SUMMARY:

Learning effectiveness is a function of personality and mental ability variables of the learner and treatment modes. Therefore, for the optimal learning, treatment modes should be individualized, which implies that the treatment modes should be in accordance with personality and mental ability variables of the learner. Researches concerned with the interaction between treatment modes and personality and mental ability variables of the learner have been termed as ATI (Attitude-Treatment Interaction) or TTI (Trait-Treatment Interaction) studies. The present study is a modest attempt in this direction. In specific terms, the present study seeks to investigate the relationship between the following personality and mental ability variables as measured by the tools shown against each and achievement through linear and branching styles of programming and expository method of teaching.

(1) Anxiety — Measured at Carasen's General Anxiety Scale for Children (GASC).

(2) Extroversion — Indian Adaptation to Eysenck's Madesley Personality Inventory (MPI) by Kapoor and Jalota.

(3) Intelligence — Mixed Type Group Test of Intelligence by Throtra.

(4) Creativity — Non-Verbal Test of Creative Thinking by Isquor Mehdi.
Previous achievement in mathematics measured by junior high school marks in mathematics and intelligence, as measured above, have been employed as control variables. The present study is likely to help in assigning treatment modes to students of differing personality and mental ability variable/characteristics for optimal achievement.

Two programmes - linear and branching on 'Measure of Central Tendencies' (Statistics) suitable for high school students of Board of High School and Intermediate Education, P.P., were developed and validated for the present study. This constituted an important part of the present study. A pre-test consisting of items for measuring entry level behaviours and terminal behaviours was constructed to ensure that the students possess the required prerequisite behaviours and do not possess the terminal behaviour before starting instructions. A post-test consisting of only items measuring terminal behaviours served as a criterion measure.

PROCEDURE.

287 students studying in class IX of three Intermediate Colleges in urban areas of U.P. constituted the subjects of the present study. The students were administered the two measures of personality (anxiety and extroversion) and the two measures of mental ability (intelligence and creativity). The pre-test was then administered to ensure that the subject possessed the required entry level behaviours
and do not possess any of the behaviours which are proposed to be taught. Three groups of students from each of the above three schools were taught separately by linear and branching styles of programming and expository methods of teaching. The post-test was administered after the instructional programme. The post-test scores served as criterion measure.

The personality and mental ability scores and criterion scores of students from three institutions taught through each of the treatment modes were pooled separately. Thus, three groups were constituted each taught by one of the treatment modes. The three groups taught by different treatment modes were divided into high and low groups on the basis of the personality and mental ability scores. Comparisons were made between the high groups on any personality or mental ability variables taught by the three treatment modes to ensure that the groups were matched. Similar comparisons were also made for the low groups. In doing so, scores of some students had to be rejected. All the 't' values were insignificant showing thereby that the differences between these groups were negligible. Comparisons were also made between the high and low groups on each variable. All the 't' values were significant beyond 0.01 level which indicated that very significant differences existed between high and low groups.

Means of post-test scores obtained by students
and low on each personality and mental ability variables taught through different treatment modes were adjusted for previous achievement in mathematics and intelligence by means of analysis of covariance. Comparisons of these adjusted means were made for different pairs of treatment modes to study the interaction between different personality and mental ability variables and achievement through different treatment modes for assigning treatment modes for optimal achievement. For this purpose, graphs of adjusted post-test means of students high and low on any personality or mental ability variable for different pairs of treatment modes were constructed. If the two treatment lines crossed and the post-test means for students either high or low on any personality and mental ability variable differed significantly, the interaction was considered significant (disordinal). This was regarded as sufficient evidence for assigning treatment mode for optimal achievement.

CONCLUSIONS:

INTELLIGENCE-TREATMENT INTERACTION:

Table CIX presents the adjusted means and 'F' values for the difference between adjusted means of high and low intelligence students for different modes viz. linear and branching styles of programming and expository method.
### Table CCIX

Adjusted means and 'F' values for the difference between adjusted means of high and low intelligence groups taught through three modes.

<table>
<thead>
<tr>
<th>Intelligence</th>
<th>Linear Style Adjusted 'F' Value</th>
<th>Branching Style Adjusted 'F' Value</th>
<th>Expository Method Adjusted 'F' Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>48.34</td>
<td>55.92</td>
<td>41.18</td>
</tr>
<tr>
<td></td>
<td>24.51*</td>
<td>124.5*</td>
<td>0.25</td>
</tr>
<tr>
<td>Low</td>
<td>43.51</td>
<td>33.52</td>
<td>38.06</td>
</tr>
</tbody>
</table>

*Significant at .05 level.

It will be seen from the above table that 'F' values for linear as well as branching styles of programming is significant at .05 level for 28 degree of freedom which shows that there is significant interaction between intelligence and achievement through linear as well as branching style of programming. The high intelligence students achieved higher as compared to low intelligence students when taught through any of the above two treatment modes or styles of programming.

But the 'F' values for expository method is not significant at 0.05 level for 28 degree of freedom, which shows that the interaction between intelligence and achievement through expository method is not significant. However, high intelligence students achieved slightly higher through expository method in comparison to low intelligence ones.
The above analysis do not provide any evidence for assignment of treatment modes to the high and low intelligence groups. Comparisons were therefore, made of the achievements through any of the two treatment modes for either of the intelligence groups for assignment of treatment modes to the high and low groups of intelligence.

It will be seen from the above table CIX that while the linear style is better for low intelligence students in comparison to branching style, the branching style of programming has proved to be more effective for the high intelligence students in comparison to linear style of programming. The interaction is disordinal according to Lubin (1967), but is not so according to Bracht and Glass (1968) and the present investigator as the 't' values for the differences between achievement scores of linear and branching styles of programming for low and high two intelligence groups were 1.91 and 1.50 respectively, which are not significant at 0.05 level for 28 degree of freedom. The low intelligence student may be taught more profitable by the linear style of programming in comparison to branching style and the high intelligence students by the branching style of programming in comparison to linear style, but the evidence is not very sound. However, since the 't' value for the low intelligence students is significant at 0.1 level for 28 degree of freedom, such students may be taught more
profitably by the linear style in comparison to branching style of programming.

It will also be seen from the table CIX that expository method is better in comparison to branching style of programming for low intelligence students, the branching style is better in comparison to expository method for high intelligence students. The interaction is disordinal according to Lubin (1967) but is not so according to the Bracht and Glass (1968), as the 't' values for the difference between achievement of branching style and expository method for high and low intelligence groups were 2.77 and 1.08 respectively, of which the 't' value of 1.08 is not significant at 0.05 level for 28 degrees of freedom. However, according to the present investigator, the interaction is disordinal as the 't' value i.e. 2.77 at one of the end (i.e. high intelligence) is significant at 0.05 level for 28 degrees of freedom.

The high intelligence students may be taught through branching style of programming in comparison to expository method for better achievement but the evidence is not equally sound for low intelligence students as 't' value for low intelligence students is not significant even at 0.1 level for 28 degrees of freedom.

Furthermore, it will be seen from the table CIX that both high as well as low intelligence students have secured better through linear style of programming as compared to
expository method. The interaction is ordinal according to Lubin (1967), Brecht and Glass (1968) and the present investigator. Alternative treatments can not be assigned on the basis of this evidence.

**CREATIVITY-TREATMENT INTERACTION**

Table CX presents the adjusted means and 'F' values for the difference between adjusted means of low and high creative students for different treatment modes viz. linear and branching style of programming and expository method.

**TABLE-CX**

**ADJUSTED 'F' S AND 'F' VALUES FOR THE DIFFERENCE BETWEEN ADJUSTED MEANS OF HIGH AND LOW CREATIVE STUDENTS TAUGHT THROUGH THREE CODING.**

<table>
<thead>
<tr>
<th></th>
<th>Linear Style</th>
<th>Branching Style</th>
<th>Expository Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Creative</strong></td>
<td>Adjusted 'F'</td>
<td>Adjusted 'F'</td>
<td>Adjusted 'F'</td>
</tr>
<tr>
<td></td>
<td>mean Value</td>
<td>mean Value</td>
<td>mean Value</td>
</tr>
<tr>
<td>High</td>
<td>37.80</td>
<td>44.11</td>
<td>17.33</td>
</tr>
<tr>
<td></td>
<td>55.8*</td>
<td>0.35</td>
<td>4.34*</td>
</tr>
<tr>
<td>Low</td>
<td>50.17</td>
<td>39.58</td>
<td>66.08</td>
</tr>
</tbody>
</table>

*Significant at 0.05 level.

It will be seen from the table 'X that 'F' values for linear style of programming and expository method are significant at 0.05 level for 28 degree of freedom which shows
that there is a significant interaction between creativity and achievement through linear style of programming and expository method. The low creative students achieved higher as compared to high creative students when taught through any of the two treatment modes viz. linear style or expository method. But the 'P' value for branching style of programming is insignificant which shows that there is no significant interaction between creativity and achievement through branching style of programming.

The above analyses do not provide any evidence for assignment of treatment modes to the high and low creative students. Comparisons were, therefore, made of the achievements through any of the two treatment modes for either of the creativity groups for assignment of treatment modes.

It will be seen from the table CX that while the linear style of programming is better for low creative students in comparison to branching style of programming, the branching style has proved to be better for high creative students in comparison to linear style of programming. The interaction is disordinal according to Lubin (1967) but is not so according to Bracht and Glass (1965) and the present investigator as the 't' values for the difference of achievement scores between linear and branching style of programming for low and high creative groups were 1.64 and 0.94 respectively which are not significant at 0.05 level for 28 degree of freedom. The low creative students may be taught more
profitably by the linear style in comparison to branching style of programming and high creative students may be taught more profitably by the branching style in comparison to linear style, but the evidence is not sound. However, since the 't' value for low creative group is significant at 0.1 level for 28 degree of freedom such students may be assigned linear style of programming in comparison to branching style of programming for maximal achievement.

It will also be seen from the table CX that expository method is better in comparison to branching style for low creative students, the branching style is better in comparison to expository method for high creative students. The interaction is disordinal according to Lubin (1967). The 't' values for the difference between achievements of branching and expository modes for high and low creative groups were 4.05 and 3.63 respectively, both of which are the significant at 0.05 level for 28 degree of freedom. Thus the interaction is also disordinal according to Bracht and Glass (1968) and the present investigator. The low creative students may be assigned expository method in comparison to branching style and high creative students may be assigned branching style of programming in comparison to expository method for maximal achievement.

Furthermore, it will be seen from the above table CX that while the expository method is better than the linear style for low creatives, the linear style has proved to be
more effective in comparison to expository method for the high creative students. The interaction is disordinal according to Lubin (1967) but is not so according to Bracht and Glass (1968) as the 't' values for high and low creative groups taught by the two modes were 3.74 and 1.95 respectively, of which 1.95 is not significant at 0.05 level for 28 degree of freedom. According to the present investigator, the interaction is disordinal as the 't' value (i.e. 3.74) at one of the end (i.e. at high creative) is significant at 0.05 level for 28 degree of freedom. The high creative students may be assigned linear style in comparison to expository method for maximal achievement. But the evidence is not very sound for low creative students as the 't' value is not significant at 0.05 level. However, since 't' values (1.95) for low creative students is significant at 0.1 level, such students may be taught a little more profitably by expository method in comparison to linear style for better achievement.

ANXIETY-TREATMENT INTERACTION:

Table CXI presents the adjusted means and 'F' values for the difference between adjusted means of high and low anxiety students for three treatment modes i.e. linear and branching styles of programming and expository method.

It will be seen from the table CXI that 'F' values for linear style and expository method is significant, which shows that there is a significant interaction between anxiety
**TABLE-CXI**

Adjusted means and 'F' values for the difference between adjusted means at high and low anxiety students taught through three modes

<table>
<thead>
<tr>
<th>Anxiety</th>
<th>Linear Style</th>
<th>Branching Style</th>
<th>Expository Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adjusted 'F'</td>
<td>Adjusted 'F'</td>
<td>Adjusted 'F'</td>
</tr>
<tr>
<td></td>
<td>mean Value</td>
<td>mean Value</td>
<td>mean Value</td>
</tr>
<tr>
<td>High</td>
<td>53.31</td>
<td>36.09</td>
<td>84.87</td>
</tr>
<tr>
<td></td>
<td>5.9*</td>
<td>0.83</td>
<td>9.68</td>
</tr>
<tr>
<td>Low</td>
<td>39.60</td>
<td>41.55</td>
<td>-4.97</td>
</tr>
</tbody>
</table>

*Significant at 0.05 level.

and achievement through linear style of programming as well as expository method. The high anxiety students achieved higher as compared to low anxiety students when taught through any of the above two treatment modes. But the 'F' value for branching style is insignificant which shows that there is no significant interaction between anxiety and achievement through branching style of programming.

The above analyses do not provide any evidence for assignment of the treatment modes to the high and low anxiety students. Comparisons were, therefore, made of the achievements through any of the two treatment modes for either of the anxiety groups of assignment of modes to high and low anxiety groups.
It will be seen from the table CXXI that while the linear style of programming is better in comparison to branching style for high anxiety students, the branching style has proved to be better in comparison to linear style for low anxiety students. The interaction is disordinal according to the standard of Lubin (1967) but is not as according to Bracht and Glass (1968) as the 't' values for the difference between achievement means of linear and branching style of programming at low as well as high anxiety students were 0.27 and 2.532 respectively of which 0.27 is not significant at 0.05 level for 28 degree of freedom. According to the present investigator the interaction is disordinal as the 't' value (2.532) at high anxiety level is significant at 0.05 level for 28 degree of freedom. The high anxiety students may be assigned the linear style in comparison to branching style for better achievement but the evidence is not satisfactory for low anxiety students as the 't' value of this group is not significant even at 0.1 level.

It will also be seen from the table CXXI that expository method is better in comparison to branching style for high anxiety students and the branching style has proved to be better in comparison to expository method for low anxiety students for maximal achievement. The interaction is disordinal according to Lubin (1967). The 't' values for the difference between achievement of expository and branching
style for high and low anxiety students were 6.5 and 6.3 respectively, which are both significant at 0.05 level for 28 degree of freedom. Thus the interaction is also disordinal according to Bracht and Glass (1968) and the present investigator. The low anxiety students may be assigned branching style in comparison to expository method and high anxiety students may be assigned expository method in comparison to branching style of programming for better achievement.

Further, it will be seen from the table CXI that while the linear style of programming is better in comparison to expository method for low anxiety students, the expository method is superior in comparison to linear style for high anxiety students. The interaction is disordinal according to Lubin (1967). The 't' value for the difference between achievement means of linear style and expository method for high and low anxiety students were 7.3 and 8.2 respectively, which are both significant at 0.05 level for 28 degree of freedom. Thus the interaction, which is disordinal as per Lubin (1967), is also disordinal as per Bracht and Glass (1968) and the present investigator. The linear style may be assigned in comparison to expository method for low anxiety students and expository method may be assigned in comparison to linear style of programming for high anxiety students for maximal achievement.
EXTROVERSION-TREATMENT INTERACTION:

Table CXII presents the adjusted means and 'F' values for the difference between adjusted means of high and low extroversion students for linear and branching styles of programming and expository method.

**TABLE CXII**

ADJUSTED MEANS AND 'F' VALUES FOR THE DIFFERENCE BETWEEN ADJUSTED MEANS OF LOW AND HIGH EXTROVERSION STUDENTS TAUGHT THROUGH THREE MODES.

<table>
<thead>
<tr>
<th>Extroversion</th>
<th>Linear Style</th>
<th>Branching Style</th>
<th>Expository Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adjusted 'F' mean</td>
<td>Value</td>
<td>Adjusted 'F' mean</td>
</tr>
<tr>
<td>High</td>
<td>43.79</td>
<td>29.79</td>
<td>36.23</td>
</tr>
<tr>
<td></td>
<td>1.24</td>
<td></td>
<td>10.76</td>
</tr>
<tr>
<td>Low</td>
<td>44.34</td>
<td>52.91</td>
<td>41.53</td>
</tr>
</tbody>
</table>

*Significant at 0.05 level.

It will be seen from the table CXII that the 'F' values is significant only for branching styles of programming which shows that there is a significant interaction between extroversion and achievement only through branching style of programming. The low extroversion students achieved higher as compared to high extroversion students when taught through branching style of programming. The 'F' values for linear style of programming and expository method are both
insignificant which shows that there is no significant interaction between extroversion and achievement either through linear style of programming or through expository method.

The above analyses do not provide any evidence for assignment of treatment modes to the high and low extroversion students. Comparisons were, therefore made of the achievements through any of the two treatment modes for either of the extroversion groups for assignment of treatment modes to the high and low extroversion groups.

It will be seen from the above table XIII that while the branching style is better in comparison to linear style for low extroversion students, the linear style of programming has proved to be more effective in comparison to branching style for high extroversion students. The interaction is thus disordinal according to the criteria of Lubin (1967) but is not as according to Bracht and Glass (1968) as the 't' values for the difference between achievement score of linear and branching styles of programming for low and high extroversion students were 1.04 and 2.48 respectively which 1.04 is not significant at 0.05 level for 28 degree of freedom. According to the present investigator, the interaction is disordinal as the 't' value (i.e. 2.48) for one end (i.e. at high extroversion) is significant at 0.05 level for 28 degree of freedom. The high extroversion students may be assigned the linear style of programming in comparison to branching style of programming
but the evidence is not equally sound for low extroversion students.

It will also be seen from the table XII that while the branching programming is better in comparison to expository method for low extroversion students the expository method has proved to be more effective in comparison to branching style for high extroversion students. The interaction is disordinal according to Lubin (1967), but is not so according to Bracht and Glass (1968) and the present investigator as the 't' values for the difference between achievement scores of branching style and expository method for low and high extroversion students were 1.77 and 1.14 respectively, both of which are not significant at 0.05 level for 28 degree of freedom. The low extroversion students may be taught more profitably by branching style in comparison to expository method and the high extroversion students by the expository method in comparison to branching style, but the evidence is not very trustworthy. However, since 't' value for low extroversion students is significant at 0.1 level for 28 degree of freedom, such students may be taught more profitably by branching style of programming in comparison to expository method.

Furthermore, it will be seen from the table CXII that both high as well as low extroversion students have secure better through linear style of programming as compared to expository method. The interaction is ordinal according to
the standards of Lubin (1967), Bracht and Glass (1968) and
the present investigator. Alternative treatment can not be
assigned on the basis of this evidence.

SUGGESTIONS

Students with different personality and mental
ability variables should be taught through instructional modes
suited to them. The conclusions of the present study may be
employed by the classroom teacher for this purpose. The
following suggestions are being submitted in this regard.

1. Intelligence has been found to interact very significantly
   with linear and branching styles of programming which means
   that high intelligence students are likely to achieve
   higher as compared to low intelligence students when taught
   through either of these modes. But the interaction between
   intelligence and expository method of teaching is not
   significant. A comparison of students achievement through
   different pairs of treatment modes revealed that high
   intelligence students may be taught through branching
   style of programming and the low intelligence students
   through expository method of teaching for maximal
   achievement.

2. The interaction between creativity and achievement through
   linear style of programming and expository method is sig-
   nificant. Low creatives have been found to achieve higher as
   compared to high creatives when taught through these two
modes. Creativity has yielded insignificant interaction with branching style of programming. A comparison of student's achievement through different pairs of treatment modes revealed that low creatives may be taught through expository method of teaching and the high creatives through either of the programming styles employed in the study preferably the branching programme for maximal achievement.

3. General anxiety has been found to interact significantly with linear style of programming and expository method. High anxiety students have achieved better through these modes. General anxiety has not yielded significant interaction with branching style of programming. A comparison of student's achievement through different pairs of treatment modes revealed that high anxiety students may be taught through expository method and low anxiety students through either of the programming styles preferably the branching style. If the choice is between the two styles of programming, the high anxiety students may be taught through the linear style of programming and the low anxiety students through branching styles of programming.

4. The personality dimension extroversion/introversion has not yielded any interaction with either linear style of programming or expository method. However, the interaction between extroversion and branching style of programming is significant. High extroversion students achieve lower than the low extroversion students when taught through branching style of
programming. A comparison of student's achievement through
different pairs of treatment modes revealed that the high extro-
version students may be taught through linear style of progra-
ming and low extroversion students may be taught through
branching style of programming. The evidence for high extro-
version students is more dependable as compared to low extro-
version students in this regard.

5. The present study has employed 'Measures of Central Tendencies'
a topic of High School statistics as the subject matter of the
different instructional treatment modes employed. This subject
matter is highly structured and follows a regular sequence. The
result of the present study may be applied with caution to
other subject matter areas. The applicability of the conclusions
of the present study to other areas will depend on the simi-
arity of the structure of the subject matter of these areas
and the area investigated.

6. The conclusions of the present study may be generalized to
other instructional treatment modes. The treatment modes
employed in the present study range from a highly structured
teaching-learning situation provided by the linear programme
to an unstructured teaching-learning situation provided by the
expository method. The branching style seems to be intermediate
between these two situations. The generalization to other
treatment modes would perhaps depend upon the degree of
structured situation which a treatment mode provides.
SUGGESTIONS FOR FURTHER RESEARCH

1. The present study has employed only four (two personality and two mental ability) variables for assigning treatment modes. Variables like neuroticism, study habits, achievement motivation, cognitive styles etc. have also been found to interact significantly with some treatment modes but the studies for assignment of treatment modes to students high or low on these variables do not seem to have been attempted. Studies should, therefore, be undertaken to investigate the interaction between these variables and different treatment modes with a view to assign treatment modes for maximal achievement.

2. The present investigation has employed only three treatment modes. There are many other treatment modes which seem to require different learner characteristics for success through them. Treatment modes which are known to require different personality and mental ability variables for success through them should, therefore, be studied for interaction effects.

3. Patterns of classroom behaviours assessed through technique like 'Flander’s Interaction Analysis' have been found to have different associations with achievement at different levels when different learning activities are employed. Attempts do not seem to have been made to study the interaction of these patterns and achievement of
student's having different personality and mental ability characteristics. Attempts should, therefore, be made to study the interaction of different patterns of classroom behaviours and achievement of student possessing different personality and mental ability characteristics.

4. It is not one aspect of individuals personality that leads to success, but rather the interaction of different personality characteristics within the individual. For example, it may not be the introverts who achieve high on programmed learning task but the neurotic-introverts who may succeed best on it. Therefore, future ATI researches must take into consideration the interaction of different personality variables within the individual.

5. The present study has employed only 'Measures of Central Tendencies' a topic of high school statistics as subject matter of different treatment modes. A review of previous researches has shown that ATI may appear in one type of subject matter and not with the other. Researches should therefore, be undertaken to investigate the interaction between different treatment modes employing a variety of subject matter areas and different learner characteristics.

6. A review of previous researches has shown that variables like age, grade and sex play an important role in interaction between learner attributes and treatment modes.
Studies should, therefore, be undertaken to investigate the interaction between these variables and different treatment modes controlling important learner characteristics.

7. The present study has employed extreme group design with analysis of covariance for studying the interaction between learner attributes and treatment modes. This technique tends to create artificial levels of a rather continuous personological variables. Regression analysis can help in the study of interaction without creating such artificial levels. However, the regression analysis cannot help in the assignment of treatment modes to students high and low on the personological variables investigated. Therefore, this technique cannot be employed in investigations like the present one, which aim at the assignment of treatment modes. Johnson-Neyman Technique which helps to define regions of personological variables in which the treatment are significantly different on the criterion can be employed for this purpose when hypothesis of homogeneous regression lines in the treatment groups rejected. Studies should, therefore, be undertaken employing this technique for the assignment of treatment modes for maximal achievement.

Study of interaction between learner characteristics and treatment modes with a view to assigning treatment
modes for maximal achievement, is a complex problem requiring well designed studies employing sophisticated statistical techniques. The present investigation is an humble attempt in this direction and has merely touched the fringe of the problem. The investigator is conscious of the many limitations of the study, but it is submitted in the hope that it might stimulate better and more detailed research.