in most cases the region of non-significance are so wide as to be of little practical value for assigning different treatment modes (Fattnoff, 1964).
ost of the ATI studies have employed treatment by level factorial design with analysis of variance. In these studies means of criterion scores obtained by students 'high' or 'low' on a personological variable have been compared for studying interaction. The significance of interaction has been ascertained by computing 't' values. Lubin (1961) made a distinction between two types of significant interaction. With reference to graph of means, a significant interaction effect is called ordinal when the treatment lines do not cross (Fig.3) and disordinal when the treatment lines do cross (Fig.4).

Some investigators interpret the crossing of treatment lines i.e. disordinal interaction as evidence for ATI i.e. students should be assigned differently to alternative treatments to obtain optimal educational payoff. Bracht and Glass (1968) have, however, recently modified Lubin's distinction by specifying that an interaction effect is operationally defined as disordinal only when the differences between alternative treatments at two levels of a personological variable are significantly different. For example, the interaction shown in Fig.4, considered disordinal on the basis of Lubin's criteria (1961), is not so according to Bracht and Glass (1968). In this figure, treatment A is significantly better for low ability (x) students but treatment B is not significantly better for high ability (y) students. Thus, the interaction in Fig.4
is not regarded as disordinal by Bracht and Glass because
of the non-significant treatment difference in the high
ability group. The standard set by Bracht and Glass (1968)
as evidence of disordinal interaction seems to be too high.
In a review of ATI researches conducted by Bracht and Glass
(1968) only 5 out of 90 studies could be considered dis-
ordinal on this standard. The present investigator while
considering the idea of disordinal interaction as fairly
sufficient evidence for assigning treatment modes feel that
if the difference between the alternative treatment is
significantly different even at one of the levels, then the
evidence is sufficient for the purpose of ATI. Therefore,
the studies in which the treatment lines cross and the
difference between the two treatments at any one of the
levels is significantly different, have been regarded as
sufficient evidence for assigning alternative treatment modes.

\[ \text{Fig. 3: Ordinal Interaction} \quad \text{Fig. 4: Disordinal Interaction} \]
As pointed out earlier very often the ATI studies require that one or more personological variables be incorporated in the research design in addition to the variable under study for the purposes of controls. A very common procedure of eliminating the effect of such control variables which may be presumed to be related to the variable under study consists in matching groups on individual to individual basis on the control variable. This is a fairly difficult procedure even when one control variable is involved. This type of matching for more than one variable quite often than not, results in a very drastic reduction of sample, rendering it unrepresentative. Walker and Lev (1953) point out the following objection to this procedure:

(1) It is usually very laborious. The search for closely matched cases often takes a very long time and the research worker quite properly feels that his energy could be better spent on something else.

(2) One or the cases, sometimes an alarmingly large number have to be eliminated because no match can be found. Thus sample size is reduced and reliability sacrificed.

(3) Very often the cases finally retained at the conclusion of matching process are not representative of either of the original populations.

The present investigator proposes to employ one or two
variables for the purposes of control. Therefore, it is likely to be very difficult to match the experimental and control groups. Analysis of covariance can help in this regard. Garrett (1971) also writes,

Covariance analysis is especially useful to experimental psychologists when for various reasons it is impossible or quite difficult to equate control and experimental groups at the start, a situation which often obtains in actual experiments. Through covariance analysis one is able to effect adjustments in final or terminal scores which will allow for differences in some initial variables.

The present study has employed analysis of covariance for studying the interaction of variables (Intelligence, creativity, anxiety and extroversion) and three treatment modes such as linear and branching programming and traditional method employing previous achievement and intelligence as control variables. The analysis would yield means on criterion measures for students high and low on the ability variables duly adjusted for the effect of control variables.

The flow chart of the procedure, employed in the present study, for testing an A.T.I. in a treatment by level factorial design can be presented in Fig.5.
Fig. 5: Flow chart showing the statistical procedure for testing ATI.
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