CHAPTER TEN

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INTRODUCTION

The present study entitled 'Differential Predictive Efficiency of Creativity and Intelligence for Academic Achievement at two Piagetian Stages of concrete Thinking and Formal Thinking' was designed with a view to exploring the extent to which creativity and intelligence, individually and conjointly predict academic achievement in different school subjects namely, social studies, general science and first language; as also to ascertain the occurrence of changes, if any, due to the intellectual growth from Piagetian concrete to formal operational stage on the predictability of these cognitive variables towards academic achievement.

Empirical studies casting doubt on IQ as an adequate summary of an individual's intellectual capacities have lent support to the fact that mere level of ability as measured through the conventional tests of intelligence is not the key factor which distinguishes successful students from others, potentially of the same ability who don't succeed (111 studies cited by Stephens, 1960; and 835 studies referred to by Rao, 1963). Guilford (1950), in his address to the American Psychological Association, too, drew attention towards the narrow conceptualization of intelligence. His
three dimensional 'Structure of Intellect' includes cognition, memory, evaluation, divergent thinking along with convergent thinking as operations. Divergent thinking, the functioning of which formulates the chief factor of creativity also incorporates idea production, fluency, flexibility and originality (Guilford, 1950). These arguments were further supported by Getzels and Jackson's (1962) findings that a similar narrowness permeated thinking regarding the kinds of processes that constitute efficient and worthwhile structural basis for academic achievement, and by the results of many more studies showing the existence of significant correlations between creativity and achievement (vide research studies cited in Chapter II). These findings, especially where measures of creativity were not highly related to intelligence but were significantly related to achievement led to the considerations that intelligence and creativity contribute independently towards achievement. Such a consideration, however, is not without contradictions as very low correlations of creativity with achievement have also been reported in several research studies referred to earlier in chapter II. The equivocal nature of results with regard to creativity-achievement relationship, and the absence of developmental and replicative studies in respect of methodology and research designs, especially in Indian conditions, necessitate more rigorous investigations
into the area leading to the furtherance of the formulation of a sound theory of correlates of academic achievement.

The present study, essentially multivariate in nature, aims at establishing the nature and extent of relationship between independent variables of creativity and intelligence and the criterion variable of academic achievement, as also ascertaining the factorial structure underlying creativity, intelligence and achievement. With a view to probing intensively into the nature of such relationships, it was attempted to making achievement independent of the variance, firstly due to intelligence and secondly due to creativity before relating the obtained achievement scores with creativity and intelligence respectively. The extent of predictability of creativity and intelligence, individually and conjointly towards achievement for each of the three school subjects i.e. social studies, general science and first language was explored across two different age levels representing Piagetian concrete and formal operations. In addition, the interactional effect of creativity and intelligence in explaining individual differences in different achievement areas was also studied.

The study was directed towards the testing of the following hypotheses:

1. (a) Creativity and achievement correlate significantly and differentially in different teaching subjects at the school level.
(b) Intelligence and achievement correlate significantly and differentially in different teaching subjects at the school level.

2. (a) Creativity and intelligence are differentially related to achievement in different subjects.
(b) The relationship of creativity and intelligence with achievement differs at concrete and formal operational stages.

3. (a) Creativity scores and intelligence free achievement scores correlate significantly and differentially in different school subjects.
(b) Intelligence scores and creativity free achievement scores correlate significantly and differentially in different school subjects.

4. (a) Creativity predicts achievement significantly and differentially in social-studies, general science and first language.
(b) Intelligence predicts achievement significantly and differentially in social-studies, general science and first language.
(c) Creativity and intelligence account for differential prediction of achievement in various school subjects.

5. The conjoint effect of creativity and intelligence in the prediction of academic achievement in different teaching subjects is significantly higher than their separate predictions.
6. (a) Measures of creativity and intelligence cluster in specific combinations with the measures of achievement yielding different common factor/s.

(b) The factor structure underlying the measures of creativity, intelligence and achievement differs at the two Piagetian stages of concrete thinking and formal thinking.

7. (a) High and low creative groups differ significantly on achievement in various school subjects.

(b) High and low intelligence groups differ significantly on achievement in various school subjects.

(c) The interactional effect of creativity x intelligence on achievement in different school subjects is significant.

METHOD

SAMPLE

Two sub-samples consisting of (a) 461 students (240 boys and 221 girls) in the age range of 10 to 11 years at the concrete stage and (b) 490 students (249 boys and 241 girls) in the age range of 14 to 15 years at the formal stage were drawn from three of the twelve district headquarters of Punjab i.e. Ferozepur, Jalandhar and Ludhiana by employing the 'Multi-staged-Stratified-Randomization' technique of sampling.
The following tools for data collection were used:

(1) Thinking Creatively with words, Form-A; and Thinking Creatively with Figures, Form-A (Torrance, 1966a & b).

(2) Group Test of General Mental Ability, 2/60 (Selota and Singh, 1967).


Achievement scores: Achievement scores in social-studies, general science and first language were based on three examinations, two terminals of the present class and last year's final examination. In order to minimize the effect of subjectivity in marking, the achievement scores on these examinations were converted into standard scores and averaged to yield one single score for each subject separately.

STATISTICAL TECHNIQUES

The raw scores obtained on the tests of creativity were converted into standard scores for the purpose of deriving additive scores in different dimensions of creativity along with the totals for the verbal and figural tests separately. Likewise, intelligence test scores for both
the verbal and non-verbal were also transformed into DLQs. The derived scores thus obtained on achievement, creativity and intelligence were utilized for further analysis of data. The descriptive statistics were computed to find out the nature of score distributions. Test of linearity was employed for studying the relationship between the criterion and predictor variables.

In addition, the following statistical techniques were used for analyzing the data:

- Product-moment correlations and multiple regression equations to examine the relationship of creativity and intelligence with original as well as discrepancy achievement scores.

- Step-up regression equations and significance of difference between R's for ascertaining the conjoint and differential predictability of creativity and intelligence for academic achievement in different school subjects at both concrete and formal stages.

- Factor Analysis to identify the factor pattern underlying creativity, intelligence and achievement.

- 2 x 2 analysis of variance and t-ratios for studying the interactional effect of creativity and intelligence on achievement in different teaching subjects and for examining differences in achievement between groups formed on the basis of levels of creativity and intelligence.
RESULTS AND CONCLUSIONS

Based upon the above analyses, as discussed in chapters IV to IX, the following results were obtained:

A. CORRELATIONS

(1) The correlations between the measures of (a) creativity and achievement, and (b) intelligence and achievement are significant at .01 level for all the three subjects namely, social-studies, general science and first language across both the operational stages - concrete and formal.

(2) Creativity significantly relates to intelligence free achievement (discrepancy achievement scores) in majority of cases. Likewise, intelligence remains significantly related to discrepancy achievement scores (i.e. achievement free from creativity).

(3) In general, the values of correlation between intelligence and achievement are higher than those between creativity and achievement. This is true for:

(i) original as well as discrepancy achievement scores,
(ii) both concrete and formal operational stages, and
(iii) all the three teaching subjects, that is, social-studies, general science and first language except for achievement in social-studies at concrete operational stage which is almost
equally related to both creativity and intelligence.

(4) The relationship of discrepancy achievement scores - creativity free achievement with intelligence; and intelligence free achievement with creativity shows a declining trend when compared with those obtained between original achievement scores and independent variables of creativity and intelligence.

(5) Verbal creativity shows higher degree of association with achievement (both original and discrepant) than figural creativity. Likewise, verbal intelligence in comparison to non-verbal intelligence reveals higher association with original and residual achievement.

(6) 'Flexibility' of verbal and figural creativity at concrete operational stage is slightly more related to academic achievement than other dimensions of these tests. No consistent picture of correlations between different dimensions of creativity and achievement emerges at the formal stage.

(7) Of the teaching subjects, at concrete operational stage achievement in social-studies shows highest values of correlation with creativity to be followed by correlations between creativity achievement in first language and general science. While, at formal operational stage, achievement in social-studies, general science and first language emerge with
almost equal values of correlation, thus suggesting that creativity, which is differentially related to achievement in different subjects at concrete stage, relates almost equally to all the three subjects at formal operational stage.

(8) Achievement in social-studies reveals higher association with creativity at concrete operational stage than at formal operational stage, while achievement in general science is more related to creativity at formal operational stage than at concrete operational stage.

(9) At concrete operational stage creativity relates more to intelligence free achievement (discrepant scores) in social-studies as compared to other two subjects. While, at formal operational stage it relates almost equally to intelligence free achievement in all the three subjects. The relationship of figural creativity with intelligence free achievement in first language, however, is slightly higher than its relationship with achievement in social-studies and general science.

(10) When achievement in different subjects is made free from creativity, at concrete operational stage the differential relationship of intelligence with achievement in social-studies, general science and first language is not observed as it is nearly
equally related to all the three subjects. But, at formal operational stage, verbal intelligence relates more to achievement in social-studies than achievement in other two subjects. Non-verbal intelligence on the other hand, is differentially related to creativity free achievement at concrete stage as achievement in social-studies and first language are favoured more than general science by non-verbal intelligence. Such relationship, however, are almost similar for all the three subjects at formal operational stage.

(11) The relationship of intelligence with achievement in various school subjects remains almost identical at each of the operational stage except for non-verbal intelligence which related more to achievement in social studies than other subjects at concrete operational stage.

The hypotheses 1(a) that "creativity and achievement correlate significantly and differentially in different teaching subjects at school level" and 1(b) that "intelligence and achievement correlate significantly and differentially in different teaching subjects at school level" hold tenable in as much as the significance of relationship between the measures of (a) creativity and intelligence, and (b) intelligence-
and achievement is found to be significant at .01 level for all the school teaching subjects across both the operational stages. But when these hypotheses are examined for differential relationship, the results reveal that creativity relates more to social-studies in comparison to first language and general science at concrete operational stage alone, suggesting thereby that divergent thinking has greater sharing of variance with social-studies than general science. In the remaining situations both creativity and intelligence do not demonstrate differential picture of relationship with achievement (vide results contained in paras at S Nos. 6, 7 and 11).

Part (a) of the second hypothesis that "creativity and intelligence are differentially related to achievement in different subjects" and hypothesis 2(b) that "the relationship of creativity and intelligence with achievement differs at concrete and formal operational stages" have been confirmed in view of the results stated in paras at serial numbers 3, 7 & 11; and 6, 7 & 8 respectively. Likewise, part (a) of the third hypothesis that "creativity scores and intelligence free achievement scores correlate significantly and differentially in different school subjects" has been accepted at both the stages except for the relationship of verbal creativity with achievement free from intelligence at formal operational stage (vide results mentioned at S Nos. 2 and 9). The second part of the third hypothesis, stating that "intelligence
scores and creativity free achievement scores correlate significantly and differentially in different school subjects" has been accepted only partially as intelligence is found to be significantly related to achievement in all the three subjects (vide result No.2) but was differentially related only in case of non-verbal intelligence and achievement free from creativity at concrete stage, and verbal intelligence and creativity free achievement at formal operational stage (vide result No.10).

Implied by the above results it can be inferred that creativity contributes higher towards achievement in social studies in comparison to other two subjects at concrete operational stage but shares relatively less common variance at formal operational stage thus leading to almost equal relationship of creativity with different school teaching subjects. Intelligence, on the other hand, contributes more towards achievement in all the three subjects at formal operational stage as compared to concrete stage. This may be because of the change in the educational practices from concrete to formal stage or because of the fact that both the abilities, that is, creativity and intelligence, grow more independent with the advancement of age as is manifested by relatively low values of correlation between creativity and intelligence at formal operational stage.
B. PREDICTIONS

INTER-SUBJECT COMPARISONS

(1) Creativity emerges as a significant predictor of academic achievement both at the concrete and the formal operational stages. It predicts achievement in various school subjects significantly differentially at concrete operational stage. The predictive efficiency of creativity for achievement in social-studies is higher than for first language and general science beyond chance factor at .01 level. On the other hand, at formal operational stage creativity predicts almost equally, yet significantly the achievement in social-studies, general science and first language. Therefore, part (a) of the fourth hypothesis that "Creativity predicts achievement significantly and differentially in social-studies, general science and first language" is accepted for its significant predictions at both the stages. But it is confirmed only at concrete operational stage with regards to differential predictions of creativity for achievement in different subjects. These findings thus suggest that achievement in social-studies which permitted creative abilities to play a role of greater magnitude than other subjects, could not do so with the advancement of age and grade at formal operational stage. Therefore, it may not be over generalization to argue that creative abilities are repressed in their predictive efficiency towards achievement due to the prevalent system of education characteristic to formal stage.
(ii) Intelligence, too, predicts significantly the achievement in all the three subjects at both the operational stages. At concrete operational stage, predictions made by intelligence for different achievement areas do not differ significantly from one another, but at formal operational stage the prediction of achievement in social-studies due to intelligence is significantly higher as compared to in general science and first language for which the predictability of intelligence is almost similar. The hypothesis \( H(b) \) that "intelligence predicts achievement significantly and differentially in social-studies, general science and first language" stands accepted in as much as significant predictability of intelligence towards different subjects is concerned. The latter part of the hypothesis dealing with differential predictive efficiency of intelligence for achievement in various subjects has been confirmed in two out of three situations at formal operational stage and for none of the situations at concrete operational stage, thereby implying that, with the shift from concrete operational stage to the formal operational stage, the general mental ability, i.e. intelligence, through its functioning in influencing achievement establishes to be a better predictor for social-studies than other two subjects.

**INTER-VARIABLE CORRELATIONS**

(i) Except for the achievement in social-studies which is predicted with equal efficacy by the variables
of creativity and intelligence, the achievement in all other subjects is better predicted by intelligence than by creativity at concrete operational stage.

(ii) At the formal operational stage, the predictability of intelligence towards achievement in all the three subjects, namely, social-studies, general science and first language is significantly higher than the predictability of creativity towards these subjects.

These results, therefore, safely permit the acceptance of hypothesis b(c) that "creativity and intelligence account for differential predictions of achievement in various school subjects," for all the three teaching subjects at formal operational stage and for two out of the three subjects at concrete operational stage. It seems that as the educational stage progresses higher in the hierarchy from concrete to formal operational stage the examination system puts an increased premium on memory and factual knowledge, which are so closely related to intelligence. The creative responses, on the other hand, find relatively less appreciation in lieu of confirmation and social acceptance in the context of the present-day examinations.

INTER-STAGE COMPARISONS

(1) Except for the prediction of achievement in social-studies which is significantly higher at concrete operational stage in comparison to formal operational stage, achievement
in all other subjects i.e. general science and first language is equally efficiently predicted by the measures of creativity at both the stages.

(ii) The prediction of achievement in social-studies and general science made by intelligence is significantly higher at formal operational stage as compared to concrete operational stage, while the prediction of achievement in first language due to intelligence is similar at both the operational stages.

The (d) part of the fourth hypothesis, that "the prediction of creativity and intelligence for academic achievement is significantly different at concrete and formal operational stages", therefore, stands accepted as during the developmental process from concrete to formal operational stage the role of creativity in predicting achievement in social-studies decreases whereas, the role of intelligence increases; for achievement in general science predictive efficiency of creativity remains stable though intelligence emerges with greater influence; and achievement in first language remains predicted with equal efficacy by the variables of creativity and intelligence at both the operational stages.

CONJOINT PREDICTIONS

The prediction of academic achievement in social-studies, general science and first language on the basis of the conjoint effect of creativity and intelligence is significantly higher than their separate prediction, at both concrete and
formal operational stages, meaning thereby that although creativity and intelligence are significantly related to each other as is found through their positive significant 'r' values yet, they have their distinctive components, which in their own way are positively related to achievement and when put conjointly increase the potentiality of these variables in predicting academic achievement. The fifth hypothesis, thus holds tenable at both the operational stages suggesting thereby that the addition of intelligence adds significantly to the predictability of creativity towards achievement in different subjects. Likewise, addition of creativity increases the predictability of intelligence.

C FACTOR ANALYSIS

The factor structure underlying creativity, intelligence and academic achievement as identified at concrete and formal operational stages, yields four interpretable original and rotated factors at each operational stage, which are relevant to the study. The original factors at concrete operational stage are: 'General factor of Cognition', 'Group factor of academic achievement' which shares significant variance with verbal intelligence and is characterized by negative loadings on figural creativity measures, 'Group factor of verbal creativity' sharing negative loadings on achievement in science and first language, 'Group factor of non-verbal intelligence' sharing just significant loadings with verbal intelligence; and rotated factors are: 'Group factor of figural creativity, 'Group factor of academic achievement' sharing commonness with verbal intelligence, 'Group factor of verbal creativity' having mild significant loadings on figural creativity and achievement
in general science and 'Specific factor of non-verbal intelligence'. At formal operational stage four original and rotated factors are: 'General factor of cognition', 'Group factor of figural creativity' sharing common variance with achievement in general science, social-studies, verbal intelligence, verbal originality, flexibility and total verbal creativity on the negative pole, 'Group factor of intelligence, creativity and achievement' with significant all loadings, all on the negative pole for the variable excepting figural creativity, and 'specific factor of non-verbal intelligence'; and 'Group factor of verbal creativity', 'Group factor of figural creativity', Group factor of scholastic ability' and 'Group factor convergent thinking' respectively. These factors indicate that:

(1) Both intelligence and creativity may be conceived as correlates of academic achievement as all the three variables belong to the same cognitive domain (vide original factor I at both the stages).

(2) Although belonging to the same cognitive domain the variables of creativity, intelligence and academic achievement are factorially distinguishable (vide Original and rotated factors II, III, IV; and I, and IV at concrete stage respectively and original factors II & IV and rotated factor I to IV at formal operational stage). This, at the same time establishes the factorial validity of verbal and figural creativity as separate
tests in the creativity test battery (vide original factor III and rotated factor I at concrete stage and, original and rotated factor II and I at formal operational stage respectively).

(3) In their factorial relationship intelligence and achievement have appeared together with almost equal frequency (vide original factors I, II & IV, and rotated factor II at concrete stage, and original factors I, II & IV and rotated factor III at formal stage) as creativity and achievement (vide original factors I, II & III and rotated factor III at concrete stage and original factors I and II, and rotated factor I at formal stage).

(4) Verbal intelligence and verbal creativity have appeared with academic achievement on various factors more frequently (vide original factor I to III and rotated factor II at concrete stage and original and rotated factors I to III and III at formal stage respectively) than non-verbal intelligence and figural creativity respectively (vide original factor I, & II at concrete stage & original factors I & III at formal stage).

(5) Academic achievement in all the three subjects namely, social-studies, general science and first language appear with more or less similar factor structure in clustering together with creativity and intelligence at both the stages.
(6) The variables of creativity, intelligence and academic achievement have emerged together with almost similar factor structure at both the operational stages.

On the basis of the nature of factor structure obtained, part (a) of the sixth hypothesis, that is "Measures of creativity and intelligence cluster in specific combinations with the measures of achievement yielding different common factor(s)" is accepted at both the operational stages. Part (b) of the same hypothesis, stating that "the factor structure underlying the measures of creativity, intelligence and achievement differs at two Piagetian stages of concrete thinking and formal thinking" does not stand accepted which further leads to infer that creativity and intelligence through their product-moment correlations are differentially related to achievement in different teaching subjects at concrete and formal operational stages but their structural relationship with achievement, as identified through factor analysis remains stable from concrete to formal operational stage as all the variables remain grouped together in first original factor and become distinguishable in subsequent factors.

D. ANALYSIS OF VARIANCE AND T-TEST

(1) The effect of the variable of intelligence on academic achievement in social studies, general science and first language is found to be significant and in favour of the high intelligence group both at concrete and formal
operational stages. In general, creativity too significantly
influences the academic achievement in various subjects at both
the stages except for a few situations at the formal operational
stage wherein the effect of creativity seems to decline with
the increase in grade.

(2) The interactional effect of intelligence (verbal and
non-verbal) x creativity (verbal and figural) in their different
combinations at concrete operational stage has been found to be
significant only for the combination of non-verbal intelligence
and figural creativity and that too for achievement in social-
studies alone. The mean differences show that the performance
of the high-high group and low-high group is significantly
better than their counterparts, that is, high-low and low-low
groups respectively. At formal operational stage too of the
various combinations of interactions involving intelligence
and creativity, namely, (1) non-verbal intelligence and verbal
creativity for achievement in social-studies and first language;
and (2) verbal intelligence and figural creativity for achievement
in first language, emerge as significant, being in favour of
high-high group in comparison to remaining three groups i.e.
high-low, low-high and low-low. Likewise, the High(Vv.Int) -
Low(V_{cy-T}) and Low (Vv.Int) - high (V_{cy-T}) groups reveal
significantly higher performance than the Low(Vv.Int) - Low
(V_{cy-T}) group, and high V.Int) - Low(F_{cy-T}) groups performs
better than the Low (V.Int) - high (F_{cy-T}) and Low (V.Int) - Low
(F_{cy-T}) groups on achievement in first language.
Thus, though part (a) of the seventh hypothesis, that is, "high and low creative group differ significantly on achievement in various school subjects" has been confirmed in fifty percent situations at the formal operational stage and all the situations at concrete operational stage, part (b) that is "high and low intelligence groups differ significantly on achievement in various school subjects" has been confirmed at both the operational stages. Regarding the emergence of significant differences on achievement due to the interaction of creativity and intelligence, (c) part of the seventh hypothesis holds tenable in one out of four combinations at concrete operational stage and two out of four combinations at formal operational stage.

In general it may be said that though the variable of creativity, which results into significant effect along with intelligence, on the academic performance at concrete operational stage becomes non-significant at the formal operational stage when the groups are formed on the basis of verbal intelligence and verbal creativity, and verbal intelligence and figural creativity, yet in its interaction with intelligence, it becomes more responsive at formal stage than at concrete operational stage, in producing variations among high creative groups than low creative groups with similar level of intelligence.
CENTRAL CONCLUSIONS AND EDUCATIONAL IMPLICATIONS

Creativity and intelligence are interrelated modes of the same intellectual functioning, yet at the same time, in factor structure, they are distinguishable from each other. During the developmental process from concrete to formal operational stage, their distinctiveness increases.

Both creativity and intelligence are significantly related and both are potential predictors of academic achievement in various school subjects namely, social-studies, general science and first language, at concrete as well as at formal operational stage. The predictive efficiency of creativity towards school subjects, in general decreases and that of intelligence increases as the educational hierarchy progresses from lower to higher grades leading to significant changes in the differential predictions of both these variables towards academic achievement.

Creativity accounts for a significant substantial amount of criterion variance even after partialling out the effect of intelligence from achievement. Likewise, when the variance due to creativity is partialled out, intelligence remains significantly related to it. This is true for both the operational stages.

The conjoint prediction of creativity and intelligence towards academic achievement in various school subjects is significantly higher than that of each variable taken separately both at concrete and formal operational stage.
The interactional effect of creativity and intelligence in explaining individual differences in different achievement areas is significant only in limited situations and the number of interactional combinations which appear significant increase from concrete to formal operational stages.

Bearing the significant and differential role played by creativity and intelligence in predicting academic achievement, sound admission policies, educational practices and evaluation techniques cannot afford to neglect either of the abilities. The findings of the present study have implications for the phenomenon of under and over achievement too, in suggesting the argument that the term 'underestimation' more meaningfully describes the phenomenon usually accounted for by the use of the term 'overachievement', when it is solely based on intelligence measures.

The trend of relatively lowered values of correlation, although none the more significant, between creativity and achievement at formal operational stage in comparison to more conventional measures may be seen as supportive of the evidence of the extent to which our schools are dominated by the emphasis on convergent processes more especially at high school stage as creative abilities, from concrete to formal operational stage although revealed developing trends (mean for verbal and natural creativity at concrete stage = 61.45 & 90.68; and at formal operational stage 138.36 & 163.06 respectively), yet their relationship with achievement emerges with relatively low values.
of correlation at formal operational stage in comparison to concrete operational stage. The changed expectations of teachers from primary to secondary schools in the form of facilitation and reinforcement of convergent processes coupled with intolerance for unconventional inquisitiveness may serve as classroom blocks to inhibit creative potential from being fully expressed. Consequently, it may not be too much to suggest that teaching strategies which encourage creative thinking assume particular importance if the educational outputs are to be innovative and adaptive rather than fixed and immutable. Thus, it may not be too far stretched to say, that both for the realization of individual potentialities and social needs, nurturing and fostering of creative talent must receive due recognition in the educational system.