CHAPTER III
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METHODOLOGY

The present study examines scholastic achievement in relation to creativity and intelligence. More specifically, it aims at determining the effect of creativity and intelligence on scholastic achievement of high school pupils in the subjects of English, Mathematics and Science. Wallach-Kogan creativity instruments in the form adapted by Paramesh (1971) was used to assess creativity and Raven's Standard Progressive Matrices was used to assess intelligence level of the subjects. With regard to scholastic achievement, three school subjects, viz., English, Mathematics and Science were chosen for the present purpose and both the marks obtained by the subjects in the half-yearly examinations conducted in the schools as well as the scores obtained by them on achievement tests were used in this study. The achievement tests on each of the school subjects chosen were specially designed and constructed by the present investigator to obtain valid measures of scholastic achievement and hence a detailed account of it is presented here.
This chapter will elucidate the rationale for formulating the hypotheses and for selecting the instruments and tests used for assessing creativity and intelligence. It also presents the details of the construction of the Achievement Tests in each of the three chosen school subjects. The procedures used in administering the various tests are also described here in detail.

**FORMULATION OF HYPOTHESES**

As stated in the earlier chapter, studies utilizing the Wallach-Kogan creativity instruments have generally yielded results which point to the absence a positive link between creativity and academic achievement. Further, some of the educational experiments (McConnel, 1934; Hutchinson, 1963) have shown that the link between creativity and achievement depends upon the teaching and evaluation techniques. If the teaching and evaluation techniques are suited to the creatives and allow scope for divergent thinking, a strong link is seen between creativity and achievement. However, under the traditional pattern of teaching and evaluation,
which is convergent, it is intelligence that is found to affect achievement, and not creativity.

In India, the educational pattern is highly tradition bound which mostly encourages the convergent processes. Hence, numerous studies have shown strong link of academic achievement to intelligence. The present study employed an Indian sample and the criteria of achievement used are marks in school examination and also scores on achievement tests which are both convergent. Hence, it is only appropriate to postulate that intelligence will have a significant positive effect on school achievement.

However, the instruments used for assessing creativity, viz., the Wallach-Kogan instruments, have very little overlap with intelligence. Therefore, the instrument used to determine creativity, and the measures of achievement utilized together with the sample employed warrant that we postulate an absence of positive effect of creativity on achievement.

Besides, it was considered useful to test the
effectiveness of the score in achievement test in predicting marks obtained in the particular subject. As studies have shown the effectiveness of achievement tests in predicting marks in examinations (e.g. Ghosh, 1960; Sinha, 1961), we can expect a positive effect of achievement test indicators on marks in the respective subjects.

The purpose of selecting the school subjects of English, Mathematics and Science for investigation is to have one subject each in the linguistic (verbal), numerical and content areas. It is found in experience that pupils react differently to these subjects, presumably due to their experience with them in regard to the nature and difficulty of the curricular subjects. It was therefore, considered probable that there will be significant differences among these subjects, viz., English, Mathematics and Science in terms of pupil's achievement in them, as assessed by marks in school examination and also by performance on achievement tests in the respective subjects.
HYPOTHESES OF THE STUDY

The following hypotheses were formulated for purposes of empirical examination.

1. Creativity will have no effect on scholastic achievement in English, Mathematics and Science, as measured by marks in the school examination.

2. Creativity will have no effect on scholastic achievement in English, Mathematics and Science, as measured by performance on achievement tests in the respective subjects.

3. Intelligence will have a significant positive effect on Scholastic Achievement in English, Mathematics and Science, as measured by marks in the school examination.

4. Intelligence will have a significant positive effect on Scholastic Achievement in English, Mathematics and Science, as measured by performance on achievement tests in the respective subjects.
5. Creativity will have no effect on Total Achievement Index (Marks), derived by pooling the school examination marks in English, Mathematics and Science.

6. Creativity will have no effect on Total Achievement Index (Test Scores), derived by pooling the scores on the English, Mathematics and Science Achievement Tests.

7. Intelligence will have a significant positive effect on Total Achievement Index (Marks), derived by pooling the school examination marks in English, Mathematics and Science.

8. Intelligence will have a significant positive effect on Total Achievement Index (Test Scores), derived by pooling the scores on the English, Mathematics and Science Achievement Tests.

9. Performance on English, Mathematics and Science Achievement Tests will have a significant positive effect on the marks in school examinations in the respective subjects.

10. There will be significant differences among the school subjects of English, Mathematics and Science,
in terms of pupils' achievement in them, as assessed by marks in the school examination.

11. There will be significant differences among the school subjects of English, Mathematics and Science, in terms of pupils' achievement in them, as assessed by scores on achievement tests in the respective subjects.

CONSTRUCTION OF ACHIEVEMENT TESTS

To obtain a dependable and objective measure of achievement, the investigator constructed achievement tests for English, Mathematics and Science for IX Standard. These tests were named the English Achievement Test (E.A.T.), the Mathematics Achievement Test (M.A.T.) and the Science Achievement Test (S.A.T.) respectively. The Mathematics and Science Achievement tests were in English.

The sample for the initial administration of the three achievement tests consisted of 218 boys of the IX Standard belonging to two high schools (under the S.S.L.C. regulations) of the middle socio-economic level in the city of Madras. The mean age of the
sample was 14.75 years and the standard deviation was 8.87 years.

The three achievement tests, viz., the E.A.T., the M.A.T. and the S.A.T. consisted of items of multiple-choice type as items of this variety are better than the true-false or the incomplete sentences in being more objective, easier and effective for the purpose (Heim and Watts, 1967). As Snel (1966, p.149) observes, "Multiple-choice test items are currently the most highly regarded and widely used form of objective test items. They are adaptable to the measurement of most important educational outcomes - knowledge, understanding and judgement; ability to solve problems, to recommend appropriate action, to make predictions. Almost any understanding or ability that can be tested by means of any other item form - short answer, completion, true-false, matching or essay - can also be tested by means of multiple-choice test items".

**FORMULATION OF TEST ITEMS**

The investigator contacted the English,
Mathematics and science teachers of the IX standard in the two schools mentioned above and those in the four schools used later for the main study, to know the portions completed in their respective subjects for the IX standard. This information was obtained early in the month of February, in the academic year June to March, when at least 75% of the portions are normally completed. The common portions completed by the six different schools were then identified for English, Mathematics and Science. These portions, therefore, formed the bases for the formulation of items for each of the three achievement tests.

PRELIMINARY FORMAT

Forty eight multiple-choice items were formulated originally in each of the three subjects of English, Mathematics and Science, following the principles for the construction of achievement tests (Travers, 1950; Michaels and Karnes, 1950; Bess, 1953; Ebel, 1966; Ausubel, 1968). The three sets of forty eight items drawn from English, Mathematics and Science were made into separate test forms which were later called the E.A.T., the M.A.T. and the S.A.T. respectively.
The items were in the form of either incomplete sentences or questions. Each item had five alternative answers out of which only one was correct. The subject had to choose the one that was correct and write 'a', 'b', 'c', 'd' or 'e' corresponding to it in the answer sheet. The key of correct answers was also prepared for each of the tests separately. The prototype version of the K.A.T., the M.A.T., and the S.A.T. together with the key of right answers were each referred to two teachers of the respective subjects. The teachers were requested to go through the items in the tests and offer their criticisms and suggestions on the following aspects:

1. the difficulty of the item-content
2. the clarity of the items
3. their distribution over the range of the portion selected
4. the importance of the items from the examination point of view, and
5. the relevance of the items for the school subject concerned.

The teachers were also requested to maintain the
confidentiality of the test items.

Based on the opinions and suggestions given by the teachers, one item each from the E.A.T. and the S.A.T. and two from the M.A.T. were eliminated and the wording of some of the items were modified. However, care was taken to see that the pattern of the items were in accordance with the requirements for the construction of achievement tests (Michaels and Kames, 1950; Travers, 1950; Bean, 1953; Ebel, 1966; Ausubel, 1968).

**Pilot Study**

The preliminary form of the E.A.T., the M.A.T. and the S.A.T. with 47, 46 and 47 items respectively were, then, administered to 218 pupils of the IX standard referred to above. These pupils were informed a week earlier through their Headmasters of the dates on which they had to take the three tests and were impressed upon to do well. The tests were administered during regular class hours in the presence of the teacher, on alternate days in the two schools. Thus, the initial administration was spread over six
successive days. Care was taken to ensure that there was no leakage of the test items from one school to the other on the successive days.

ADMINISTRATION OF THE ENGLISH ACHIEVEMENT TEST

(Preliminary Form)

The Test was administered in a big hall in the school. The pupils were seated in optimal distance from each other as in regular examination to prevent possible copying. The answer sheets were first distributed, one each to the pupils and they were asked to fill-in the particulars called for in them.

The R.A.T. booklets were then distributed, one each, to the pupils. The investigator read aloud the instructions contained in the first page of the booklet instructing the pupils to simultaneously read them silently. The following instructions were given for the R.A.T.

"This test is based on the portions done in your English course.

Each of the questions or incomplete statements in this test is followed by five suggested answers. You
have to decide which one of these answers is correct and write the letter 'a', 'b', 'c', 'd' or 'e' corresponding to the correct answer. Write your answer on the separate answer sheet given to you.

Example:

Which one of the following is a flower?
(a) Bed
(b) Dog
(c) Chair
(d) Rose
(e) Box

Since 'Rose' is a flower, the correct answer in this case is 'Rose' and you have to write the letter 'd' as your answer. You will find many questions of this type in the test here. Choose only one answer. If you want to change after marking your answer, score out well the answer you marked first and write the answer you think is correct.

You will have one hour for answering the test. Be sure to answer all the questions because your score will be the number of answers you get correct. Therefore, work speedily and carefully but don't spend too
much time on any one question as the time you take to complete this test will be noted.

Before you start answering the test, please fill-in the information called for in the answer sheet.

Do not turn the page until told to do so.

After going through the instructions, the pupils were asked if they had any doubts. The investigator then clarified the doubts raised by some subjects and explained to them the mode of answering the test. They were told to stand in their place when they completed answering the test. Meanwhile, care was taken to see that no subject started answering the test in advance.

After the subjects had understood the instructions well and were clear about the method of writing their answers, the investigator gave the signal to start by saying, "Ready, go". Strict invigilation was maintained with the assistance of the teachers during the course of the test, to prevent any attempt at copying the answers.

The instructions required the subjects to answer
all the items as speedily as possible under a liberal time of one hour. However, the answer sheets as well as the test booklets were collected back from the subjects, as and when they completed the test. Time was noted when 90% of the subjects taking the test completed it. This was done to standardize the time-limit for the test, as it is recommended that test time-limit be generous enough for at least 90% of the pupils to complete it (Ebels, 1966).

After collecting the answer sheets and test booklets from the subjects, they were reminded of the dates of the Mathematics and the Science Achievement Tests.

**ADMINISTRATION OF THE MATHEMATICS ACHIEVEMENT TEST**

*(Preliminary Form)*

The method of administration of the M.A.T. was essentially similar to that of the S.A.T. However, they were informed that the test was based on the portions covered in Mathematics and that they should do rough work, if any, on the reverse side of the answer sheets.

The maximum time allowed for this test was also
one hour. However, time was noted when 90% of
the subjects completed this test. After the com-
pletion of this test, the pupils were reminded of the
date of the Science Achievement Test.

ADMINISTRATION OF THE SCIENCE ACHIEVEMENT TEST

(Preliminary Form)

The method of administration of the S.A.T. was
essentially similar to those of the S.A.T. and the
M.A.T. However, the subjects were informed that the
test was based on their portions in science. Here
again the maximum duration was one hour, but the time
was noted when 90% of the subjects completed this
test. Test being over, the subjects were thanked for
their co-operation and were told that they would be
intimated of their performance in the three tests in
due course.

SCORING OF THE ACHIEVEMENT TESTS (Preliminary Form)

The scoring of the S.A.T., the M.A.T. and the
S.A.T. was done with the key for correct answers for
each of the tests. The number of items correctly
answered was determined for each pupil for each of
the three tests. Besides, the number of correct
answers for the odd and the even items were also
determined separately, for each pupil for each of the
three tests. This was done for determining the
reliability of the tests.

**THE RELIABILITY OF THE ACHIEVEMENT TESTS (Preliminary Form)**

The reliability of each of the three tests was
determined by the split-half (odd-even) techniques.
Product-moment co-efficients of correlation between the
odd and the even items of 207 pupils, for whom complete
data were available, were computed for the E.A.T.,
the M.A.T. and the S.A.T.

The co-efficients were then corrected by the
Spearman-Brown Prophecy Formula (Guilford, 1954). The
reliability co-efficients for the preliminary forms of
the three Achievements Tests are presented in
Table 1.
Table 1. The Reliability Co-efficients for the Preliminary Forms of the B.A.T., the H.A.T. and the S.A.T.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the Test</th>
<th>Reliability Co-efficient (after correction by Spearman-Brown Formula)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The English Achievement Test (Preliminary Form)</td>
<td>.46</td>
</tr>
<tr>
<td>2.</td>
<td>The Mathematics Achievement Test (Preliminary Form)</td>
<td>.56</td>
</tr>
<tr>
<td>3.</td>
<td>The Science Achievement Test (Preliminary Form)</td>
<td>.59</td>
</tr>
</tbody>
</table>

As may be seen from Table 1, the reliability Co-efficients for the B.A.T., the H.A.T. and the S.A.T. are .46, .56, and .59 respectively. These Co-efficients are significant and fairly adequate which ensures the internal consistency of our achievement instruments.

VALIDITY OF THE ACHIEVEMENT TESTS

Besides reliability, another important component
of validity is 'relevance'. For tests of educational achievement, relevance is a matter of logical analysis and expert judgement (Ebel, 1966). Unlike reliability, it ordinarily cannot be measured statistically, on the basis of the obtained data. Relevance must be built into the test (Huddleston, 1956).

Validity that is based on relevance and reliability is "the kind most classroom tests of educational achievement ought to have, and indeed the only kind they ordinarily can have. It is primary, direct, intrinsic validity (Ebel, 1966, p. 391). Sometimes, it is referred to as "Content validity" or "Curricular validity".

As the prototype version of the E.A.T., the M.A.T. and the S.A.T. have each been referred to two teachers already for their opinions and criticism, and as the contents themselves provided their face validity, no attempt was made to determine the validity of these tests.

ITEM ANALYSIS

According to Davis (Ebel, 1966, p. 346), "the construction of solid and reliable tests requires
consideration of quantitative information regarding the difficulty and discrimination power of each test exercise, or item, that is proposed for use; such information is provided by item-analysis data. The analysis of pupils' response to test items is a powerful tool for test improvement. Item-analysis brings to light which items may be too easy or too difficult and which may fail for other reasons to discriminate clearly between the good and the poor examinees. Finally a test composed of items revised and selected on the basis of item-analysis data is a much more reliable test than one composed of untested items (Ebel, 1966). It was, therefore, thought necessary to subject the data obtained on preliminary administration of the three tests to item-analysis.

Many different processes of item-analysis and many different indices of item quality have been developed (Davis, 1952; Turnbull, 1956). A procedure, simple enough for use, yet complete and precise enough to contribute substantially to test improvement, suggested by Ebel (1966), has been adopted here for purposes of item-analysis.
ITEM ANALYSIS OF THE R.A.T.

Firstly, the scores in the R.A.T. for 207 subjects were arranged in decreasing order, from high to low. Secondly, an upper group, consisting of 27% of the total sample (56 pupils) and a lower group, consisting of an equal percentage of the total sample (56 pupils again) were identified. The answer sheets of these 112 pupils were then separated from those of the rest. The selection of the criterion groups on the basis of 27% of the upper and the lower groups provided the best compromise between two desirable but inconsistent aims (a) to make the extreme groups as large as possible and (b) to make the extreme groups as different as possible. Kelley (1939) demonstrated that by taking the upper and the lower groups of 27% of the total sample, one can say with the greatest confidence that those in the upper group are superior in the ability measured by the test to those in the lower group.

Thirdly, the number of times each alternative response was chosen, out of the five for each item, was counted for the pupils in the upper group. The same
was then determined for the pupils of the lower group. Fourthly, these response counts were recorded against the alternatives they refer to, on a copy of the test.

Fifthly, response counts to the keyed correct alternative for the upper and the lower groups were added. This sum was divided by the maximum possible sum, i.e., the sum of the number of pupils in the upper and the lower groups, here it is 112. The quotient was multiplied by 100 to express it as a percentage. This percentage is the index of item difficulty.

Finally, the response count for the lower group was subtracted from that of the upper group. This difference was, then divided by the maximum-possible difference, i.e., the number of pupils in the upper (or lower) group, here it is 56. This quotient, expressed as a decimal fraction, is the index of discrimination (D). This index of discrimination which was first described by Johnson (1951) has since attracted considerable attention and approval. It is simpler to determine and to explain than such other indices of discrimination as the biserial and tetrachoric co-efficients of correlation, Flanagan's.
co-efficients and Davis' co-efficients (Flanagan, 1939; Davis, 1946). It has the very useful property, which most of the correlation indices lack, of being biased in favour of items of middle difficulty (Ebel, 1966).

A copy of the preliminary form of the S.A.T. with response counts for the upper and the lower groups recorded separately against each alternative and the indices of difficulty and of discrimination (D) entered separately is presented in Appendix (1).

Items with an index of difficulty below 16% and above 85% have been considered too easy and too difficult respectively and hence to be eliminated. Items with difficulty indices between 16% and 85% have been construed to be of mediocre difficulty and therefore to be retained. Similarly, items with index of discrimination .30 and below are construed to be poorly discriminating and hence to be rejected (Ebel, 1966).

There were totally five items which fell short of these specifications. Such items were those with
serial numbers 1, 8, 17, 20 and 30. It was decided to eliminate these five items from the final form of the S.A.T. The final form of the S.A.T., therefore, consisted of 42 items.

**ITEM ANALYSIS OF THE S.A.T.**

Item analysis was done for the S.A.T. on the scores of the same pupils. The procedure was essentially the same as was adopted for the E.A.T. A copy of the preliminary form of the S.A.T. with response counts for the upper and the lower groups recorded separately against each alternative and the indices of difficulty and discrimination entered separately for each item is presented in Appendix (2).

There were totally ten items of the S.A.T. which failed to come up to the specifications given above. Such items were those with the serial numbers 8, 15, 18, 29, 31, 33, 34, 36, 43 and 44. These ten items had to be rejected, and hence the final form of the S.A.T. consisted of 36 items.
ITEM ANALYSIS OF THE S.A.T.

Item analysis was done for the S.A.T. on the scores of the same sample, i.e., 207 pupils. Here again, the procedure was essentially the same as was employed for the F.A.T. and the M.A.T. A copy of the preliminary form of the S.A.T. with response counts for the upper and the lower groups recorded separately against each alternative and the indices of difficulty and of discrimination entered separately for each item is presented in Appendix (3).

There were totally seven items of the S.A.T. which failed to satisfy the requirements for retention set forth above. Such items were those with the serial numbers 6, 8, 24, 34, 37, 42 and 44. These seven items had to be given up and therefore, the final form of the S.A.T. consisted of 40 items.

DETERMINATION OF TIME-LIMITS

The time-limits for the final form of the F.A.T., the M.A.T. and the S.A.T. were determined on the basis of the total time at which 90% of the sample completed each of the tests in the preliminary administration (Ebel, 1954; 1966).
This duration was 28 minutes for the S.A.T. Dividing this duration by 47, the total number of items in the preliminary form of S.A.T., get 0.60 minutes as the time required for each item of the test. This time per-item for S.A.T. was multiplied by 42, the total number of items in the final form of the S.A.T. The time-limit was fixed as 25 minutes for this test.

The durations at which 90% of the sample completed the preliminary forms of the S.A.T. and the S.A.T. were 52 minutes and 36 minutes respectively. Employing the same method as for the S.A.T., the time per-item for the S.A.T. and the S.A.T. were found to be 1.10 minutes and 0.75 minutes respectively. Thus, the time-limits for the final forms of the S.A.T. and the S.A.T. were fixed at 40 minutes and 30 minutes respectively.

The total number of items in the three achievements tests before and after item-analysis together with the time-limits for the final form are presented in Table 2.
Table: 2. The total number of items in the E.A.T., the M.A.T. and the S.A.T. before and after item-analysis, together with the time-limits for the final form.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Test</th>
<th>Total items before item-analysis</th>
<th>Total items after item-analysis</th>
<th>Total items retained</th>
<th>Time limit for the final form</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>M.A.T.</td>
<td>46</td>
<td>10</td>
<td>36</td>
<td>40 &quot;</td>
</tr>
<tr>
<td>3.</td>
<td>S.A.T.</td>
<td>47</td>
<td>7</td>
<td>40</td>
<td>30 &quot;</td>
</tr>
</tbody>
</table>

THE MAIN STUDY

THE SAMPLE

The variables of sex, educational standard, socio-economic level and age have been found to be important in affecting the cognitive variables of creativity and intelligence and also the variable of scholastic achievement (Stein 1953; Davis, 1957; Reid et al, 1959; Nelson, 1961; 1967; 1968; Curry, 1962; Mackinnon, 1962 b; Kaplan, 1963; Torrance, 1965; Wallace and
Kogan, 1965; Heagin, 1967; Straus and Straus, 1968; Wallach and Wing 1969; Rao, 1970). The sample for the main study consisted of 288 boys (control on sex) of the IX standard (control on educational standard). They were drawn from four high schools of comparable standard and middle socio-economic level (control on socio-economic level) in the city of Madras. The mean and the standard deviation for the age of the pupils were 14.30 years and 9.64 years respectively.

**SEQUENCE OF ADMINISTRATION**

The task context for the creativity instruments used here requires that no impression of testing and evaluation be created in the subjects so as to obviate the generation of test anxiety in them (Wallach and Kogan, 1965). Towards fulfilling this condition, the Creativity instruments were first administered, in a stress-free and non-evaluative context. The verbal creativity instruments were administered first with the visual ones given next. This was followed by the administration of the intelligence test under the usual testing context. Finally, the three achievement tests, viz., the B.A.T., the M.A.T. and the S.A.T. specially
developed after item-analysis by the investigator, were administered in the same order.

**Measures of Cognitive Abilities**

**The Creativity Measure**

**Selection of the Instruments**

The study, as stated earlier, adopted the associative conception of the creative process. There are two different instruments for assessing creativity based on the associative theory. They are the Remote Associates Test (R.A.T.) devised by Mednick (1962) and the Wallach-Kogan Battery of Creativity Instruments (Wallach and Kogan, 1965). Of these, the R.A.T. has been shown to be unsatisfactory in that it had significant correlations with intelligence and other convergent measures and had low or nil correlations with creativity indicators (Katsam and Kheiralla, 1962; Andrews, 1965; Copley, 1966; Karlins, 1967; Karlins et al 1969).

On the other hand, the Wallach-Kogan instruments have been found to be considerably effective in assessing the unitary dimension of creativity. Wallach and Kogan (1965) have demonstrated the empirical distinction
of their creativity measures from intelligence, within a framework of "convergent and discriminant validity" (Campbell and Fiske, 1959). They found their creativity measures to be unitary and cohesive in that the intercorrelations among them were high (convergent validity). Further, their creativity measures were shown to be in near-complete orthogonality to convergent thinking skills, in that the intercorrelations between their creativity measures and intelligence measures were low (discriminant validity).

They attributed their success in obtaining convergent and discriminant validation for their creativity measures to the absence of time and evaluation pressures in their investigation. Conversely, the failure to obtain the said validations for creativity in the other studies, which they reviewed (Wallach and Kogan, 1965) was ascribed to the presence of time and evaluation constrains in them.

The applicability of the Wallach-Kogan Instruments to all age-levels with replicability of results have also been demonstrated in a number of studies (Biller et al 1967; Crepley, 1968; Pankove and Kogan, 1968;
Ward, 1966; Appleton, 1969; Cropley and Feilshemy, 1969; Kogan and Morgan, 1969; Wallach and Wing, 1969; Paramesh, 1971; 1972; Binger and Hummo, 1971). The factorial validity of these instruments has also been reported by Kogan (1971).

As the Wallach-Kogan Instruments were developed in the American cultural milieu, it was adapted for Indian conditions by Paramesh (1971). A short scale of the original Wallach-Kogan battery, consisting of three items in each task, was successfully employed by Wallach and Wing (1969), who found them to be equally effective as the original battery. Hence, a short scale consisting of three items in each of the three verbal and two visual tasks of the Paramesh adaptation (1971) of the original Wallach-Kogan Battery of Creativity Instruments (Wallach and Kogan, 1965) were employed in the present study for obtaining a composite measure of creativity.

**THE CREATIVITY INSTRUMENTS**

The Paramesh adaptation (1971) of the Wallach-Kogan battery (Wallach and Kogan, 1965) consists of three verbal and two visual tasks. The verbal tasks are the Instances,
the Alternate uses and the similarities. The visual tasks are the Pattern Meanings and the Line Meanings. With a view to use a shorter version of the original instruments, only three items from each of the five tasks were made use of in the present study. The verbal instruments comprising the three tasks were included in one booklet and the two visual tasks were presented together in another booklet.

Though Wallach and Kogan (1965) originally used individual administration for their creativity instruments, group administration of these instruments has been successfully employed by Cropley (1968) and Paramesh (1971). Hence, in the present study too, these instruments were administered to 268 pupils in small groups of 25 subjects each. The tasks were administered in a non-evaluative and stress-free context, with no time-limits and with the teacher not present. The use of the term “test” was scrupulously avoided. The tasks were introduced to the pupils as “Imagination games”.

Administration of the Verbal Instruments

The answer sheets for the verbal tasks were first
distributed, one each to the pupils. The answer sheets had sufficient space for answering all the three tasks. It was divided into three sections, meant for the three tasks, Instances, Alternate Uses and Similarities. Each of these sections was further sub-divided into three, and each item was presented on the top of each such division. The pupils were first asked to fill-in the particulars called for in the answer sheets.

The verbal instruments booklets were then distributed, one each to the pupils. The general instructions for the verbal techniques were contained on the first page of the booklet. The subjects were asked to read them silently as the investigator read them aloud. The instructions were as follows:

"This booklet contains a few games for imagination. These games are a measure of how people think about various things. They are not a measure of how smart they are. There are three kinds of games in this. They are (1) Instances (2) Alternate Uses and (3) Similarities. For each of these games, you may take as much time as you need. Be sure not to skip anything. Answer all the items. There are no right or wrong
answers. And do not be thinking about whether your answers are nice, silly or ridiculous. Do not make any markings on this booklet.

The instructions for answering each game are given are given at the beginning of the games".

I. INSTANCES

This was the first of the three verbal tasks. It contained items which required the subjects to generate possible instances of a class concept which was given in verbal terms. The following instructions were read to the pupils as they read them silently.

"In this game, you are given some items like "things that are cold", "things that are round", etc. We would like you to write as many things as you can think of for each item. For "things that are cold", probably you would come out with answers like the following: water, ice, dew, winterdays and so on. There are all kinds of different answers that are possible. Try to write as many as you can in the answer sheets given to you. You may take as much time
as you need. Remember to write as many things as you can think of for each item.

They were then asked if they had any doubts with respect to what they are to do. After clarifying the doubts, the signal for doing the task was given.

The following three items comprised the Instances Task:

1. Name all the square things you can think of.
2. Name all the things you can think of that make noise.
3. Name all the things you can think of that move on wheels.

2. **Alternate Uses**

After the pupils had finished the first task, they were asked to do the Alternate Uses, which was the second of the verbal techniques. This contained items which required the generation of possible uses for a verbally specified object. The following instructions were read to the pupils as they read them silently from their booklets:

"In this game, you are given some objects like
'bulb', 'floor', or 'string'. Your task will be to write all the different ways in which that object can be used. For example, think about a piece of string. One can use a string to tie a packet, jump rope, to sew or hang clothes. You probably can think of many other uses of a string. Write all of the different ways of using each object in the answer sheets given to you. You are not timed on this game; so take as much time as you need."

The doubts expressed by the pupils were then clarified and the signal for doing the task was given.

The following were the three items in the Alternate Uses Task:

1. Write all the different ways in which you can use a knife.

ii. Write all the different ways in which you can use a car tyre - either the tube or the outer part.

iii. Write all the different ways in which you can use a key - the key that is used in doors.
3. SIMILARITIES

This was the last of the verbal tasks. It contained items which required the generation of possible similarities between two verbally specified objects. The following instructions were read to the pupils as they read them silently from their booklets.

"In this game you are given pairs of objects. We would like you to try to think of all the ways in which the objects in each pair are alike. For example, think of all the ways in which an apple and an orange are alike. Probably you would answer as follows: both are round, fruits, have seeds, sweet, have skins and so on. For each of the pair of objects given below, we would like you to write as many similarities as you can think of in the answer sheets. Please remember that you are not timed on this game. So take as much time as you need".

The doubts of the pupils were cleared before starting them on the task.

The following three items comprised the similarities task:

1. Write all the ways in which a potato and a carrot are alike.

2. Write all the ways in which a grocery store (Provision Store) and a hotel are alike.

3. Write all the different ways in which a radio and a telephone are alike.
A copy of the verbal creativity instrument is presented in Appendix (4).

ADMINISTRATION OF THE VISUAL INSTRUMENTS

These instruments were administered on a different day. The answer sheets for these instruments were distributed, one each to the pupils. These were like those for the verbal tasks, except that there were two sections in them, meant for the two visual tasks, Pattern Meanings and Line Meanings. The serial numbers of the patterns and the lines were presented at the top of each division in the answer sheets. The pupils were told to fill-in the particulars called for in them, which were the same as those of the answer sheets of the verbal instruments.

The visual instruments booklets were then distributed, one each to the pupils. The general instructions for these were given in the first page as in the verbal instruments. The pupils were asked to read them silently as the investigator read them aloud. These were as follows:

"This booklet contains a few games for imagination."
These gages are a measure of how people think about various things. They are not a measure of how smart they are. There are two kinds of games in this: (1) the Pattern Meanings and (2) the Line Meanings. For each of these games, you may take as long as you wish. Be sure not to skip anything, but write about all the items. There are no right or wrong answers. And do not be thinking about whether the answers are nice, silly or ridiculous.

Do not make any markings on the booklet.

Please proceed to Pattern Meanings now. Instructions for this game are given at the beginning of the game.

1. PATTERN MEANINGS

This was the first of the visual instruments, which contained visual stimulus materials. The subjects were required to generate possible meanings or interpretations for each of the three visual designs. The following instructions were read to the pupils, as they read them silently.

"On this game we would like you to feel free to
use your imagination. You are going to see some drawings. After looking at each one, we would like you to write down all the things you think each complete drawing could be. Here is an example - you can turn it any way you would like to".

"Some of the kinds of things you might have thought of are: the rising sun, a porcupine, eyelashes, a brush, coronation, etc. For each of the patterns on the following pages, please write down all the things you think each of the drawings could be. Write your answers on the answer sheet provided separately. Take as much time as you like".
After clearing the doubts of the pupils, they were started on this task.

The items comprising the Pattern Meanings Task are presented in Appendix (5).

2. LINE MEANINGS

This was the other visual instrument. It consisted of one or another kind of line. The subject had to generate meanings or interpretations relevant to the form of the three lines. The following instructions were read to the pupils, as they read them silently.

"You are going to see some lines and after looking at each one, we would like you to write down all of the things it makes you think of. Take your time, and be sure that when you look at the line you write down what the whole line makes you think of, and not just a part of it. On the following pages are a number of different lines. You can turn these any way you want to. For each of these lines, please write down all the things it makes you think of. Remember there are no right or wrong answers and you can take as much time as you like".

The doubts of the pupils were then clarified and
they were started on the task.

The items comprising the Line Meanings Task are presented in Appendix (5).

**SCORING OF THE CREATIVITY INSTRUMENTS**

Whereas Wallach and Kogan (1965) advocated scoring for number and uniqueness of responses, Pankove and Kogan (1968) adopted only the fluency or the number score in their study. Their contention was that fluency score by itself is a good index of creativity, as these two variables, viz., number and uniqueness scores, were highly correlated in the Wallach-Kogan study (1965). As the determination of uniqueness is a highly time-consuming process, Pankove and Kogan (1968) decided in favour of only the fluency score.

In line with the view of Pankove and Kogan (1968), in the present study also, the number or fluency score alone was arrived at for each of the three items in each of the three items in each of the five creativity tasks. All the ideas which the students wrote for each item were summed to determine the number score for each item. The scores for three items comprising
the instrument were summed to represent the score for that instrument.

**THE INTELLIGENCE MEASURE**

As the study adopted Raven's (1960) view of intelligence for conceptual purposes, for the determination of intelligence, the Raven's Standard Progressive Matrices (1960) was employed. The Standard Progressive Matrices (SPM) is a non-linguistic test which is therefore, "culturally-reduced measure of general intellectual ability" (Elley and MacArthur, 1962) and hence of international usage and reputation. It is a test "to apprehend meaningless figures presented for observation, see the relations between them, conceive the nature of the figure completing each system of relations presented and by doing so, develop a systematic method of reasoning" (Raven, 1960, p.1). "A person's total score on this test provides an index of his intellectual capacity, whatever his nationality or education" (Raven, 1960, p.1).

The SPM comprises 60 problems which are divided into five sets of 12 each. In each set, the first problem is self-evident and the ones that follow are progressively more difficult. The five sets afford five opportunities
for grasping the method and "five progressive assessments of a person's capacity for intellectual activity" (Raven, 1960, p.1).

**ADMINISTRATION OF THE SPM**

The SPM can be given either as an individual, a self-administered or as a group test. In the present study, it was administered to small groups of 25 pupils each, according to the standard instructions in the Guide to the test (Raven, 1960). The subjects were seated sufficiently apart to prevent copying, if any. The answer sheets were first distributed, one each to the pupils and they were asked to fill-in the particulars called for in them. They were the same as those required for the creativity instruments.

The SPM test booklets were then distributed, one each to the pupils. They were told not to open the books until everyone was ready. The investigator then said, "Open your books to the first page. At the top, it says set A, and you have a column A on your answer sheet. You see what it is. The upper part is a pattern with a bit missing. Each of these bits below (the investigator pointed to each in turn) is the
right shape to fit the space, but they do not all complete the pattern. Number 1 (the investigator pointed to the bit and then to the pattern) is quite the wrong pattern. Numbers 2 and 3 are wrong - they fit the space, but they are not the right pattern. What about Number 6? It is the right pattern (the investigator illustrated that the pattern was the same as the pattern above) but it does not go all over. Put your finger on the one that is quite right". The investigator then surveyed if that was done correctly. He gave further explanations where necessary and then said, "Yes, number 4 is the right one. So the answer to A.1 is 4 - write 4 here, against number 1 in column A on your answer sheet. Do not turn over yet".

The investigator waited for everyone to finish and then continued the instructions: "In every page in your book, there is a pattern with a bit missing. You have to decide each time, which of the bits below is the right one to complete the pattern above. When you have found the right bit, you write the number of it down on your answer sheet, against the number of the pattern. They are simple at the beginning and get harder as you go on. There is no catch. If you pay
attention to the way the easy ones go, you will find
the latter ones less difficult. Try each in turn, from
the beginning right to the end of the book. Work at
your own pace. Do not miss any out. Do not turn
back. See how many you can get right. You can
have as much time as you like. Turn over and do the
next one”.

The investigator allowed sufficient time for everyone to write down the answer to A.2. He then continued,
"The right one, of course, is number 5. See that you
have written the figure 5 against number 2 in column A
on your answer sheet. Go on like that by yourselves
until you get to the end of the book”.

After about half-an-hour, the pupils were asked
if they had finished. But nobody had finished by then.
However, after about ten more minutes, some pupils
indicated they had finished. From then on, the answer
sheets as well as the test booklets were collected from
the subjects, as and when they finished answering.

**SCORING OF THE SPN**

The scoring for the SPN was done according to the
"Key to 1956 Revised order of Problems", given in the
Guide to the test (Haven, 1960). A subject's score on the test was represented by the total number of problems he solved correctly, of the 60 problems in the test.

MEASURES OF SCHOLASTIC ACHIEVEMENT

Two measures of scholastic achievement were obtained. They are:

1. The marks in the Half-yearly Examination in the school subjects of English, Mathematics and Science.
2. The scores on English, Mathematics and Science Achievement Tests, developed by the investigator.

MARKS AS ACHIEVEMENT MEASURE

As school marks are the criteria of achievement which are in practical use, it was considered necessary to have them, along with the scores on achievement tests, for a dual measure of the dependent variable of scholastic achievement.

The Half-yearly Examinations conducted in the schools are considered to be important in providing a good index
of the progress made by the pupils. Hence, the marks secured by the 288 pupils in the school subjects of English, Mathematics and Science in the Half-yearly Examinations held in the four schools were obtained from the records of the respective schools.

1. Scores on Achievement Tests as Achievement Measure

Although marks are the criteria of achievement that are in practical use, there is yet the likelihood of subjective considerations creeping in in the evaluation done at the school. It was, therefore, thought desirable to have a measure of achievement in terms of scores on achievement tests, in addition to the marks.

The B.A.T., the M.A.T. and the S.A.T. which were specially developed and refined after careful item-analysis, were used for obtaining the achievement measures based on scores on achievement tests, on the subjects of English, Mathematics and Science respectively.

Administration of Achievement Tests

Schedule of Administration

The order of administration of achievement tests was the same as in the preliminary administration.
described earlier, viz., the E.A.T., the M.A.T. and the S.A.T. The E.A.T. was administered in the four schools referred to above on four successive days with the M.A.T. administered on the next four successive days in the same schools. The S.A.T. was administered on the next four days successively in the same schools. Thus, the administration of achievement tests was spread over twelve successive days in the four schools. Care was taken to ensure that there was no leakage of test items across the schools on the successive days. As in preliminary testing, the subjects were informed beforehand of the dates of the three tests through their Headmasters and impressed upon to do well.

**ADMINISTRATION OF THE E.A.T.**

The pupils were seated at optimal distance from each other for group administration of the E.A.T. Each subject was first given one answer sheet of the M.A.T.

They were asked to fill-in the particulars called for in them, which were the same as in the other tests. The test booklets were then distributed to the pupils. They were asked to read silently the instructions on the
first page of the booklet as the investigator read them aloud and explained them. The following instructions were contained in the first page of the E.A.T.:

"This test is based on the portions done in your ENGLISH course.

1. Each of the questions or incomplete statements in this test is followed by five suggested answers. You have to decide which one of these answers is correct and write the letter 'a', 'b', 'c', 'd' or 'e' corresponding to the correct answer. Write your answer on the separate answer sheet given to you.

2. Example:

Which one of the following is a flower?

(a) Bed
(b) Dog
(c) Chair
(d) Rose
(e) Box

Since 'rose' is a flower, the correct answer in this case is 'rose' and you have to write the letter 'd' as your answer. You will find many questions of this type in the test here. Choose only one answer. If you want to change your answer after marking it, score
out well the answer you marked first and write the answer you think is correct.

3. Be sure to answer as many questions as possible because your score will be the number of answers that you get correct. Therefore, work speedily and carefully, but don't spend too much time on any one question. You will have 25 minutes for this test.

4. Before you start answering the test, please fill-in the information called for in the answer sheet.

Do not turn the page until told to do so.

After going through the instructions, the investigator cleared the doubts of some pupils. The investigator then gave the signal to start by calling out, "Ready, go". Simultaneously, the interval timer set to ring after 25 minutes was started. To prevent any possible attempt at copying, strict invigilation was maintained with the assistance of the teachers during the course of the test. The investigator called out "Stop writing, pencils down", at the expiry of 25 minutes. Immediately, the answer sheets and the test booklets were collected from the pupils. The subjects were then reminded of the dates of the Mathematics and the Science
Achievement Tests.

**ADMINISTRATION OF THE M.A.T.**

The method of administration of the M.A.T. was essentially similar to that of the E.A.T. However, they were instructed that the test was based on the portions done for them in mathematics and were also directed to do rough work, if any, on the reverse side of the answer sheets. The time-limit for this test was 40 minutes. The rest of the instructions were the same as in the case of the E.A.T.

At the end of this test, the pupils were reminded of the Science Achievement Test.

**ADMINISTRATION OF THE S.A.T.**

The method of administration of the S.A.T. was essentially similar to those of the E.A.T. and the M.A.T. However, the pupils were instructed that the test was based on the portion done in science and that the time-limit for this test was 30 minutes. Except for this, the instructions were the same as with the E.A.T. and the M.A.T.

At the end of the test, the pupils were thanked
for their cooperation and were assured that they would be informed of their performance in the three tests in due course.

**SCORING OF THE ACHIEVEMENT TESTS**

Scoring of the E.A.T., the M.A.T. and the S.A.T. was done in accordance with the key of right answers for each of the tests. The number of items answered correctly was determined for each pupil for the subjects of English, Mathematics and Science.

**RELIABILITY OF THE INSTRUMENTS**

1. **RELIABILITY OF THE CREATIVITY MEASURES**

The reliability of each of the five Wallach-Kogan instruments was determined by two methods, vis., by the split-half (odd-even) technique and also by item-sum correlation.

In the first technique, two halves of the test, represented by all the odd items on the one hand and all the even items on the other are compared for the degree of relationship between them. Product-moment Co-efficients of correlation were calculated between
the data for the odd and the even items in each of the five creativity instruments for 286 subjects. The obtained correlations were then corrected by the Spearman-Brown Prophecy Formula (Guilford, 1954) to get the reliability coefficients for the five creativity instruments, which are presented in Table 3.

Table 3: The Reliability Co-efficients for the five creativity instruments.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the Test</th>
<th>Reliability Co-efficient (after correction by Spearman-Brown Formula)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Instances</td>
<td>.71</td>
</tr>
<tr>
<td>2.</td>
<td>Alternate Uses</td>
<td>.59</td>
</tr>
<tr>
<td>3.</td>
<td>Similarities</td>
<td>.77</td>
</tr>
<tr>
<td>4.</td>
<td>Pattern Meanings</td>
<td>.77</td>
</tr>
<tr>
<td>5.</td>
<td>Line Meanings</td>
<td>.80</td>
</tr>
</tbody>
</table>

Note: For 286 df, r's of .11 and .15 are significant at .05 and .01 levels, respectively.

It is seen from Table 3 that all the five reliability co-efficients are substantial in that all of them
are .50 or better. Indeed, four of the five reliabil-
ity co-efficients exceed .70. It is, therefore,
evident that all the five measures of creativity
employed here possess a high degree of internal
consistency.

In the second method to test the reliability of the
creativity measures, an item-analysis was carried out,
which would show the contribution that each item had
made to the total score of an instrument. This item-
analysis consists of item-sum correlations in which
the score in every item is correlated with the total
score for an instrument. The item-sum correlations
for the five creativity instruments are presented in
Table 4.

Table 4: The item-sum correlations for each of the
five creativity instruments.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the Instrument</th>
<th>Item Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1.</td>
<td>Instances</td>
<td>.46</td>
</tr>
<tr>
<td>2.</td>
<td>Alternate Uses</td>
<td>.64</td>
</tr>
<tr>
<td>3.</td>
<td>Similarities</td>
<td>.77</td>
</tr>
<tr>
<td>4.</td>
<td>Pattern Meanings</td>
<td>.78</td>
</tr>
<tr>
<td>5.</td>
<td>Line Meanings</td>
<td>.76</td>
</tr>
</tbody>
</table>

Note: For 286 df, r's of .11 and .15 are significant
at .05 and .01 levels respectively.
It is clear from the above table that no item in any of the five tasks is unrepresentative of the instrument of which it is a part. All the fifteen item-sum correlations are .45 or better, and 12 of the 15 are .60 or better. Thus, this second approach lends additional evidence to the high degree of internal consistency that each of the five creativity measures enjoys.

RELIABILITY OF THE SPM

The reliability of the Standard Progressive Matrices, which was the test used for obtaining the intelligence measure, was determined by the split-half (odd-even) technique. Hence, Product-moment Co-efficient of correlation was calculated for the odd and the even items in the SPM for 268 subjects. The obtained correlations were then treated with the Spearman-Brown Prophecy Formula (Guilford, 1954) to obtain the reliability co-efficient for the SPM which is presented in Table 5.
Table 5: The Reliability Co-efficient for the SPM

<table>
<thead>
<tr>
<th>Name of the test</th>
<th>Reliability Co-efficient (corrected by Spearman-Brown Formula)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The SPM</td>
<td>.86</td>
</tr>
</tbody>
</table>

As is seen from Table 5, the reliability co-efficient for the SPM is substantial in being .86. Therefore, the intelligence measure obtained in this study possesses a high degree of internal consistency.

No attempt was made to determine the validity of the SPM in the present study, as it is an established test of intelligence that commands international usage and reputation.

INDEPENDENCE OF THE CREATIVITY AND THE INTELLIGENCE MEASURES

An attempt was also made in the present study to test if the creativity measures employed here were
cohesive and unitary, and if they were different from
the intelligence measure of SPM. To test the first
issue, correlations were computed among the five
creativity measures for the data of 286 subjects.
These inter-correlations are presented in Table 6.

Table 6: The Inter-correlations among the five creati-

vity measures.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Creativity Measures</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A.U.</td>
<td>S</td>
<td>P.M.</td>
<td>L.M.</td>
</tr>
<tr>
<td>1.</td>
<td>Instances (I)</td>
<td>.37</td>
<td>.17</td>
<td>.23</td>
<td>.15</td>
</tr>
<tr>
<td>2.</td>
<td>Alternate Uses (A.U.)</td>
<td>-</td>
<td>.32</td>
<td>.30</td>
<td>.39</td>
</tr>
<tr>
<td>3.</td>
<td>Similarities (S)</td>
<td>-</td>
<td>-</td>
<td>.17</td>
<td>.24</td>
</tr>
<tr>
<td>4.</td>
<td>Pattern Meanings</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.49</td>
</tr>
<tr>
<td>5.</td>
<td>Line Meanings (L.M.)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

NOTE: For 286 df, r's .11 and .15 are significant at
.05 and .01 levels respectively.

It may be seen from Table 6 that all the five crea-
tivity measures are interrelated among themselves, in that
all the ten correlations in the table are significant
beyond the 0.1 level. This lends evidence to the
unified and cohesive nature of the five creativity
measures employed here.
To test the independence of the creativity and the intelligence measures employed here, correlation co-efficient was calculated between the composite creativity index, comprising the sum of scores in the five creativity instruments through their standard scores (Garrett, 1965) and the score in the SPM. This correlation is presented in Table 7.

**Table 7:** The correlation between the creativity and the intelligence measures.

<table>
<thead>
<tr>
<th>Measures</th>
<th>Co-efficient of correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercorrelation</td>
<td></td>
</tr>
<tr>
<td>Creativity and Intelligence</td>
<td>.001</td>
</tr>
</tbody>
</table>

It is abundantly clear from Table 7 that the creativity and the intelligence measures employed in the present study are quite independent of each other. The correlation between the two dimensions is almost nil, being .001, which testifies to the fact of their mutual exclusiveness.
The cohesive and unified nature of the creativity measures, reinforced with their high reliability indices and clear distinction from the intelligence measures lends evidence to the validity of the creativity measures employed here.

As the validity of the Wallach-Kogan creativity instruments has been well established, no attempt was made in this study to determine the same.

**RELIABILITY OF THE ACHIEVEMENT MEASURES**

The reliability of the three achievement measures, viz., the E.A.T., the M.A.T. and the S.A.T., were determined by the split-half (odd-even) technique. The data of the 288 subjects for the odd and the even items were correlated by the Product-Moment-Co-efficient technique for each of the three achievement measures separately. The resultant correlations were treated with the Spearman-Brown Prophecy Formula (Guilford, 1954) to obtain the reliability co-efficients, which are presented in Table 8.
Table 8: The reliability co-efficients for the three achievement tests:

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of the test</th>
<th>Co-efficient (corrected by Spearman-Brown Formula)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>E.A.T.</td>
<td>.57</td>
</tr>
<tr>
<td>2</td>
<td>M.A.T.</td>
<td>.82</td>
</tr>
<tr>
<td>3</td>
<td>S.A.T.</td>
<td>.82</td>
</tr>
</tbody>
</table>

Note: For 286 df, r’s of .11 and .15 are significant at .05 and .01 levels respectively.

As may be seen from Table 8, the reliability co-efficients for the three achievement tests are all substantial in that all are .55 or better and two of the three are .80 or better. Thus, all the three achievement tests constructed for the purpose possess a high degree of internal consistency ensuring reliability.

There is an opportunity here to test the efficacy of item-analysis of the three achievement tests. Comparing the reliability co-efficients of the final form of the three achievement tests with those of the preliminary form that is given in Table 1, it is seen that the reliability indices have increased quite
substantially after the item analysis. The reliability co-efficient for the E.A.T. has improved from .46 to .57 and for the A.A.T. from .56 to .82 and for the S.A.T. from .52 to .82. Thus, it bespeaks of the effectiveness of the item-analysis that was carried out of the three achievement tests. This, in effect, enhances the validity of the achievement tests.