CHAPTER IV

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DEVELOPMENT

OF

TEST OF CREATIVE THINKING

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First, the highly creative children have a reputation for having wild and silly ideas, especially the boys. Second, their work is characterized by the production of ideas "off the beaten track," "outside the mould." Third, their work is characterized by humour, playfulness, relative lack of rigidity, and relaxation."

Mackinnon (1960 b) describes a syndrome of creativity, including such aspects as: (a) the creative person's self image as one who should be respected; (b) his sense of destiny about self; (c) his openness to experience; (d) his struggling towards reconciliation of opposites; (e) his seeking to tolerate increasing tension while striving for creative solutions to even more difficult problems; and (f) his high orientation to aesthetic and theoretical interests and values.

Taylor (1962) has described the creative individual as unconventional and as resisting the drives towards conformity and the conventional thinking often found in the schools." Barron (1958) in his studies of highly creative people found them "more original, less suggestible and more tolerant of structural disorderliness."

Reid, King and Wickwire (1959) investigated the differences in cognitive and other personality attributes between twenty four creative and twenty four non-creative seventh graders as nominated by peer ratings. The creative children were more sociable, more warm-hearted, and less anxious. The students from upper class socio-economic backgrounds appeared more stable emotionally. Creative lower class boys were more confident and self-sufficient than non-creative lower class boys,
but no differences were found among upper class boys. Creative lower class girls, however, were less confident and secure than non-creative lower class girls.

Barron (1955) on the basis of his study on 100 captains in the United States Air Force, concludes, "Freedom of expression and movement, lack of fear of dissent and contradiction, a willingness to break with custom, a spirit of play as well as of dedication to work, purpose on a grand scale; these are some of the attributes which a creative social entity, whether vast or tiny, can be expected to have."

A good picture of the highly creative person as contrasted with the highly intelligent emerges out of a study by Getzels and Jackson (1958). They found that the creative group rated aspects of personal aspiration, such as marks, I.Q., character and goal-directedness lower than the high I.Q. group. The creative group rated a wide range of interests, emotional stability and a sense of humour higher than the high I.Q. group. The high I.Q. group wanted to possess those qualities that would lead to success, whereas the creative child did not express ambitions in terms of that goal. Personal aspirations of the high I.Q. group were those which they thought teachers would approve; the creative children were unmindful of teacher approval and showed a slightly negative correlation. Differences between the two groups also appeared both in quality and quantity of occupational goals. The quantity of possibilities mentioned was significantly greater for the highly creatives. Also, the highly creative group mentioned a significantly greater proportion of unconventional occupations than the highly intelligent group.
Parloff and Datta (1965) found that the most creatively promising students were characterized as more independent, autonomous, self-reliant, having broad interests (Achievement via Independence), more efficient, clear in thinking, and planful (Intellectual efficiency); more perceptive, resourceful, and rebellious towards rules and constraints (Psychological-mindedness); and more imaginative and impatient and less like the typical respondent to a test (Communality).

Getzels and Jackson (1962) found that compared with high I.Q. students on fantasy productions, high creatives made greater use of stimulus-free themes, unexpected endings, humour, and playfulness. The high creatives have superior ability to produce new forms and to risk joining together elements usually seen as independent and dissimilar. They seem to enjoy risk and uncertainty or the unknown. They prefer the anxieties and delights of growth rather than the anxieties and delights of "safety". Sixty-two percent of them chose unconventional occupations, such as adventurer, inventor, writer, and the like. Only 16 percent of the high I.Q. group made such choices.

As a group, Drews' (1963) creative individuals were characterized as "rather prickly young people, who ask below-the-surface or, for some teachers, below-the-belt questions." The group seemed to contain future scientists, artists, writers, and scholars-at-large. Many of them seemed to be interested in all these areas. They had a skepticism combined with a deep-seated idealism and a tendency to probe into basic issues. They were aware of and bothered by the discrepancy between people's expressed beliefs and their actions.
Torrance and Dauw (1969) found that a major characterization of students high on original thinking and elaboration is their freedom orientation rather than control orientation. They are also more achievement, recognition, and anxiety oriented than their unselected peers.

High creative students (Torrance and Dauw, 1965) express stronger creative motivations, a greater striving for excellence, a greater attraction to unusual and unconventional jobs and kinds of achievement, and more discontent rather than aspiring to a "life of comfort, normality, conformity, satisfaction, and happiness," when contrasted with a comparable sample of unselected high school seniors. They seem to be characterized by strong desires to discover and use their potentialities.

Goel (1972) designed a study to find out some of the personality traits of high creative children at school stage. He came to the conclusion that high creative children at school stage; (1) possess a high level of energy, (2) reject repression and suppression for the control of their impulses, (3) are more introvert, (4) are more independent in both thought and action, (5) have open minds, (6) can tolerate ambiguity, and (7) entertain opposing values.

Maslow (1959) contends that creative people live far more in the real world of nature than in the verbalized world of concepts, abstractions, expectations, belief and stereotypes that most people confuse with the real world. Their creativity seems to be an apiphenomenon of their greater wholeness and integration, which is what self-acceptance implies. Rogers (1954) sees the motive for creativity in man's tendency to actualize
himself, to become his potentialities. Bhan (1973) designed a study to determine the relationship between creative potential and aspiration. He concludes that people endowed with high degree of creative potential maintain harmony between their aspiration level and creative potential, whereas people with low creative potential suffer from disharmony between their creative resources of the personality and aspiration level. Thus creative people seem to be self-actualizing.

B. DEVELOPMENT OF TEST ACTIVITIES

In order to identify and measure the abilities involved in the creative process, it is necessary to understand the nature of the creative process. Wallas (1926) and Patrick (1955) have identified four steps: Preparation, Incubation, Illumination, and Revision. Torrance (1969) observes that the process flows something like the following. First, there is sensing of a need or deficiency, random exploration, and a clarification or 'pinning down' of the problem. Then ensues a period of preparation, accompanied by reading, discussing, exploring, and formulating many possible solutions, and then critically analysing these solutions for advantages and disadvantages. Out of all this comes the birth of a new idea — a flash of insight, illumination. Finally, there are experimentation to evaluate the most promising solution for eventual selection and perfection of the idea. Such an idea may find embodiment in inventions, scientific theories, improved products or methods, novels, musical compositions, paintings or new designs.

Rugg (1952) has given the following successive steps of the creative process:

1. There is to begin with, the urge to create, hazy and
intangible at first, often manifesting itself as vague restlessness.

2) Then there is the illuminating flash of insight, the intuition which suddenly reveals to the artist a conception, perhaps indefinite, of the meaning towards which he is groping.

3) Thirdly, the translation of this vision into the visible symbols of the art practised — it may be poetry, painting, music or anything else — which needs a mastery of the necessary technique.

4) Then comes the educative effort— the long, gruelling enterprise of the creative process itself, the tenacious grip on the clearing vision of the completed product, the persistent application of the necessary techniques in shaping and reshaping the work as it develops, the successive stages of ruthless self-criticism — the insistence upon unsparing exactitude, precision, the constant polishing and changing.

5) Finally, when the whole process has been completed and culminated in beautiful expression, it gives a sense of achievement and of joy which, in the words of Bergson, "is the seal which nature sets on every completed, creative act."

After understanding the meaning of creative thinking, the creative process and the personality correlates of creative individuals, the investigator prepared himself to develop an instrument to measure creative thinking ability in student teachers studying in Teachers' Training Colleges in Panjab. Since the sample of the study constituted student teachers rather than established writers, poets, artists etc, therefore,
the investigator accepted Torrance's exposition of the creative process as most appropriate. Therefore, he decided to develop his test on the lines of Torrance Tests of Creative Thinking. He further decided to include in the test only verbal activities having verbal stimuli.

Creativity of an individual can flourish in a field in which he has specialised or has sufficient background. A creative individual often proves an asset to the vocation he belongs to. He enriches the field of his activities through his ingenuity. But he can tap his creativity to make improvement in his own field and not in other fields. A creative engineer can be expected to enrich the existing stock of knowledge in the field of engineering and a teacher is likely to explore new grounds in the sphere of teaching only. This means that a large stock of information or knowledge is a pre-requisite for blossoming of creativity. In this regard, Guilford (1970a) has rightly remarked, "The student must be reminded that the accumulation of information for storage in his memory system is an absolute requirement for creative problem-solving. Outstandingly creative people who have expressed themselves on the needs for information seem to agree that a wealth of personal storage is essential. Information is the substance of intellectual functioning."

This also implies that an instrument designed to measure creative thinking ability must include such activities or tasks as pertain to the field of the individuals for whom the test is meant. The present investigator had to develop a test to assess creative thinking ability in teacher-trainees,
therefore, it was thought advisable to develop such tasks as are drawn from teaching-learning situations.

The investigator started experimenting with a large number of activities of various types. While developing these activities, due help was taken from Torrance Tests of Creative Thinking, Guilford Tests of Divergent Production and a number of other tests of creative thinking. About 30 student teachers were selected to participate in the experiment. The investigator would call some students to his office and ask them to write their responses to two or three problems in a given time. Thus, he took many months to try 20 activities with the selected students in different sessions. As a result of these explorations, twelve activities or tasks were found to be more suitable for the purpose of present study. These activities constituted X-form (Appendix III) of the test.

The X-form of the test, comprising twelve activities, was sent to Dr. E. Paul, Torrance for his suggestions and comments. He was also requested to select seven most appropriate items out of the 12 items. As a result of preliminary trials with the selected few students, it was found that 5 minutes' time was the most appropriate and quite sufficient time for each task. It was not desirable to develop a test, having a working time of more than 30 or 35 minutes. A lengthy test is likely to make the testees bored and un-cooperative and in that case, the investigator does not succeed in drawing best out of the testees. This consideration had prompted the investigator to include not more than seven activities in the final form of the test.
Dr. Torrance found eleven items suitable for being included in the proposed test of creative thinking. To reduce the length of the test to seven activities, he recommended that the activities No. 1, 4, 5, 6 and 7 may be eliminated and the rest should be retained for inclusion in the final form of the test. Thereafter, the selected activities were shown to seven Psychologists in India. Rationale of the test items was discussed with them. All of them were fully satisfied with the test activities. After getting a green signal from them, the investigator proceeded to finalise the test. The selected items were arranged in a rational sequence and a few changes were made in the language of the items. These activities constituted Y-form (Appendix IV) of the test.

C. RATIONALE OF THE TEST ITEMS

1. Giving Arguments

"Suppose you want to change your 'section' and you have to go to the Principal with an application to this effect. Please write as many convincing arguments as possible which will force the Principal to give you necessary permission."

This item has been included in the test to give an opportunity to the subjects to advance maximum number of arguments to convince a superior person. Thus, they have to advance such arguments as are not given by ordinary individuals. There is much scope for the utilization of original thinking. Moreover, they are expected to give such arguments as will appeal to another person. This means, they will have to look at
the problem from the angle of a different person, that is, they will have to place themselves in the shoes of another person. This will require flexibility in thinking and optimum use of imagination on the part of subjects.

The activity is also attractive from the standpoint of administration and scoring. It enables the subjects to play with ideas that they would not dare express in a more serious task. 'Sensitivity to problems' is an important component of creative thinking ability. 'Sensitivity to problems' implies becoming aware of the presence of disturbing situations or to become sensitive to defects in the present situation. In this activity, the subjects are supposed to enumerate the causes of their attraction for some other 'section' or causes of their dissatisfaction with their present section. Hence, we can say that the item is quite suitable for being included in a test of creative thinking.

The number of relevant responses produced by a subject yields one measure of ideational fluency. The number of shifts in thinking or number of different categories of causes, gives one measure of flexibility. The statistical infrequency of the arguments given or the extent to which the response represents a mental leap or departure from the obvious and common-place, gives one measure of originality.

2. Asking Questions

"Suppose you visit the college library for the first time. Write as many questions as possible which you will ask the Librarian."
It was included in the test to give an opportunity to the subjects to express their curiosity which has long been accepted as an important aspect of scientific creativity and is recognized as being reflected in the number and kind of questions asked. A creative individual is a living question mark; he is a born skeptic and his insatiable thirst to know each and everything compels him to ask a number of questions. Thus, the ability to ask maximum number of questions is an essential characteristic of a creative personality.

Scoring is similar to that described for the first item.

3. Unusual Uses

"List below the most interesting and most unusual uses you can think of for a piece of Chalk."

This activity is a direct modification of Guilford's 'Brick Uses Test'. In his tests of creative thinking, Torrance substituted 'tin cans' and 'cardboard boxes' for bricks as he believed that children would respond more creatively to 'tin cans' and 'cardboard boxes' since bricks are less available for use by children in their play, and constructive, or experimental activities. As the present test is meant for use with student teachers, the investigator decided to substitute 'a piece of chalk' for 'bricks' 'tin cans' and 'cardboard boxes'. He believed that student teachers would respond more creatively to 'a piece of chalk' because it is frequently available to them in their professional activities. Moreover, it has almost unlimited potentialities as a stimulus to productive thinking.

The subjects are made clear that they have to write only unusual uses of 'a piece of chalk'. 'Writing on a blackboard'
is its common use and, therefore, will earn no score for them. Thus, the subjects are required to think off the beaten track and to break out of the mould.

This activity yields scores for fluency, flexibility, originality and elaboration determined in a manner similar to that described for the first item.

4. Guessing Causes

Mr. Sharma, a senior teacher, was reading a newspaper in the school library. A peon came to him and said, "Sir, Principal Sahib wants to see you." "Just coming," answered Mr. Sharma. When the peon had gone, Mr. Sharma got up and went to the Principal's office. As soon as he entered the office, the Principal shouted at him, "I have warned you many a times to change your ways but you have turned a deaf ear to my repeated warnings. So, I can't help suspending you. You will get the order of suspension and charge-sheet in a few minutes. You can go now."

The above account shows that the Principal and Mr. Sharma were having some differences. Think of as many causes as possible for their conflict.

5. Guessing Consequences

"What will be the consequences of the conflict between the Principal and Mr. Sharma? Give as many consequences as you can think of."

These two items were included in the test to give subjects an opportunity to exhibit their ability to develop hypotheses and think in terms of possibilities. In this regard, Torrance (1966b) has rightly observed, "Much of the essence of creative thinking, especially creative scientific thinking,
is captured in the processes of asking and guessing. Such a concept is certainly in harmony with the definition of creative thinking as a process."

These items are designed to reveal the subjects' ability to formulate hypotheses concerning cause and effect. We have already said that the ability to formulate hypotheses is an important component of creative thinking ability. These items provide unlimited opportunities to subjects to generate maximum number of ideas without any sort of inhibition.

These items also yield scores for fluency, flexibility and originality determined in a manner similar to that described earlier for the first item.

6. Suggesting Improvements

"Give concrete and practicable suggestions to bring about improvements in the library of your college. Give as many suggestions as you can think of."

This type of item is generally relished by the subjects. It is also attractive from the standpoint of administration and scoring. It permits the subjects to "regress in the service of the ego" and enables them to play with ideas that they would not dare express in formal situations. The subjects have a feeling of pride when they are asked to sit in judgement on some existing condition and to suggest a variety of ways to bring about improvement in that condition. Because of this strong motivation, they get uninhibited opportunities to play with ideas. In order to suggest improvements in an existing condition, a person has to become aware of its defects first. This means, he must be sensitive to the presence of problems and we have already said that "sensitivity to problems" is an important aspect of creativity.
As in the case of previous activities, the fluency score for this item is the number of scorable responses produced. The flexibility score is the number of different approaches used in producing ideas for improvement. The originality score is based on the statistical infrequency and appropriateness of the ideas produced.

7. Constructing Sentences

Make as many sentences as possible by using the following words:

Student, book, school, teacher.

Please see that every sentence includes these four words.

Ingenuity and inventiveness are important aspects of creativity. This item has been included in the test to enable the subjects to construct maximum number of sentences by using their ingenuity and inventive power. In a way, creativity also implies evolving new combinations out of existing elements. It is quite evident that a subject will be able to construct sentences in proportion to his level of creativity, that is, a highly creative subject will construct a large number of sentences, whereas a less creative individual will be able to construct a lesser number of sentences. Hence, the inclusion of this item in the test stands justified.

The sentences constructed by subjects defied categorisation. Therefore, flexibility score could not be determined in respect of this item. Besides, different subjects had constructed different sentences. Very few sentences had been repeated by different subjects. Therefore, it was difficult to determine originality score also. Thus, the only alternative left with the investigator was to entertain only fluency score.
D. DEVELOPMENT OF SCORING PROCEDURE

The Y-form of the test was administered to 200 teacher-trainees with a view to develop scoring procedure. Appropriate instructions were given to the subjects before starting the actual test. In order to ensure mental and emotional involvement of the subjects, suitable examples were explained.

The responses given by all the subjects were arranged alphabetically. The irrelevant responses were considered to be unscorable and, therefore, were struck off. The remaining relevant responses were categorised and category No. was assigned to each response, that is, each response was placed under a suitable category. The frequency of each response was counted and a response given by less than 5% of the testees was considered to be an original response and was assigned an additional credit of one score.

The scoring procedure thus developed is given in Appendix V. The most frequent responses to each item are listed category-wise. In each category, responses are listed alphabetically and originality weight is given in front of each response.

E. SCORING

After developing scoring guides for the test items, the investigator proceeded to score the tests. Each response given by subjects was evaluated on its merit. First of all, it was determined whether a response is scorable or not, that is, whether it has got relevance to the test activity or not. A response found to be irrelevant was eliminated from further scoring, that is, it was assigned a score of zero.
In all test items, compound sentences containing two or more distinct ideas were treated as two or more responses. These were, however, not confused with elaborated responses in which the additional information only elaborates a single idea.

Each scorable response was given a basal credit of one and was noted in front of it in the right hand margin of the response sheet. Thereafter, originality weight of each response was determined and was entered in the right hand margin by putting a sign of + after the fluency score. The originality weights of various responses have been given in the scoring guides (Appendix V).

The flexibility score is defined as a 'change' or shift in attitude or focus. Each shift or change in attitude or focus receives a point for flexibility. To determine the flexibility score for activities 1–6, the category No. of each response was noted in the left hand margin of the response sheet. The category duplications were struck out and the remaining responses were counted to get flexibility score on an item.

An elaborated response was given an additional credit of one point, but if a response had become an original response only because of elaboration, then, it was assigned only one additional credit for originality and no additional credit was given for elaboration. On the other hand, an elaborated response which is only an ordinary response, was given an additional credit for elaboration only. A response which was found to be both original and elaborated, was given additional credit for both originality and elaboration. The elaboration score was not
entered separately in the response sheet, but was added to the fluency score. Thus, an ordinary but elaborated response was assigned a fluency score of two.

In summary, we can say that an ordinary, common and routine type of response was assigned a score of 1, an original or elaborated response was assigned a score of 2, whereas an original as well as elaborated response got a score of 3. The scores thus assigned to all the responses to a test item were counted and further added to the flexibility score. In this way, one composite score was obtained for each of the items 1-6. In the case of item No. 7, only fluency and elaboration scores were added to get one score. The total scores on all the test items were combined together to get one composite score on the whole test. The average of inter-correlations among originality, fluency and flexibility scores was found to be .41. This positive substantial relationship justifies combining the three scores to get one composite score.

F. ITEM ANALYSIS

The scoring procedure outlined above was followed in scoring 200 tests out of which 180 tests were selected at random for the purpose of item-analysis. In order to know discriminative power of each test item, the investigator decided to follow the same procedure as was followed in the case of vocational anxiety scale. It was thought that an item would not prove a suitable item if it yields almost equal scores in respect of high creative and low creative individuals.

In the case of a creative thinking test, maximum possible score on an item is not known before hand because no
fixed value can be assigned to it. A subject will get score on an item in proportion to the number of responses he has produced and to the creative strength of his responses. Therefore, the highest score actually obtained by any subject was considered to be the maximum possible score on that item.

The index of discrimination of each item, as calculated by the modified Sumner's formula, is given in Table 5.

**TABLE - 5**

**ITEM-ANALYSIS OF THE TEST OF CREATIVE THINKING**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Total score U group</th>
<th>Total score L group</th>
<th>Max. score</th>
<th>Max. Possible score for N/3</th>
<th>I.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>847</td>
<td>550</td>
<td>23</td>
<td>1380</td>
<td>.22</td>
</tr>
<tr>
<td>II</td>
<td>1276</td>
<td>719</td>
<td>31</td>
<td>1860</td>
<td>.30</td>
</tr>
<tr>
<td>III</td>
<td>1006</td>
<td>592</td>
<td>25</td>
<td>1500</td>
<td>.28</td>
</tr>
<tr>
<td>IV</td>
<td>1333</td>
<td>773</td>
<td>33</td>
<td>1980</td>
<td>.28</td>
</tr>
<tr>
<td>V</td>
<td>1145</td>
<td>739</td>
<td>30</td>
<td>1800</td>
<td>.23</td>
</tr>
<tr>
<td>VI</td>
<td>1242</td>
<td>864</td>
<td>29</td>
<td>1740</td>
<td>.22</td>
</tr>
<tr>
<td>VII</td>
<td>382</td>
<td>225</td>
<td>10</td>
<td>600</td>
<td>.26</td>
</tr>
</tbody>
</table>

If both high achievers and low achievers obtain almost equal scores on a particular item, then, that item has little discriminative power. Such an item will not be a fit item to be included in a standardized psychological test. How much I.D. a good item must have? Most investigators generally fix .15 to .20 as the minimum desirable value of an I.D. Hence, in the present study also, it was decided arbitrarily that an I.D. of .20 adequately discriminates between the upper and lower group.
As all the items in the present test have an I.D. of more than .20, therefore, all the seven items were retained for the final form of the test.

In order to be more sure about the suitability of test items, it was further decided to determine the validity index of each item by some other procedure too. In this regard, Garret (1971a) states, "The validity index of an item, that is, its discriminative power, is determined by the extent to which the given item discriminates among examinees who differ sharply in the function (or functions) measured by the test as a whole. A number of methods have been devised for use in determining the discrimination power of an item. But biserial correlation is usually regarded as the standard procedure in item analysis. Biserial r gives the correlation of an item with total score on the test, or with scores in some independent criterion."

The discriminative power of an item implies its consistency with total score on the test and it is gauged by the correlation (r bis) of the item and the whole test. The biserial r is an estimate of the product-moment r, when the trait being measured is continuous and normally distributed.

Biserial r and point biserial r are both useful in item analysis, but biserial r is ordinarily not as valid procedure (nor as defensible) as is point biserial r (Garret, 1971b). Again, the point biserial r is a product-moment r and can be checked against r (Garret, 1971c).

Prompted by a desire to include only the most suitable, reliable and trustworthy items in the test, the
investigator chose the most laborious and time consuming procedure of computing Pearson r (product-moment) between each item and the test criterion (Total score on the test). The obtained coefficients of correlation between different test items and the criterion (Total score) are given in Table 6.

**TABLE - 6**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>r with Total Test</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>.64</td>
<td>highly significant</td>
</tr>
<tr>
<td>II</td>
<td>.59</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>.49</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>.62</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>.73</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>.55</td>
<td></td>
</tr>
<tr>
<td>VII</td>
<td>.57</td>
<td></td>
</tr>
</tbody>
</table>

It is clear from the above table that all coefficients of correlation between Item-total and Test-total scores are highly significant. Thus, all the seven items have proved their worth and indeed are very good items for being included in a test of creative thinking.

**G. RELIABILITY OF THE TEST**

The concept of reliability has already been discussed in the preceding chapter. The four main methods of establishing
reliability, that is, Test-retest method, Parallel test method, Sub-divided test method and the method of Rational equivalence were also mentioned.

It was not difficult to develop a parallel form of the present test of creative thinking. But it could not be done because of some practical difficulties including shortage of time. The test was administered in groups of 30 to 40 each. Thus, it took eight days to administer the test to about 300 subjects. Principals of Colleges had given permission to the investigator to administer the test only once in each group. Administration of a parallel form of the test to the same subjects was considered to be merely a wastage of time. Test-retest method could also not be employed due to these very practical difficulties. Besides, the subjects had become familiar with the test items after the first administration of the test. All the test items were quite interesting and thought-provoking. This might have tempted some subjects to think and discuss afterwards some more possible responses to various test items. This might have inflated the scores of such subjects if they were required to take the test for the second time. Therefore, the idea of using Test-retest method for establishing reliability was also dropped. Thus, the investigator resorted to split-half method which is equally useful in pointing towards internal consistency of the test.

The main objection to the Sub-divided test method is that a split-half reliability coefficient becomes meaningless when a test is highly speeded. The present test does impose
time limit but the time limit is for individual items and not for the whole test. Five minutes are given to the subjects to give responses to each of the items. After every five minutes, the subjects get a pause for sometime when the next item is explained and made clear by the examiner. Moreover, it has been found that five minutes is quite a sufficient time to give responses to an item. Most of the subjects stop giving responses to an item before the fixed time is over. Therefore, the present test of creative thinking is not a speed test in the sense most intelligence and achievement tests are. Like a personality inventory, all the subjects complete the whole test, whereas in an intelligence test, the subjects are able to attempt only a part of the test.

PROCEDURE

The seven-itemed test was administered to about 300 student teachers studying in three different colleges of education in Panjab. Out of the total lot, 200 tests were selected at random for determining reliability of the test. These 200 tests included 100 tests of male student teachers and the remaining 100 were those of female student teachers. All the tests were scored according to the scoring procedure described earlier.

Scores on odd and even items were totalled separately. A scattergram was plotted with total score on odd-items as Y-variable and total score on even-items as X-variable. Pearson product-moment $r$ was computed which came out to be .73. This value of correlation is between two half-lengths of the test. In order
to find the reliability coefficient of the full length test, the Spearman-Brown Prophecy formula was applied. The reliability coefficient of the whole test by this formula came out to be 

\[ r_{sb} = \frac{2r}{1 + r} \]

The significance of the obtained coefficient of reliability was tested by Fisher's Z function. Table G from Garret was consulted for converting \( r \) into \( Z \) and then \( Z \) back into \( r \). In \( r \) of .84 is equivalent to a \( Z \) of 1.22. The standard error of \( Z \) was found to be \( .07 \left( \frac{1}{\sqrt{N-3}} \right) \). In terms of \( Z \), the fiduciary limits were computed to be 1.08 to 1.36 and 1.04 to 1.40 at .05 and .01 levels of confidence respectively. When converted back into \( r \), the fiduciary limits came out to be .793 to .876 and .776 to .885 at .05 and .01 levels of confidence respectively. The width of fiduciary limits is so narrow that the trustworthiness of \( r \) is very high. For example, there are 95 chances out of 100 that \( r \) of .84 may fluctuate from .793 to .876 and 99 chances out of 100 that it may fluctuate from .776 to .885. In other words, we can say that there are only 5 chances out of 100 that the population \( r \) will miss the class interval .793 to .876 and only one chance out of 100 that it will miss the class interval .776 to .885.

**TESTING OF NULL HYPOTHESIS**

The null hypothesis 'that population \( r \) is zero' was tested by the following formula:

\[ t = \frac{r \sqrt{1 - r^2}}{\sqrt{1 - (r^2)}} \]

The 't' value computed as under is:

\[ t = .84 \left( \frac{200 - 2}{1 - (.84)^2} \right) = 21.78 \]
The computed 't' value of 21.78 is significant well beyond .01 level of confidence. Thus, the null hypothesis that 'the population r is zero,' stands rejected. This implies that we can be confident about the reliability of the present test of creative thinking. Its internal consistency is beyond doubt, that is, its various constituents measure what is measured by the whole test. The internal consistency of the test has already been demonstrated in a preceding section of this chapter. We have seen that each item of the test correlates significantly with the whole test (Table 6). The coefficients of correlation given in Table 6 are an adequate proof of the internal consistency of the test.

H. VALIDITY OF THE TEST

Validity has to do with the question of what test scores measure and what they will predict. A test is valid if it measures what it claims to measure. In the case of the test of creative thinking, we are interested in knowing whether it measures creative thinking ability or not. The test will be valid only if it measures creative thinking ability and not something else.

Torrance (1966 b) is of the view that the concept of an overall validity coefficient for tests of creative thinking ability is grossly inappropriate. In an effort to make the problem of validity approachable, he was led to think of creativity as a process. With this approach, one can then think in terms of the kinds of abilities necessary for the successful operation of the process in various situations or for the
production of various kinds of products. He can also think in
terms of the qualities of the products resulting from the process.
He can think of the kinds of personality characteristics,
group dynamic variables, and other environmental characteristics
that facilitate or impede the kind of functioning described by
the process definition.

A number of psychologists have given two main types of
evidence bearing on the validity of a test, rational and
empirical. In rational validity, we encounter a wide range of
testing situations in which appraisal of the validity of a
measuring procedure depends primarily upon the rational analysis
and professional judgement. The analysis may be of the topics
and areas included in the test -- its content. For this type
of analysis, we shall speak of content validity. The rational
analysis may be of the activities and processes that correspond
to a particular concept (such as scientific method), and we
may then speak of concept or construct validity.

The second main type of evidence of validity is empirical
and statistical. This type of evidence comes from the relation-
ship of the instrument that we are studying to some other measure
or fact. This 'other measure or fact' may be very closely
similar to our test, or it may be quite different. It may be
obtained at about the same time our test is given, or it may not
be available for a long time in the future. Congruent validity,
Concurrent validity and Predictive validity are three types or
categories of the empirical and statistical evidence of validity.

The method of congruent validity is widely used to
determine the validity of a measurement procedure. Torrance Tests
of Creative Thinking and a number of Guilford's Tests of Divergent Production are generally used by research workers to measure creative thinking ability. But the investigator could not use any of these tests because of a number of practical difficulties. The Principals of Colleges were reluctant to spare their students for more than three sittings. Moreover, the present test has been developed on the lines of TTCT and its correlation with this test would have been nothing but self-correlation. Again, very high coefficient of reliability of the present test indirectly speaks of its congruent validity.

Peer nominations, teacher nominations, educational achievement etc are generally acceptable criteria of concurrent validity. But no such method could be used in the present case because of practical difficulties. Predictive validity is, by far, the best procedure to establish validity, but it becomes very difficult to procure a suitable 'criterion measure'. The evidence of the effectiveness of our prediction is found in the coefficient of correlation between the test score and the later measure. In the limited time available for the present study, no suitable and practical 'later measure' different from the present test could be developed to assess 'creative thinking ability'. In the case of creative thinking, the later measure could only be a systematic record of the creative behaviour of the subjects. It was not possible for the investigator to adopt this very long procedure of establishing validity by following up 3, 200 cases individually. However, an humble attempt was made by the investigator in this direction. The student teachers who had obtained more than 120 scores on the test were selected by him
from his own college for intensive study. There were twenty one such students whose names are given in Appendix - VI.

The investigator interviewed all of them individually to know their interests, their past achievement in various fields and their ability for problem solving. Their performance in the various activities of the college was also watched carefully. For example, their performance in formal discussions, debates, declamation contests, poetical symposia, poetry, story and essay writing competitions was observed; their contributions to the Wall magazine, to the college magazine and other literary and professional magazines was taken into consideration; their performance in the fields of art, painting and music was also accounted for. Above all, their ability to improvise new teaching aids and to draw sketches and cartoons was also given due consideration. The investigator also discussed these subjects with his colleagues with a view to know their opinion about their personality characteristics and intellectual abilities.

The evidence collected about these creative individuals through various sources was then processed and organised to arrive at certain conclusions. It was generally realised that all these individuals possessed creative thinking ability in sufficient degree. Their behaviour in various situations could rightly be called 'creative behaviour.'

The subject at Sr. No. 1 was very quick in doing things. She was always very curious to know such things as do not have any interest for ordinary students. Her two articles on 'Fossils' and 'Hypnotism', published in the college magazine, are a
sufficient proof for her interest in uncommon things. The subject at Sr. No. 2 was very good in painting and music. One painting of her was highly commended in the regional youth festival of Guru Nanak University. The subject at Sr., No. 3, had qualities of leadership in abundance. By virtue of her qualities, she was appointed head-girl of the college girls' hostel. The hostel superintendent told the investigator that she was very quick in solving even very complicated problems which she encountered while running the hostel. The subject at Sr., No. 4, was known for having curiosity and originality in abundance. According to her Art teacher, she was very imaginative in her paintings. The subject at Sr., No. 5 was very bold in speaking and could give a number of suggestions in the class very fluently. She used to participate very effectively in class-room discussions. The subject at Sr., No. 6, was thought to be a rebellious student because of her free and frank opinions. She was very good in painting. One of her paintings still adorns the walls of the college Art Room. The subject at Sr., No. 8, was known for her independent thinking. The subject at Sr., No. 9, was very quick in thinking a number of alternative examples while teaching a lesson. She published a poem and an article in the Hindi Section of the college magazine. She had already published a number of articles and poems in the magazine of her previous college. The subject at Sr., No. 10, was generally thought to be independent in thinking. She was very sensitive to problems and could put her heart and soul in finding solutions to her problems. The subject at Sr., No. 11, had stood first in the regional youth festival of Guru Nanak University in the
symposium of speakers, she was required to ask maximum number of relevant questions to other competitors and was also obliged to answer the questions put by other contestants. Later on, she was adjudged second in the inter-region youth festival of the university in a similar contest. Besides, she won a number of prizes in many declamation contests. Her story published in the college magazine was highly appreciated. The subject at Sr. No. 12 was thought to be a mischievous student. However, he was thought to be original in his thinking. He was good in painting too, and one of his paintings still adorns the walls of the college art room. The subject at Sr. No. 13, composed very good poems in English which were later published in the college magazine. He also wrote a couple of beautiful articles for the college magazine. He was also selected as the editor of English section of the college magazine. The subject at Sr. No. 14 was appreciated for his ability and skill in art and painting. His art teacher had found him imaginative in thinking. The subject at Sr. No. 15 was known for his unusual ideas. His articles published in the Panjabi section of the college magazine were warmly received by the readers. The subject at Sr. No. 16, prepared original and altogether different articles of wood. His craft teacher was very appreciative of him because of originality and novelty of his work. The subject at Sr. No. 17, was adjudged best poet of the college in Hindi. He recited his self-composed poems on many occasions and won appreciation from the audience. The subject at Sr. No. 18 possessed sense of humour in sufficient quantity. He could make even sad and gloomy persons laugh. He was generally able to make his lessons interesting for
the students by giving interesting examples and improvising good teaching aids. The subject at Sr. No. 19 used to put very thought provoking questions in the classes. He published two articles in the college magazine. The subject at Sr. No. 20 had practised the art of stimulating interest in the pupils by making use of alternative methods of teaching. The subject at Sr. No. 21 was observed many times participating in informal discussions very effectively.

The content and construct validity of the test were established rationally through critical examination and professional judgement. A list of twelve items (X-form) was sent to Dr. E. Paul, Torrance of Georgia University, U.S.A; for his suggestions and comments. The purpose of the test and the population with which it was to be used, were explained to him. He found eleven items out of a total of 12, quite suitable for a test of creative thinking. He was also kind enough to select seven most acceptable items in order to reduce the length of the test.

In India, seven psychologists having good standing in the field of measurement, were approached to go through the seven selected items of the test. A few of them were actually guiding research in creativity. The investigator also met them personally and explained to them the meaning and nature of creativity and also administration procedure of the test. He sought from them answers to the following questions—What is the nature of the psychological variable being measured? Is administration procedure all right? Are examples and instructions relevant?

All the judges were perfectly satisfied with the relevance of the test.
ESTABLISHING VALIDITY INDIRECTLY FROM OTHER STATISTICS

Index of Reliability

The degree to which a test measures what it is designed to measure may be called the index of reliability or intrinsic validity. This definition can also be stated in terms of how well the obtained scores measure the test's true score component.

The intrinsic validity is indicated by the square root of the proportion of true variance, in other words, the square root of its reliability. The reliability coefficient of the present test has been computed to be .84. Therefore, its index of reliability is .92, which is definitely very high and speaks of the intrinsic validity of the test.

For validity, the test has to be reliable first. Only a highly reliable test can prove to be a valid test. We cannot think of validity of an unreliable test.

Index of reliability is very useful in determining relation of validity to length of the test. Guilford (1954) states, "The nearer the index of reliability is to 1.00, the less effect will lengthening have on validity." The index of reliability in the case of present test is very near to .92, so there is no need of lengthening the test.

It has become evident that the present test of creative thinking is a quite reliable and valid instrument to measure creative thinking ability in teacher-trainees. It will get refined and perfected in due course of time, when it will be used in some later studies and will be validated against some other suitable criterion measures.


Ibid 1971 c, pp 383.


Ibid 1969 b, pp 16-43

Ibid 1969 c, pp 78.
Torrance, E.P. (1966)


Ibid

Torrance, E.P. and D.C. Dauw (1965)


Torrance, E.P. and D.C. Dauw (1966)


Wallach, M.A. and Nathan Kogan (1966)

Modes of Thinking in Young Children.

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