CLASSROOM INTERACTION, ACADEMIC ACHIEVEMENT AND CREATIVE PERFORMANCE IN SIXTH GRADE CLASSROOMS

Thesis for the Degree of Ph. D.
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JOHN R. ANDERSON
1972



This is to certify that the

thesis entitled

CLASSROOM INTERACTION, ACADEMIC ACHIEVEMENT AND CREATIVE PERFORMANCE IN SIXTH GRADE CLASSROOMS

presented by

John R. Anderson

has been accepted towards fulfillment of the requirements for

Ph. D. degree in Secondary

Education and Curriculum

College of Education

Major professor

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Purpose:

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Procedures: Creativity wa

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ABSTRACT

CLASSROOM INTERACTION, ACADEMIC ACHIEVEMENT AND CREATIVE PERFORMANCE IN SIXTH GRADE CLASSROOMS

Bv

John R. Anderson

Purpose:

The purpose of the study was to answer the following two questions: (1) What relationships exist between measures of divergent thought and measures of problem-solving devised for the study? (2) What relationships are found between measures of classroom verbal interaction and measures of divergent thought and problem-solving performance?

Procedures:

Creativity was defined as a problem-solving activity in which solutions, unique among peers, are produced in response to given conditions and problem requirements. Data were obtained from 769 pupils in thirty sixth-grade classrooms in twenty-four schools. Teachers were selected from a larger sample of 101 sixth-grade teachers of South Central Michigan. Based upon average classroom score obtained from the Michigan Pupil Attitude Inventory, ten high, ten middle and ten low-scoring classrooms were selected for further study.

Two figural and were selected from th tasks of problem solv and Suggesting Solut: The seven tasks 1st Your Imagination with two Forms of th inns of the Metropo in January and May, Seven observers deservation to obtai from each of the thi Four classroom issted in multiple r of creative performa termed pupil-initia frequency of pupil-j The second variable, similarly defined as

suspected or discussed ulled by the mnemon distancer talk ideal wranging, and acces we defined as the URD). The ratio o Two figural and two verbal tasks of divergent production were selected from the <u>Minnesota Test of Creativity</u>. Three tasks of problem solving--Seeing Problems, Asking Questions, and Suggesting Solutions, were developed prior to the study.

The seven tasks were combined to form the instrument,

Test Your Imagination. A pre-, post-treatment design was used
with two Forms of the test, Test Your Imagination, and two
forms of the Metropolitan Achievement Test (MAT) administered
in January and May, 1965.

Seven observers used the Flanders system of classroom observation to obtain at least seven hours of interaction data from each of the thirty classrooms.

Four classroom interaction variables were defined and tested in multiple regression with pre-experimental test scores of creative performance and academic achievement. The first, termed pupil-initiated talk mesh (PIM) was defined as the frequency of pupil-initiated talk accepted by the teacher. The second variable, pupil-directed talk mesh (PDM) was similarly defined as the frequency of pupil-directed talk accepted or discussed by the teacher. The third variable, called by the mnemonic, IDEAS, was defined as the frequency of teacher talk identifying, developing, expanding and encouraging, and accepting student ideas. The fourth variable was defined as the ratio of silence to silence plus confusion (10R). The ratio of indirect to direct teacher influence

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Results

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$^{ m Conclusions}:$

Four conclusi

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PDM Was generally

- (1) Creative
- solving product ar
- (2) Creative the quality of the

(i/i+d) from an earlier study by Flanders was included as an additional variable of classroom interaction.

Results

The coefficients of correlation between problem-solving and divergent thinking measures of creative performance were found to be positive and statistically significant at the .05 level. The problem solving measures correlated as high with the figural and verbal tasks scores of divergent thinking as the correlation coefficients obtained between the latter two measures. Three classroom interaction variables, PIM, IDEAS and 10R were found significant independent variables in regression with scores of creative performance. In addition, PIM was a significant variable in regression with the verbal task sub-scores, IDEAS was found significant in regression with figural and problem-solving tasks sub-scores and 10R was found significant with all three tasks' sub-total scores.

Conclusions:

Four conclusions were made:

- (1) Creative performance can be considered a problemsolving product and process.
- (2) Creative performance of pupils can be facilitated by the quality of the verbal classroom interaction.

(3) The promot detract from a supp (4) The class:

seatwork will faci: formance.

- (3) The promotion of creative performance does not detract from a support of academic achievement.
- (4) The classroom that exhibits flexibility in the use of pupil-initiated ideas, IDEAS and the use of silence and seatwork will facilitate both academic and creative performance.

CLASSROOM

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in part:

Department

CLASSROOM INTERACTION, ACADEMIC ACHIEVEMENT AND CREATIVE PERFORMANCE IN SIXTH GRADE CLASSROOMS

By John R. Anderson

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

College of Education
Department of Secondary Education and Curriculum

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ACKNOWLEDGMENTS.

Threaded throughout this study are the ideas of Harold H. Anderson and Ned Flanders. Dr. Anderson saw so clearly the pedagogical significance of both the integrative-dominative relationships between people and the demands of creative problem-solving. The insights Dr. Flanders shared made possible the divising of additional classroom interaction variables described in this study. The kind permission of E. Paul Torrance to use the Minnesota Test of Creativity was followed with the use of his scoring protocols. The importance of silence as a form of classroom interaction was brought to light by Richard Suchman who "bent" his own rule to allow me to attend and participate in his summer institute on Inquiry Training.

Trial testing of the problem-solving tasks was made possible through the generous time and professional advice of four teachers in the vicinity of Lansing, Michigan. (The promise of anonimity of schools and school district preclude public acknowledgment by name.) The cover drawings and stimulus figures were the creations of Nancy Madtes, art teacher in the Lansing School District.

My admiration and thanks are extended to Bill Rubin who seemingly can converse simultaneously with the language of the computer, the statistician and researcher. My appreciation is offered to the members of the committee, Frank H. Blackington, Charles A. Blackman, and Jack B. Kinsinger, for their individual and collective contributions to the ideas expressed in this study. Acknowledgement is particularly due to my advisor and committee chairman, Wayne T. Taylor, whose counsel guided the development of the study. My thanks to Julian R. Brandou who unhesitantly picked up the loose ends of the final chapter and assumed overall responsibility for the thesis after Dr. Taylor's death this summer.

The example and help of my wife, Agnes, in scoring the verbal tasks of creativity, and trying some of my schemes in her classroom, made it possible to "know" that some of the ideas were worth trying.

Finally, my thanks to Mrs. Shirley M. Goodwin who translated my notes to their final form.

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<u>latroduction</u>

tion is to facilita Mist few studies t attain that goal. Mactices can or do ity of children. (

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tive thinking and p the classroom? Wha

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Nalifred North J. W. Getzel: Mery of Learning Minnal Society for Society, 1964)

CHAPTER I

INTRODUCTION AND BACKGROUND

Our schools then do not exist to discover and train leaders for the future. They exist to start persons on a venture intrinsically worthwhile, namely, the discovery of the kind of creativity which can be theirs along with their fellowmen in this kind of universe. 1

Alfred North Whitehead

coduction

h is to facilitate creative abilities of pupils, there it few studies that suggest the means or techniques to an that goal. Even fewer studies indicate that teaching stices can or do have a significant impact on the creativof children. One may ask along with Getzels, "Can creatinhing and problem-solving be systematically taught in classroom? What exactly is it that teachers do that makes fference? Can this be communicated to others?"

Despite general agreement that a legitimate aim of educa-

¹Alfred North Whitehead, Aims of Education (London: iams and Norgate, 1951), p. 27.

²J. W. Getzels, "Creative Thinking and Instruction," <u>ry of Learning and Instruction</u>, Sixty-Third Yearbook of the onal Society for the Study of Education, Part I (Chicago: Society, 1964), p. 258.

The Problem The problem p tion of relationsh of classroom verba dtained from sele served as a focus 1. What relat

thought and measur from tests devised 2. What relat

measures of teache thirty sixth-grade thought and probl

A construct of of cognitive proce Noint of creativi

of performance. conceptualization teacher-pupil int

interaction varia Modesses; the te the viewpoint of

Theory

The theory i to occur as a res

e Problem

The problem presented in this study was the investigaon of relationships that exist between selected measures classroom verbal interaction and measures of performance tained from selected measures of creativity. Two questions rved as a focus for investigation of the problem.

- What relationships exist between measures of divergent ought and measures of problem-solving performance obtained om tests devised for the study?
- 2. What relationships are there between different asures of teacher-pupil classroom interaction observed in arty sixth-grade classrooms and measures of divergent bught and problem solving performance?

A construct of creativity was developed from a viewpoint cognitive processes or thought operations and from a viewnt of creativity as a product to be evaluated by criteria performance. Both viewpoints were required to permit ceptualization and the subsequent test of variables of cher-pupil interaction. The initial conceptualization of eraction variables stemmed from an analysis of the cognitive cesses; the test of the interaction variables stemmed from viewpoint of creativity as a product of pupil performance.

ory

The theory is straightforward. Creativity is considered occur as a result of the problem-solving performances of

popils in which so by an effort to ma fied by the requir Creative performa: tesses of converg

predicted an association ties of the class: creativity. There diversity of ideas ences permitting with those of the who have experien logical safety to criticism and the bility, to test th their performance to propose solution Additionally creativity that is

Wes posited that to more than one tion appropriate divergent thought

Med for the Stud An analysis

ai pupil perform

an effort to manipulate one or more of the conditions speciad by the requirements of a task or goal. Thus, there is
adicted an association between the problem-solving activiss of the classroom and pupil performance on tasks of
activity. There will be an increase in the frequency and
versity of ideas among children who have classroom experies permitting the expression and sharing of their ideas
the those of the teacher. The theory suggests that pupils
have experiences of this nature in which there is psychoical safety to express ideas without fear of negative
ticism and the freedom, with concommitant shared responsiity, to test their ideas and judgment, will increase in
ir performance to sense problems and apply past experience

ativity that included more than one operation of thought. Ative performance was presented as including several proses of convergent and divergent thought operations. It posited that creative performance will be found related more than one measure of teacher-pupil classroom interactional appropriate to different requirements of convergent and extent thought operations.

Additionally, the present study presented a construct of

for the Study

An analysis of creativity in terms of cognitive processes pupil performance can be a first step toward a construct .

of creativity. If

are found to be re

can be a significa

teacher gains info

1. Before in: to foster or deve

The following stat

determined only the control of the c

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tional data from
3. Training

produced some inc nowever, the train tions. In the partions were offered interaction variations

muld provide ev

eativity. If cognitive processes and pupil performance ound to be related in predictable ways, such information e a significant aid in the classroom as the classroom er gains information concerning the process of creativity. ollowing statements indicate the importance of the study:

1. Before initiating programs in the schools that purport ster or develop creative performance, it is necessary to if and how creativity can be facilitated. This can be mined only through experimental test.

2. Few studies have objectively evaluated the influence

e teacher on creativity through an analysis of teacherinteractions. In the present study, the verbal interas of thirty teachers were objectively coded during a
d of one academic year. Eight classroom observers,
and by Ned Flanders to use the Flanders system of classobservation, provided a minimum of seven hours of observadata from each of the thirty classrooms.

Training elementary pupils in thinking creatively has ed some increase in performance on tests of creativity.

Training was very similar to the testing situating the present study, no special training or suggestieve offered from the experimenters. A comparison of ction variables demonstrated in different classrooms provide evidence that pupil creative performance can be ed by classroom influence.

4. Research of interaction use

teachers control a

hypotheses

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Six hypothese tween measures of

action.

l. There wil tionship between selected tasks of

of problem solvin

<u>lmagination</u>.

2. No relati

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3. There wil

tionship between treative performa

len solving.

4. No statis

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5. There wil

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4. Research on teacher education suggests that feedback teraction used in the classroom is an aid in helping ers control and modify their behavior. This study proa model from which teachers can compare classroom intern.

heses

nation.

Six hypotheses were formulated to test relationships bemeasures of creativity and measures of classroom intern.

- There will be found no statistically significant relanip between measures of divergent thought obtained from ted tasks of the <u>Minnesota Test of Creativity</u> and scores oblem solving obtained from the instrument, <u>Test Your</u>
- 2. No relationship of statistical significance will be between scores of academic achievement and measures of two performance.
- There will be found no statistically significant relaip between the frequency of pupil-initiated talk and we performance measures of divergent thought and problying.
- . No statistically significant relationship will be between a measure of teacher talk, accepting and using ideas, and measures of creative performance.
- . There will be no statistically significant relationound between a measure of acceptable silence and

seatwork and measur

not be found statis

There are two

Statistics

Is different inter upotheses 3 throuses 3 through 1 throu

be positive.

There are two Mior to a statist Here were signifi Item the test, Tes ork and measures of creative performance.

6. The ratio of indirect to direct teacher influence will e found statistically related to creative performance s of divergent thought and problem solving.

stics

There are two types of relationships that may be tested. ifferent interpretations are possible particularly with nesses 3 through 6 above. These four hypotheses include by of relationships of classroom interaction variables outly performance variables. The relationships may be add with Pearson intercorrelation, r or may be studied tiple linear regression analysis, R. The former might at interpretations of characteristics of classrooms or a associated with creative performance; the latter is might suggest classroom interactions predictive of the performance. Although both types of relationships is investigated and a positive relationship is predicted the of the hypotheses in question, it would be premature dict which type of relationship (or combination) will itive.

tical Assumptions

here are two important assumptions that must be met
to a statistical test of hypotheses. It was assumed that
were significant differences in classroom scores obtained
ne test, Test Your Imagination. It was further assumed

that there were si influence observed

Delimitations

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t there were significant differences in teacher-pupil luence observed in the sample of thirty classrooms.

imitations

- 1. The criterion of creativity was restricted to the sures used and limited to the validity of those instruments. particular, the tests required pupil response to a paperactile test within short time durations to problems, with attle personal commitment to the consequences of alternative lutions. Creativity in the artistic and imagistic and the seative forms expressed on non-paper-pencil forms are not a cet of this study.
- 2. Undoubtedly, the total range and variation in teacher that influence was not observed within the sample. Data re limited to that collected with the presence of an observer and to what could be heard and understood.
- 3. A total test of possible sources of teacher influence is not included, rather the study was restricted to those usures identified within the study. By design, the study chasized the analysis of what was done in existent classmus rather than what could or should be done in the classmus to foster creativity among pupils.
- this study is made. In particular, the sample of chers was limited to those from an area of a State that did include a large metropolitan center and to those who writeered and consented to allow classroom observers to

4. Careful appraisal is required before generalization

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it the classroom.

5. While reference to several theories may be made in ious parts of the study, no single theory of creative nking is under study. Thus, results of the study will not interpreted within any single psychological view of ought, e.g., S-R or Gestalt.

initions

The following frequently used terms will be used in the atext of the following definitions:

- 1. Creative performance for the purposes of this study, limited to measures of student performance on tasks from sts of creativity or to the scores obtained by pupils by sponding to the task requirements. Five factors of create performance were scored: Fluency, Flexibility, Origitativ, Elaboration and Adequacy (see Appendix A). For the cross of the study two measures of creative performance are termed divergent thought and problem solving.
- 2. <u>Divergent thought</u> measures of creative performance quested the unique response of the pupil to four tasks: cture Completion," "Circles" or "Squares," "Product provement," and "Unusual Uses." Scores of Fluency, Flexity, Originality and Elaboration were obtained using scorprotocols from the Minnesota Test of Creativity.
- 3. <u>Problem-solving</u> measures of creative performance uested pupil identification of discrepancies, and problems two tasks, "Asking" and "Seeing Problems." A third task,

ving Problems" requested pupils to suggest solutions that might resolve the problem and be equitable to several lved parties.

4. Creative thinking refers to the processes used to solve oblem with a unique and acceptable answer. For example, ance defined creative thinking as, "the process of sensing or disturbing, missing elements; forming ideas or hypotheconcerning them; testing these hypotheses; and communing the results, possibly modifying and retesting the hyeses." The terms, "cognitive processes" and "problemng" also refer to those activities of thought designed tain a satisfactory resolution of a deterrent to a goal. 5. Problem-solving pattern refers to a measure of classuse of pupil-initiated ideas, teacher use of student , and the frequency of silence observed in the classroom. ggregate score includes measures of classroom interacof teacher and pupils across different activities. ers defined teacher flexibility, "as a measure of the e a teacher makes in his verbal influence when one activeriod is compared to another."4 The problem-solving rn is a measure of verbal interaction observed for several

rent activities.

³E. Paul Torrance, <u>Guiding Creative Talent</u> (Englewood s: Prentice Hall, <u>Inc.</u>, 1962), p. 16.

Ned A. Flanders, <u>Teacher Influence</u>, <u>Pupil Attitudes</u>, <u>chievement</u>, <u>Cooperative Research Monograph No. 12</u> ington, <u>D.</u> C.: U. S. Government Printing Office, 1965),

Pir are cre ex! sho 268 Ţ Org 'n Şÿ JS.

CHAPTER II

REVIEW OF LITERATURE

It should be possible to postulate on a basis other than faith that children are able and willing to produce original and productive ideas.

A review of literature was conducted in two parts.

t, the characteristics of creativity as process or product identified. Both the identification of characteristics of civity and approaches to its study are presented, not as astive lists, but as recurring ideas of authors that also promise as answers to some of the many problems of arement of creative performance.

Suggested, used or tested instructional approaches are inted in the second part of the literature review. The ization of the second part moves from suggested to tested uctional practice. A brief description of Flanders' m of Interaction Analysis was also included since it was as the instrument of data collection of teacher-pupil 1 behavior.

erview of Literature on Creativity

Interest in creativity has increased markedly since 1950.

at year, the subject of Guilford's Presidential Address

e American Psychological Association was "Education's

App in of 250 let %at eve 300 ief the "Cr qxe rid int Tie . 101 io êxi 14. e! 10: 10/10

lling Neglect of Creativity." Along with the increase nterest has come a diversity of meaning and definitions he term "creativity." I. A. Taylor has catalogued over of the more widely used definitions. To some, it is a physical quality of man's nature. Bertocci wrote, "The re of God's purpose involved sharing creativity with man if this means risk and danger for everything within the e of man's power."2 More recently, creativity has been ned as the product of educational experiences that permit exercise of curiosity and other motivated activity. tivity then is the product of a curriculum which opens ciences to children, creates new needs to know, and prothem with the skills which enable them to put curiosity action."3 While there may be little quarrel with the that creativity is a legitimate goal of education, the arity of the term has, in part, detracted attention a continuing effort to study creativity objectively. The study of creativity would be simplified if there ed either a criterion of creative performance accompanied

¹I. A. Taylor, "Creativity Research for Future Creativity," uture of Creativity Research, Symposium sponsored by Los Bes State College and Chouinard Art Institute, 1962.

Peter A. Bertocci, Education and the Vision of Excel-(Boston: Boston University Press, 1960), p. 20.

Association for Supervision and Curriculum Development, iving, Behaving, Becoming: A New Focus for Education. fearbook (Washington, D. C.: The Association, 1962), p.

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of the

e creative process. Either the criterion or the process aid the evaluation of instructional methodology.

er exists. Referring to the more general case of problem ng, Bloom and Broder suggest three alternatives:

- Give primary attention to the product criterion as has been done in the past.
- Establish a relationship between processes of thought and product.
- Secure evidence on both process and product by varying the problem-solving task.

hird alternative most closely parallels the design of study and the two-part review of the literature that

Part I

Creativity: Process and Product

Creativity results from complex human thought and behavior unifies the unique experiences of man in some expressive Creativity may be viewed as a product, in which case and utility receive more attention than the interaction and environment. Or it may be viewed as a process, in case the activities, experiences and motivations are

Benjamin Bloom and Lois J. Broder, "Problem-Solving s of College Students," <u>The Learning Process</u>, ed. re L. Harris and Wilson E. Schwahn (Chicago: University cago Press, 1950), p. 60.

considerations. Maslow, ⁵ and Thurston ⁶ stress that vity is self-initiated and self-fulfilling. Creativity ociated with behavior that is self-directed, controlled individual. There is thus an identification of the dual with his actions and accomplishments.

ogers and Stein stress that creativity is an on-going ction with environment. "The creative process is the nee in action of a novel relational product, growing out uniqueness of the individual on the one hand, and the als, events, people, or circumstances of his life on her." ⁷ The emphasis is on the on-going process of man is environment. Novelty, originality and satisfaction from the unique qualities and experiences of man him-

H. Anderson has similarly emphasized the here and now open system, but would also emphasize the product. oduct and the process are both important. Without the there would not be the product. Without the product ence of action or achievement there might not be more

teracting with an ever-changing environment.

braham H. Maslow, "Creativity in Self-Actualizing" Creativity and Its Cultivation, ed. H. H. Anderson rk: Harper and Bros., 1959).

L. Thurstone, "Creative Talent," Applications of Pgy, ed. L. L. Thurstone (New York: Harper and Bros., pp. 18-37.

arl R. Rogers, "Toward a Theory of Creativity," <u>tty and Its Cultivation</u>, ed. H. H. Anderson (New York: <u>ind Bros.</u>, 1959), p. 71.

ntasy."8

goal-directed. "Creativity is goal-directed manipulaknowledge into a novel, relational product." Nevell,
i Simon, Crutchfield, Henle, 2 and Wertheimer;
creativity as a special case of problem-solving.
coblem-solving is certainly goal-directed and involves
ipulation of knowledge, it is also associated with
ing some obstacle to a goal. Nevell, Shaw and
cite, "Creativity is a special class of problem-solving

terson would add the important qualifier that creativ-

Marold H. Anderson, <u>Creativity and Its Cultivation</u> k: Harper and Bros., 1959), p. 243.

rval L. Petersen, "Creativity: Some Aspects and Impli-" <u>Science Education</u>, 43 (December, 1959), 420-427.

Nevell, J. C. Shaw and H. A. Simon, "The Process of Thinking," Contemporary Approaches to Creative Think-Howard E. Gruber, Glenn Terrell and Michael Wertheimer k: Atherton Press, 1962), pp. 63-119.

ichard S. Crutchfield, "Instructing the Individual in Thinking," <u>Explorations in Creativity</u>, ed. Ross L. nd Taher A. Razik (New York: Harper and Row, 1967),

ary Henle, "The Birth and Death of Ideas," <u>Contemporary</u> es to <u>Creative Thinking</u>, ed. Howard E. Gruber, Glenn and Michael Wertheimer (New York: Atherton Press, 1962), 2.

ax Wertheimer, Productive Thinking (New York: Harper,

erle W. Tate, Barbara Stanier and Berj Harootunian, <u>Ses Between Good and Poor Problem-Solvers</u>. Project No. nsylvania: University of Pennsylvania, School of Edu-1959).

onald M. Johnson, The Psychology of Thought and Judg-Vork: Harper and Bros., 1955).

racterized by novelty, unconventionality, persistence and iculty in problem formulation." From a third dimension, tivity may be viewed as a product of problem-solving vity.

The notion of product invites the consideration of eria of product acceptability. Harmon writes, "... (the) tive process results in either a new form or a new combion of old elements; the new combination must be either cal or aesthetic or both, and must solve a problem."

Id would add that a tangible product must result. Arnold agrees that the product results from recombinations, negements of past experiences to meet an existing need.

Now the creative process is similar to all problemsolving processes. You must work with the information you have on hand. You bring to bear all your past experiences, distort it perhaps, combine it and recombine it into new patterns, configurations, arrangements, so that the new totality formed better solves some need of man and this need may be implied as well as expressed. I

In passing, Arnold and Harmon have contributed two issues; s an issue of mental activity or process. Are novel

¹⁶ Nevill, Shaw and Simon, op. cit., p. 77.

¹⁷L. R. Harmon, "Social and Technological Determinants of ivity," 1955 University of Utah Research Conference on the iffication of Creative Scientific Talent, ed. C. W. Taylor Lake City: University of Utah Press, 1956).

¹⁸ John E. Arnold, "Education for Innovation," A Sourcebook reative Thinking, ed. Harold F. Harding and Sidney J. S (New York: Scribner's, 1962), p. 128.

ucts formed through the recombinations of past experis in memory? Or should the emphasis be on transactions
on-going experiences as presented by Rogers and Stein?
Drevdahl presents a more comprehensive view of possible
al functions that may lead to diverse forms of creative
acts. He describes creativity as the

ideas of any sort which are essentially new or novel, and previously unknown to the producer. It can be imaginative activity or thought synthesis, where the product is not a mere summation. It may involve the forming of new patterns in combinations of information derived from past experience, and the transplanting of old relationships to new situations and may involve the generation of new correlates. It must be purposeful or goaldirected, not mere idle fantasy, although, it need not have immediate practical application or be a perfect or complete product. It may take the form of an artistic, literary or scientific production or may be of a procedural or methodological nature.

Drevdahl suggests several ways the mind may produce novel

capacity of persons to produce compositions, products or

ed to new experiences or recombined through the imaginative ity of the mind. Spearman included the possibility of s as well as the mental construction of relationships and . Spearman believed the mind could build a relationship en two concepts or entities or build an entity from a ion and another entity. Whether the restricted view of d is adopted or the more comprehensive view of Drevdahl or

¹⁹J. E. Drevdahl, "Factors of Importance for Creativity,"
al of Clinical Psychology, 12 (1956), 22.

²⁰C. Spearman, The Creative Mind (New York: Appleton,

rman, these three would agree that past experience and ledge can enrich creative production.

One additional characteristic often associated with civity is the originality of the product. Stephenson as succinctly, "Creativity is pregnancy with newly assed emotions." 21

Russell believes associative thinking, problem-solving, cal thinking and creative thinking represent the differ-

burposes in thinking rather than discrete processes.²²

the too used originality of ideas to distinguish the
rities of critical thinking and creative thinking.

tive thinking involves the thinking of new ideas whereas

cal thinking involves reactions to the ideas of others one's own previous ideas. It may be described as

em-solving plus."23

To Parnes, originality is something new and gifted.²⁴
qualifies giftedness to a criterion of acceptability to
group at some point in time.²⁵

 $^{^{21}\}mbox{W}.$ Stephenson, Testing School Children (London: Long-Green, 1949), p. 64.

²² David H. Russell, "Higher Mental Processes," Encycloof Educational Research, ed. C. W. Harris (New York: 1lan, 1960), pp. 652-653.

²³David H. Russell, <u>Children's Thinking</u> (Boston: Ginn, p. 306.

^{2 *}Sidney J. Parnes and Harold F. Harding, <u>A Source Book</u> reative Thinking (New York: Scribner's, 1962).

^{2 5}Morris I. Stein, "Creativity and Culture," <u>Journal of</u> ology, 36 (1953), 311.

Different authors emphasize particular aspects of crea-

ity from a position of their interests and experience.

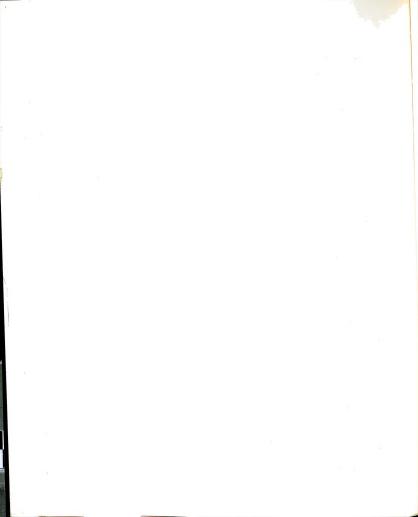
ally the product is characterized with uniqueness and the plution of a problem; the process is characterized with experience with the vertransaction and self-direction. Johnson brought tower the sometimes conflicting demands of process and fluct when he wrote, "In the light of the present account of the experience imagination is not a different process..., a search which is free enough to yield a solution new to searcher, yet controlled in such a way that the product be cherished." 26

oaches

The approaches to the study of creativity may be grouped dly as the <u>logical</u>, the <u>psychological</u> and the <u>psychometric</u>. first refers to the activities of the mind, usually conred in some act (process) of solving a problem. The nd refers to the content that is available to the conscious-of the mind. The third approach is actually a modification logical analysis, but assumes prominence as an approach to study of creativity.

The analysis of thought by Dewey in 1910 was both subive and philosophical. Yet, it has for over a half century ided a basis for a formal description of reflective-

²⁶D. M. Johnson, "A Modern Account of Problem-Solving," hological Bulletin, 41 (1944), 208.



ntific thought. 27 Dewey recognized five phases:

- 1. Recognition of a problem
- 2. Analysis of a problem
- 3. Suggestions of a possible solution
- 4. Testing of the predictions
- 5. Judgment of the selected solution

Later, Dewey was to distinguish between recognition of amiliar and observation of the unknown or the unexpected.

vation that is exploratory for the sake of discovering

exity and an act of search and inquiry. While Dewey ained that five phases of thought could be enumerated,

d also recognized that problem solving activities to ify the problem may be necessary. The stages were de-

nt, in part at least, on the familiarity of the problem e pupil. Unfortunately, the five steps have received more tion for their logical appeal and simplicity than the

lency of the stages upon the learner.

As Johnson²⁸ noted, there is no evidence for or against spondence of these five logically distinct steps to plogical processes save the frequency with which educa-

nuote them.

¹John Dewey, How We Think: A Restatement of the Relaof Reflective Thinking to the Educative Process (Boston: Heath and Co., 1933), p. 9.

⁸D. M. Jöhnson, op. cit., p. 27.



aham Wallas²⁹ analyzed thought activity in much the y, using his own thoughts, reports of friends and some stions from Helmholtz and others. Although Wallas at these steps to be used as a guide in the thinking of vidual, this analysis is now frequently accepted as a statement of creative production. Wallas described

<u>Preparation</u>: a period in which the problem is investigated and facts collected.

<u>Incubation</u>: a period of non-directed activity, perhaps at a sub-conscious level.

.lowing steps:

Illumination: includes a period of conscious revelation of the solution(s). It would include the period in which the sudden flash of insight would most likely occur.

<u>Verification</u>: the final period in which the solution(s) are evaluated and a decision reached.

me evidence in support of Wallas' analysis comes from a of studies by Patrick.³⁰ In her first study (1937), 55 and 58 non-poets wrote poems under her direction.

ng their comments, she found that most changes in ideas I in the first time period. The first line of poetry,

raham Wallas, <u>The Art of Thought</u> (London: Jonathan 26).

atherine Patrick, "Whole and Part Relationship in Creaught," American Journal of Psychology, 54 (1941),

as evidence of <u>illumination</u>, occurred in the second or period. In a second study, she collected additional nce, including testimony, that three-fourths of artists <u>incubation</u>. She arrived at substantially similar findwith a third group of subjects in scientific fields. In last study, it was noted that stages overlapped and did ecessarily follow a precise order.

Eindhoven and Vinacke were critical of Patrick's studies

everal reasons. The studies were based on introspective ts, conducted under laboratory conditions, and results zed under a priori considerations. Under different conns, including the use of four separate settings on dift days at the option of the subjects, artists sketched a hromatic picture. Not surprisingly, artists were found we more control over the production than non-artists and not stages were not detected. Unfortunately, there was not to collect evidence of incubation or illumination during anys the subjects were outside the studio. 32

Rossman used a survey of a sample of over 700 productive cors in his study. Chapter 8, in particular, contains wits affirming the experience of sudden insight. 33

¹Catherine Patrick, "Creative Thought in Artists," <u>1 of Psychology</u>, 4 (1937), 35-73.

²J. E. Eindhoven and W. E. Vinacke, "Creative Processes nting," <u>Journal of General Psychology</u>, 47 (1952), 139-

Joseph Rossman, The Psychology of the Inventor (Wash-D. C.: Inventors Publishing Co., 1931), pp. 80-96.

nts out that the phenomenon of a flash of creative genius t one time, been a criterion of patentability. He also ed a sequence of steps:

- . Detection of a difficulty or obstacle
- . Analysis of need (in the marketplace)
- 3. Survey of information available
- . Formulation of possible solutions
- . Critical analysis of solutions prior to decision
- . Invention
- . Test and development
- cossman's audience was chiefly inventors. He stressed the
- racticality of proposed solutions (Step 5) before invest-
- orther time with an invention. Thus, there was more in-
- ce on a sequence of steps than in the proposals of Wallas
- rick. Wallas suggested that the pattern is seldom a
- cut series of four steps and the sequence varies from o step. 34
- atrick, in her 1941 study, decided that parts proceeded we to a general idea of the whole and the whole precedes
- rts as details are brought out for verification. 35

sman, Dewey and Wallas with the qualifications that

ne evidence offers slight support for the stages proposed

Wallas, op. cit.

Catherine Patrick, "Whole and Part Relationship," of Psychology, 54 (1941), 128-131.

th of time, sequence and repetitions probably vary with viduals and problems.

The logical approach with its stages tends to exclude

emotional, human aspects of creativity. Rossman writes,
The important thing is an obstacle which prevents the
satisfaction of the need by a direct response. Every
need, every problem that cannot be readily solved causes
a distinct emotional tension, restlessness and discomfort
which is followed by active exertion and effort, physical
and mental. ... Unquestionably, in all creative effort
there is a decided emotional tone.³⁶

From a logical analyst's viewpoint, the problem and solu-

may entail a series of progressive steps. But the logical presents an imperfect picture of the thought, reasoning emotional commitment of the learner. The logical approach is to be complemented with regard to the thought processes which the learner progresses through a problem. Some help covided from a psychological approach to the study of civity. The behavioral, Gestalt and humanistic orientative had varying success in operationalizing theoretical

ss in identifying training procedures and developing inentation. Mednick's Remote Associates Test (RAT) presents words and requests the subject to supply a fourth, e.g. tree, skin (bark). According to some formulations of iative theory, the production of original ideas reinforces herefore increases the frequency of low dominance

The Behaviorists' approach to the study has had the most

ions.

⁶Rossman, <u>op</u>. <u>cit</u>., p. 80.

nks.³⁷ In one research effort, 120 college freshmen iven free association word lists and divided into three of 40 subjects. One group received no training ol); the other two groups received practice in producing ent responses, one group also receiving praise. The was a significant difference in performance between the perimental groups and the control group, but not between perimental groups.³⁶

he behaviorist approach to date has emphasized frequency a lesser degree, novelty of responses, but has given tention to quality or practicality of ideas. Guilford to this problem (not necessarily his own position), we thinking is distinguished by the fact that there is no novel about it; novel that is, to the thinking indithe degree of creativity shown is directly propor-

to the degree of novelty."39

392-398.

e Gestalt psychologist has less difficulty demonstrate validity for his tests of problem-solving. Test situor problems are typically constructed to require insight o successful performance.

Sarnoff A Mednick, "The Associative Basis of the Creacess. Psychological Review, 69 (1962), 220-232.

rving Maltzman, William Bogartz and Louis Breger, dure for Increasing Word Association Originality and sfer Effects," Journal of Experimental Psychology, 56

P. Guilford, "Intellectual Factors in Productive," Productive Thinking in Education, ed. Mary Jane and Charles E. Bish (Washington: National Education ion, 1968), p. 6.

Persons whose problems are such that they can be solved by logical analysis advance their work, as we have seen, deliberately, progressively, with a minimum of trial-anderror activity and with full awareness of the meaning of each step taken. But the thinker who relies on insight, having employed every known technical or dialectical device of the science or the art involved and being yet fundamentally baffled, is forced in sheer desperation and defense of emotional balance to relax his efforts for a time. ... When it reappears as insight, or solution, it more fully represents the whole range of mental experience, the entire intellectual and emotional background than the less related products of the logical method. "0

Here, insight is seen as a problem solving venture that ludes a more intensive, complete solution than possible

the use of methods of logic alone.

Several studies have investigated relationships between hing in divergent thinking and performance on tasks requirinsightful problem solutions. In one study, Richard C. Richard M. Anderson trained 24 boys in the sixth grade to unusual uses for objects. There were ten 30 minute ions. The experimental (trained) subjects excelled on

eer Box Problem.* While other problems may require difit reasoning that may be found related to practice in givmusual uses, the authors did conclude that the transfer

requesting novel uses for objects, but not on a modified

⁴⁰ Eliot Dole Hutchinson, How To Think Creatively (New Abingdon-Cokesbury Press, 1949), pp. 35-36.

^{*}The Duncker Box Test presented the problem of attaching candles to a door. The preferred solution required the f a matchbox as a platform rather than as a conventional iner.

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actice will be difficult to demonstrate in areas of nation and training. "1

There is some reason to suspect that practice on dint thinking tasks will not reliably transfer to tasks ring convergent insight e.g., Duncker's Box Problem., from the viewpoint of measurement, a test of unusual is scored for frequency, a nearly continuous variable, the all-or-nothing quality of insight suggests a ete variable. Second, practice is generally not given prescription to increase insightful performance. er would have the thinker vary appropriate elements ingfully" in an effort to reformulate the problem. *2

ingfully" in an effort to reformulate the problem. "2" r, whose own work to identify strategies in problemng is well known, asks, "... what methods of exercise in iven field are most likely to give the student a sense telligent mastery over the material?..." Bruner cons in partial answer,

Teaching specific topics or skills without making clear their context in the broader fundamental structure of the field of knowledge is, in many deep senses, uneconomical. First, such teaching makes it exceedingly difficult for the student to generalize from what he has

Richard C. Anderson and Richard M. Anderson, "Transfer ginality Training," <u>Journal of Educational Psychology</u>, 63), 300-304.

²Karl Duncker, "On Problem-Solving," trans. Lynne S. <u>Psychological Mimeographs</u>, 58 (1945), 21, 47.

³Jerome S. Bruner, <u>The Process of Education</u> (Cambridge: d University Press, <u>1963</u>), p. 30.

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earned to what he will encounter later. Second, learnng that has fallen short of a grasp of general princiles gives little intellectual excitement. Third,
nowledge acquired without sufficient structure to tie
t together is knowledge that is likely to be forgotten.
ndividuals who have extensive familiarity with a subject
opear more often to leap intuitively into a decision or
ob a solution of a problem, one which later proves to be
oppropriate."

oth Duncker and Bruner insist that insight or intuition

Training in making remote or low frequency responses usually considered a part of the Gestalt approach to ad problem-solving capability. As Hilgard points out, all issue is in describing how past experience is used the demands of a problem situation. According to as-response theory, sufficient past experience should see the solution; according to insight theory, sufficient perience will not guarantee the solution unless the is so arranged that the relevant experiences are appro-

e two theoretical positions highlight a disparity in used to assess creativity. Present tests of creativity nly adaptations, advocated by the Associatists' S-R

n. Future tests of insightful problem-solving may well be composed of a series of appropriate steps or stages

y brought to bear."45

Ibid., pp. 30-31; 62.

Ernest R. Hilgard, "Creativity and Problem-Solving," <u>tty and Its Cultivation</u>, ed. Harold H. Anderson fk: Harper and Bros., 1959), p. 163.

le **5**0 à(ng to a reasonable incidence of solutions within a chosen

Numanistic psychologists, Maslow, May and Rogers, concreativity "a product of man's healthy tendency to lize himself to his potential." 6

The inner conditions within the individual include:

- 1. Openness to experience
- 2. Internal locus of evaluation
- 3. Ability to play with elements and concepts

ivity is seen to be facilitated by an environment free of nal evaluation, having empathetic understanding, uncondil acceptance of the worth of the individual and psychoal freedom with responsibility. Rogers' position is ling to those disposed to give attention to teacher ince in the classroom. However, Maslow points to the dif-

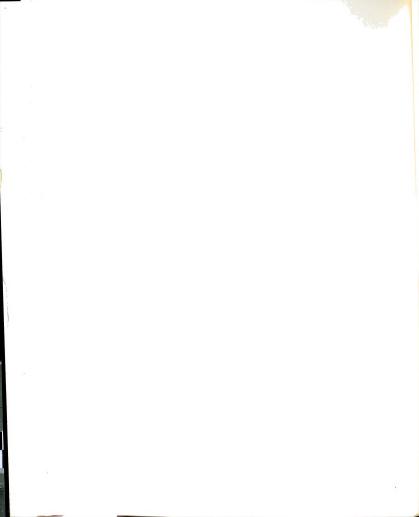
As I come to the end, I am quite aware that I have been trying to break up widely accepted concepts of creativity without being able to offer in exchange a nice, clearly defined, clean-cut substitute concept. Self-actualizing creativeness is hard to define because it sometimes seems to be synonomous with health itself.... It is as if self-actualizing creativity were almost synonomous with, or a sine qua non aspect of, or a defining characteristic of essential humanness. 47

ties inherent in the constructs developed to date.

theless, openness to experience and awareness add a human ty. Openness, says Rogers, is the "opposite of psychoal defensiveness, when to protect the organization of the

⁶Maslow, op. cit., p. 83.

⁷Ibid., p. 94.



ertain experiences are prevented from coming into

ss except in distorted fashion."⁴⁸ One problem in eduis to obtain a balance between an environment that is ning to a pupil because it allows more freedom than the ual can tolerate and sufficient freedom to allow creato occur. At least at the elementary grade levels, lual tolerance for ambiguity and perplexity must be due regard when devising a combination of structure ternatives and choice.

ch, the mind is considered to consist of mental abilities.

mental abilities are postulated mainly on a subjective
l basis. Tests are then constructed and data analyzed

tally. The approach is appealing to those who seek some

tive evidence that creativity can be translated to quanti-

ne psychometric approach, the last approach to be disin this chapter, is dominated today by the work of rd, Wilson, Lewis, Terman and Christensen. In this

a 1951, the above authors hypothesized the existence at primary factors:

recognition of the existence of problems.

Fluency of ideas: an ability to call up large numbers of ideas per unit of time.

Sensitivity to problems: an ability of awareness and

nat align in predictable ways.

Rogers, op. cit., p. 75.



Flexibility: two abilities

adaptive flexibility to changing rules, conditions or problems.

spontaneous flexibility to shift to additional categories of objects to obtain additional

Originality: an ability to make statistically infrequent responses.

- Analysis: an ability to find component parts.
- . Synthesis: an ability to organize parts to wholes.
- Redefinition: an ability to reorganize the functional aspects of a problem to achieve insightful solution(s) to a problem. It was anticipated that flexibility and synthesis would cover the process.
- Penetration: an ability to apply judgment in a way to emphasize the quality of response.^{4,9}

aree statistical methods for measuring originality were

- Uncommonness of response
- Remoteness of association
- Cleverness

ults: These three scoring methods were factor analyzed dings of 0.30 or greater were achieved, thus lending

J. P. Guilford, R. C. Wilson, P. R. Christensen and ewis, "A Factor-Analytic Study of Creative Thinking," from the Psychological Laboratory, Stanford University, 1951.



port to a general factor of originality.⁵⁰

By 1954, four factors of interest to this study were stified and reported.⁵¹ (Table 1)

TABLE 1

A SUMMARY OF RESULTS OF FACTOR ANALYSES

tional Fluency		Factor Loading
Consequence Test Brick Uses	(fluency score) (fluency score)	.55 .54
inality		
Consequences Unusual Uses Common Situations	(remote)	.42 .31 .31
taneous Flexibility		
Brick Uses Unusual Uses Consequences Common Solutions	(flexibility score) (flexibility score) (remote)	.43 .39 .33 .33
itivity to Problems		
Social Institutions Apparatus		.70 .59

While the factors: fluency, spontaneous flexibility, inality and problem sensitivity were identified with loadof 0.30 or larger, the factors of penetration, analysis

⁵⁰R. C. Wilson, J. P. Guilford and P. R. Christensen, Measurement of Individual Differences in Originality," <u>Psychological Bulletin</u>, 50 (1953), 362-370.

⁵¹R. C. Wilson, J. P. Guilford, P. R. Christensen and Lewis, "A Factor Analytic Study of Creative Thinking ties," Psychometrika, 19 (1954), 297-311.

synthesis were not obtained in this set of data. And to

e, tests derived from Guilford's battery of instruments, uding those obtained from McNemar and others, are still ally scored for fluency, flexibility and originality.

A decade after the initial work to identify factors of tivity, a theoretical model was proposed as a "structure ntellect." Five "thinking operations" process four types ental "content" to form six levels of "products." idered in a three dimensional matrix, 120 different mental ities or factors are possible. Guilford has stated that oximately 50 of these have been identified. 52 One way to

ations that process existing information:

Cognition - Recognition or discovery

Memory - Retention of information

ations that generate additional information from existing ledge:

ribe the <u>Products</u> is in terms of the <u>Operations</u> used in mental process. Guilford considers these terms in the

Convergent Production - Thinking process that leads to a single, right or best answer.

Divergent Production - Thinking process that leads to alternative or better or unconventional answers.

ation that leads to a decision or choice or selection

Evaluation-Judgment

owing wav:

⁵²Robert Wilson, "The Structure of the Intellect," <u>News of</u> <u>Project on the Academically Talented</u>, 2 (February, 1961).

Callagher suggests that the "Structure of the Intellect" oular because it encompasses a wide breadth of cognitive ors in one system rather than looking at mental abilindividually. 53 There is one additional reason the has received considerable attention: the Operations defined in terms of products produced (if communicated) given conditions. Thus, Divergent Thinking (operation) defined as the production of two or more solutions to n problem situation. The Aschner-Gallagher system of fication of verbal questions, discussed later in this r, is the result of operationally defined Operations. 54 allagher also presents the consideration of changing ations for different stages in productive thinking. erations of thinking proposed by Wilson and Guilford. with considerations of personality have been juxtaposed stages of thought as presented by Wallas (Table 2). allagher suggests that a training program, designed to tate creative problem-solving, should, at the very least, ubjects become aware of the various cognitive demands at tage.

reativity need not be limited to the four stages identiy Wallas and used by Gallagher. Creativity may be

James J. Gallagher, "Productive Thinking," Review of <u>Pevelopment Research</u>, 1 (1964), 358-360.

Mary Jane Aschner and James J. Gallagher, A System for Ying Thought Processes in the Context of Classroom Verteraction, Institute for Research on Exceptional Children University of Illinois, 1962) (Mimeographed).

TABLE 2

of ve	Expected Form	Predominant Thinking Operation	Personality Factor or Attitude Required			
ation	Neat Well organized Well stated	Cognitive Memory	Studiousness Sustained Attention			
tion nation	Sloppy Often confused Incoherent	Divergent Thinking	Intellectual freedom Risk Taking Tolerance of Failure and Ambiguity			
cation	Neat Well organized Clearly stated		Intellectual Discipline Following Logical Sequence			

J. Gallagher, "Productive Thinking," Review of Child opment Research, 1 (1964), p. 360.

as both process and product. In tabular form, the

teristics and approached to creativity are used to t an expanded conceptualization of creativity (Table 3). allagher's column, "Personality Factor or Attitude," be added for additional explication of behavioral and activities. However, the concept of creativity prehere suggests that originality results not only from ent thinking of alternatives, but from insight and the duality of the person interacting with the environment. Evity to problems, awareness and openness are included of the creative process.

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TABLE 3
A PROCESS-PRODUCT PATTERN OF CREATIVITY

itive	Characteristics	Approach			
	Active transaction	Openness Awareness Individuality Self initiation			
ess	Identification				
	Originality	Insight Alternatives			
uct	Solutions	Analysis Evaluation			

A concept of creativity in tabular form presents an

nization and structure that should be tempered by the ings of Patrick, the opinions of Wallas and the observas of Bruner. Logical stages are considered more as conent demarcations than representations of actual practice.

um, creativity results from the iterative and heuristic
of an individual (or group) to produce alternative solus, unique and acceptable among peers.

Part II

Teaching and Related Research

In Part II of this chapter, teaching practices and reresearch are reviewed to describe an environment cive to creativity. A review of related research is

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d into three sections titled:

- . Learning objectives
- . Interaction Analysis System
- . Research findings

he first section summarizes "learning objectives" recomby four authors. The learning objectives serve as a between the general description of creativity of Part I review of reports of research findings.

f the many recommendations found in the literature, few

rning Objectives

that, "... we do not know how we can best teach for rity." 55 Four authors have directed their attention to relopment of curricular materials, test measures, and ties to encourage and assess creative expression.

Try of the major recommendations offered by Arnold, the, Ferebee, Denny, Rusch and Ives appear in Table 4.

That directed his remarks to the person, usually an who would increase his own creativity. The latter three generally provide recommendations to an audience in cation field: Torrance in elementary education; Ferebee ish; Denny, Rusch and Ives in Art. Generally, the ndations specify intended outcomes of curricular

J. P. Guilford, "Creativity Its Measurement and Develop-Source Book for Creative Thinking, ed. Sidney J. Parnes old Harding (New York: Scribner's, 19620, p. 164.



Arnold	Torrance	Ferebee	Denny
Know yourself	Acknowledge potentialities		
Ask a new question daily			
Read to broaden interests Develop creative readers Provide active and quiet	Develop creative readers Provide active and quiet time		
Carry a notebook			
Develop a sense of humor	Develop a sense of humor Teach to avoid peer sanctions	Fend off negative criticism	
Observe question predict associations	Use methods of research Ask provocative questions	Heighten sensory awareness	Plan, explore, experiment
Develop craftmanship	Use a variety of work methods	Make children aware	Respect art and writ-
Speculate and daydream	Recognize and value originality	of what is good	ings of professionals
Provide a permissive	Respect unusual ideas		inal remarks
atmosphere	Occasionally do without evalua-	Build atmosphere of	
Develop creative associ-	tion	receptive listening	
ations	Encourage manipulation of		
Develop willingness to gample	objects Test full implication of ideas		
	Teach child to value his crea-	Relieve fears of timid	Relieve fears of timid Refer to pupil successes
	Support self-initiated learning	Insure sincere effort is rewarding	Use failure as learning experiences
	Relate cause evaluation and result		
	Plan for creative thinking		Conduct Lessons on di- vergent thinking

iences but the methods or curricular experiences them-

s are rarely specified.

Nevertheless, the agreement among the four authors lends rt for the four characteristics of creativity proposed in I. Most recommendations are directed toward the encournt and acceptance of originality, but problem-solving ities, awareness and the feelings of the originator also

teraction Analysis

g from zero to 0.35.57

the attention of these authors.

rement and teacher classroom behavior and proficiency an early state of development. Domas and Tiedeman that prior to 1950, ratings were used in the overing majority of studies in lieu of observation of class-behavior. The studies is studies mounted a most comprehensitudy with a sample of 99 teachers in grades two through in five Wisconsin cities. In all, mineteen inventories, rement measures and ratings were used. Yet, correlations

Summaries of research of relationships between pupil

ecedent variables were to Barr, "exceedingly low,"

⁶S. J. Domas and D. V. Tiedeman, "Teacher Competence: otated Bibliography," <u>Journal of Experimental Education</u>, 50), 101-218.

⁷A. S. Barr, "The Measurement and Prediction of Teaching ency: A Summary of Investigations," <u>Journal of Experi-Education</u>, 16 (June, 1948), 203-283.

H. H. Anderson, Helen and Joseph Brewer, and Mary F.

d observed pre-school children and their contacts with er children. The terms, "Dominative" and "Integrative" tacts were defined in terms of observable acts. Dominative tacts tend to reduce alternatives and increase resistence. Exprative contacts tend to increase flexibility and the per of alternatives with a decrease in resentment and nority. Anderson extended these early studies to the classem and found that the contacts between teacher and pupil is to establish a class-wide tendency toward "integrative" dominative" acts. Pupils of teachers that exhibited intective contact behaviors were observed to show more spontant, initiative, voluntary social contributions and fewer so of aggression. 58

Independently, Lewin, Lippett and White conducted their sical experiments. Under laboratory conditions, three dership patterns were identified. Although terminology fers, the integrative-dominative contacts have a close vioral correspondence with the democratic-authoritarian dership patterns.

Withall introduced a seven category system of teacher ements to classify classrooms along a teacher-centered to

⁵⁸Harold H. Anderson, J. E. Brewer and Mary F. Reed, dies of Teachers' Classroom Personalties," <u>Applied hological Monograph</u>, 11 (1946), 101-156.

ner-centered continuum. Withall described the student tions to an extremely learner-centered classroom reminesof the Lewin, Lippett and White description of group vior with laissez-faire leadership. 59

The picture of the learning situation and pupilteacher relationship obtained from these evaluation sheets filled out by the pupils is, on the whole, one of an impartial and cooperative individual who helped the learners to get some new ideas, but who, despite the pleasant, interpersonal relationships she created with them, did not from their frame of reference, help them sufficiently in identifying new problem areas and did not help them visualize the actual possibilities arising from such problems. This teacher, it would appear, did not adequately structure the situation for the learners so that they could identify and work upon problems that were challenging to them and pertinent to their interests. The constant reiteration by members of the class in their evaluation scales that they wasted their time and were bored, may be due to the fact that lack of structuring by the teacher frustrated many of them. The teacher seems to have related herself adequately as an individual to the majority of the pupils, but this satisfactory, social relationship failed to meet the needs and expectancies of the learners in so far as problem-solving and learning activities were concerned. $^{6\,0}$

Smith raised the question of overlapping concepts. For ole, the autocratic leaders, identified in the Lewin, ett, White study used praise most frequently of the three ership types. Yet, praise is included in the "integrative" cner-centered" and "indirect" classifications of teacher vior.

⁵⁹Kurt Lewin, Ronald Lippitt and Ralph K. White, "Patterns gressive Behavior in Experimentally Created Social Clib," The Journal of Social Psychology, 10 (1939), 271-299.

⁶⁰J. Withall, "The Development of a Technique for the rement of Social-Emotional Climate in Classrooms," (Unpubd doctoral dissertation, University of Chicago, 1948), pp.

These findings suggest that extreme positions on Withall's inuum are not always optimal for gain in pupil achievement. recognized the complexity of the research problem as he e, "It is probably erroneous to assume that specific acts good or bad divorced from purposes, principles, person and ation; this generalization may or may not apply to broad erns of behavior." 61

A second observation, sometimes lost in the terminology focus on the social-emotional dimensions of interaction.

hat the Anderson and Withall systems of observation include ific categories of problem-solving activity. Flanders osed a testible theory relating patterns of teacher-pupil raction with problem-solving. Flanders modified the

rson and Withall systems, adding one category of pupil
(later two categories) and one omnibus category. Indirect
mence was defined by categories one through four as verbal
vior that expands pupil alternatives. Direct influence
defined by categories six and seven as verbal behaviors
restrict pupil alternatives (see Table 5).
An increase in pupil-initiated acts oriented to the de-

s of a problem and a decrease in compliance to the demands irections of the teacher, would result in an increase in ning. To test this, three hypotheses were given:

^{1.} Indirect teacher influence increases learning when

⁶¹Barr, op. cit., p. 205.



TABLE 5 CATEGORIES FOR INTERACTION ANALYSIS**

1	.*	ACCEPTS FEELING: accepts and clarifies the feeling tone of the students in a nonthreatening manner. Feelings may be positive or negative. Predicting or recalling feelings are included.
2	.*	PRAISES OR ENCOURAGES: praises or encourages student action or behavior. Jokes that release tension, not at the expense of another individual, nodding head or saying, "um hm?" or "go on" are included.
3	.*	ACCEPTS OR USES IDEAS OF STUDENT: clarifying, building, or developing ideas suggested by a student. As a teacher brings more of his own ideas into play, shift to category five.
4	. *	ASKS QUESTIONS: asking a question about content or procedure with the intent that a student answer.
5.	. *	LECTURING: giving facts or opinions about content or procedure; expressing his own ideas, asking rhetorical questions.
6.	*	GIVING DIRECTIONS: directions, commands, or orders to which a student is expected to comply.
7.	*	CRITICIZING OR JUSTIFYING AUTHORITY: statements intended to change student behavior from nonacceptable to acceptable pattern; bawling someone out; stating why the teacher is doing what he is doing; extreme self-reference.
8.		STUDENT TALKRESPONSE: a student makes a predictable response to teacher. Teacher initiates the contact or solicite student statement and sets limits to what the student says.
9.		STUDENT TALKINITIATION: talk by students which they initiate. Unpredictable statements in response to teacher. Shift from 8 to 9 as student introduces own ideas.
10.		SILENCE OR CONFUSION: pauses, short periods of silence and periods of confusion in which communication cannot

re is NO scale implied by these numbers.

be understood by the observer.

INDIRECT

DIRECT

A. Flanders, <u>Teacher Influence</u>, <u>Pupil Attitudes</u>, <u>and Achievement</u>, perative Research Monograph No. 12 (Washington, D.C.: U. S. Govern-Printing Office), Office of Education, Dept. of Health, Education Welfare, p. 20.

- a student's perception of the goal is confused and ambiguous.
- Direct teacher influence increases learning when a student's perception of the goal is clear and acceptable.
- 3. Direct teacher influence decreases learning when a student's perception of the goal is ambiguous. 62
 Flanders found that students of teachers who used an e average ratio of indirect to direct behavior learn more

ested by instruments developed during this study.

and, teachers with an above average proportion of indirect unence were found to exhibit more variability in their use of the direct and indirect behaviors. Analyses did reveal a first trend to shift from an initial indirect influence to be direct influence pattern during a two week unit. This must pronounced with social studies teachers. Flanders luded, "Perhaps the conclusion that needs to be emphasized most in this summary is that the students who achieved the and had significantly higher scores on our revised classatitude instrument were in classes which were exposed to table patterns of teacher influence. This flexible pattern unded periods of predominantly indirect influence." 63

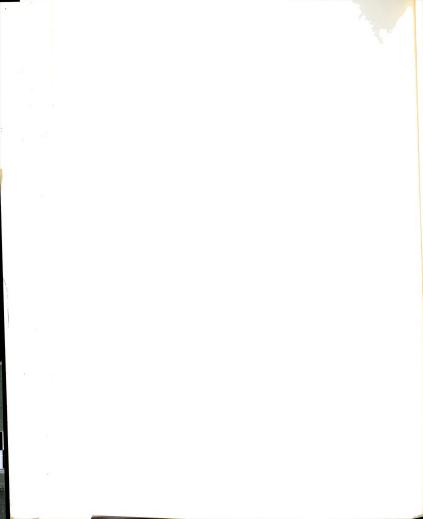
⁶²Ned A. Flanders, <u>Teacher Influence</u>: <u>Pupil Attitudes and Wement Cooperative Research Project No. 397. (Minneapolis: of Minnesota, 1960).</u>

⁶³ Ibid., p. 117.

The data are recorded and preserved in sequence by three second time intervals. Thus data provide a record of frequency of category behaviors and the verbal behaviors that precede and immediately follow each time unit. To capitalize on this quality, Flanders may display data within a 10 x 10 matrix. Interpretations of regions in the matrix have evolved during the past decade. Table 6 is a matrix with a rather laborate display of areas of interest and use in research.

Cells in a matrix designate the intersection of a cate-

provide the provided at T₁ with the category of behavior at T₂ observed three seconds later. The first number of each pair indicates the row; the second number indicates the column. The second number will be reentered in the next data pair, but is the row designator. Thus, it is possible to trace the flow" of interaction among classroom members because each ell represents the intersect of the verbal interaction found in a previous column and subsequent interaction to be found in succeeding row. The cell, 10 x 10 would contain the frequency pupils and teacher were observed to be silent or the erbalization was non-interpretable for periods exceeding 3 econds. Areas G₁ and G₂ are also of interest for the cells indicate the frequency of indirect and direct influence of the eacher in response to pupil talk. A high frequency in area G₂



AREAS OF MATRIX ANALYSIS*

П	П	T-	т-	_	Т-	Т	T	T-				
TOTAL											Area D	Silence
10				1		1						alk
6				A Feer		1		Area I			Acra C	Student Talk
σο					!	!		A			Ac	Stud
7				1			Area F	0	2		m	cher
و				1 2 2 2		1	A.	Area	Area G ₂		Area	Direct Teacher Talk
5				ent C				_		11	_	Direc
4		Content Cross							her			
ю		Area E										t Tead
7								Area G			Area A	Indirect Teacher Talk
н	_			Ľ.		! 				Ш		Ü
CATE- GORY	1	3 2		4	2	9	7	8	6	10	Total	
CLASSIFI- CATION		INDIRECT			INEPAENCE			TATUTENT TALK				
CATEGORY	ACCEPTS FEELING	ACCEPTS FEELING PRAISE STUDENT IDEA		ASK QUESTIONS	LECTURES	GIVES DIRECTIONS	CRITICISM	STUDENT RESPONSE	STUDENT INITIATION	SILENCE		

*Ned A. Flanders, Interaction Analysis: A Technique For Quantifying Teacher Influence, The University of Michigan: Undated (Mimeographed).

high incidence of incorrect responses by pupils or the currence of divergent ideas that obtain negative teacher sponses. Additional analysis of the data in the matrix can iten resolve competing alternative interpretations. It would be pointed out however, that the interpretation follows nalysis of data; the data collected by the classroom observer reserves frequency and time-sequence information for later nalysis. Medley and Mitzel conclude.

Flanders' scheme is extremely ingenious. Every one of the 100 cells in the matrix of Fig. 1 represents a different item of behavior with its own intrinsic interest. Yet the observer needs to learn and use only 10 categories. The idea of categorizing the dominant pattern of a three-second period rather than each statement or other unit of behavior is also ingenious. If, as Flanders says, the observer develops a natural "rhythm" in recording after some training the task must become at least as easy as that of using Withall's categories after the manner of Mitzel and Rabinowitz.

The dimension of classroom behavior which we have called classroom climate has been measured more successfully than any other. There are differences in the terms applied to the dimension as it has been operationally defined in various studies—Dominative—integrative, teacher—centered versus learner—centered, hostile—supportive, direct—indirect influence. Yet there is little question that all are referring to highly similar, even identical, dimensions of behavior, reliably measurable, and important in educational theory. ⁶⁴

⁶⁴Donald M. Medley and Harold E. Mitzel, "Measuring Classoom Behavior by Systematic Observation," <u>Handbook of Research</u> 124 (Chicago: Rand McNally, 1963), p. 174

C. Review of Research

Few studies exist that include research on teacher-pupil interactions and creative performance. The studies that do exist are usually small exploratory or feasibility studies with teacher populations too small to warrant statistical tests of significance. Most of the studies, nonetheless, did include statistical analyses, usually with ambiguous results. Thus, a conservative review is reported more often as trends than as results. However, collectively they offer information and suggestions relevant to the purpose of this research.

There is not as yet a common terminology or construct of creativity or of teacher behavior that would facilitate a tidy, logical review. In this section, attention is given to those studies applicable to categories of Flanders' System of Interaction Analysis.

Crutchfield⁶⁵ has developed programmed instruction
materials designed to encourage pupils and provide practice
in both convergent and divergent problem-solving activities.
This study is unique not only in its use of programmed instruction materials, but also for the broad spectrum of objectives
which include both cognitive process skills and affective
attitudes of pupils regarding their own creativity. Crutchfield
reported evidence of increased performance by pupils on the
Minnesota Test of Creativity and on other measures developed

Crutchfield, op. cit., pp. 196-205.

by project staff. There was a trend toward a positive shift on measures of self-confidence and self-evaluation, but the author indicated further development of materials was planned.

In addition to curricular materials, a supportive teacher, one who can give opinion in a non-threatening manner, may be needed to effect a greater shift in positive affect. Mearns considered the influence of the teacher and the desire of children for his opinion. He gave detailed and tender attention to the concerns and anxieties of children engaged in creative endeavors. He observed that children eventually sought the teacher's opinion and reactions about their work. He wrote, "They would not know it was good until someone had told them." He was realized that his opinion, in his position as teacher, contained an element of evaluation. Rather than shirk evaluation, he stressed the need for the teacher to be sensitive to the child's close identity with his work.

Guilford noted a close tie between a feeling of satisfaction and evaluation.

Too much evaluation applied too early is, of course, detrimental but there is one special role of evaluation that must be pointed out. The act of evaluation leaves us satisfied with our results or it leaves us dissatisfied. If we are too easily satisfied, we miss opportunities for making corrections and improvements and the general opportunity to grow. 67

 $^{^{6\, \}delta} Hughes \; Mearns, \; \underline{Creative \; Power} \; \; (New \; York: \;\; Dover \; Publications, 1958), p. 20.$

⁶⁷J. P. Guilford, Creative Intelligence in Education (Los Angeles: Los Angeles County Superintendent of Schools, Division of Research and Guidance, 1958), p. 6.

Evaluation that is constructive and related to the problems and alternatives of a problem-solving effort has been advocated by Torrance. Yet, he concluded after a series of field studies that teachers did not use evaluation as a learning opportunity. He concluded in part:

Criticism and praise are among the favorite weapons and defenses of the respondents. Appeals to the child's own creative resources, the use of self-evaluative approaches, and the like are rarely used.

Torrance has argued that praise and blame are often used by teachers as a form of evaluation that allows little opportunity for self-evaluation on the part of the pupil. Instead, evaluative statements by teachers were found over-simplified, generalized praise or criticism especially in so far as content was concerned. This description of the classroom use of evaluation is in sharp contrast to an environment advocated by H. H. Anderson. He described an open environment in which there is integrity of differences, along with an openness devoid of threat and manipulative control. 69

The results of a study by Sears involving ten teachers and 195 pupils lend some support to the opinions expressed by Guilford, and Anderson and the observations of Torrance.

She found that, "Children who get high scores on measures of

⁶⁸E. Paul Torrance, Role of Evaluation in Creative Thinking, Cooperative Research Project #725 (Minneapolis: University of Minneapola Press, 1964), p. 398.

⁶⁹Harold H. Anderson, On the Meaning of Creativity, prepared for a workshop on Creativity in Childhood and Adolescence, 1962.

creativity tend to have teachers who reward by a technique of personal interest and praise for personal attributes and who avoid rewarding by evaluation."⁷⁰ (Sears used the term "evaluation" to include criticism.) Interestingly, the trained observer, using Flanders System, probably would not record evaluative statements as criticism. The observer might well record such events in the category of giving opinion. As Mearns observed, teacher opinion is a part of evaluation and the source of satisfaction for the child, closely identified with his work. But evaluation that does not include the student and his ideas is not likely to be the learning experience or bring the satisfaction alluded to by Guilford.

The term used by Anderson, "open environment" is sometimes interpreted to mean, "permissive environment." As an outgrowth of the Sears study, Spaulding initiated a study involving twenty-one teachers in grades four and six. He found, "Only business-like lecture method with insistence upon attention-to-task and conformity to rules of procedure was found to have an educationally desirable relationship with all eight target variables." ⁷¹ There was also some evidence from

⁷⁰ Pauline Snedden Sears, The Effect of Classroom Conditions on the Strength of Achievement Motive and Work Output on Elementary School Children. Cooperative Research Project No. 873 (Stanford, California: Stanford University, 1963), p. 297.

⁷¹ Robert L. Spaulding, Achievement, Creativity and Self-Concept Correlates of Teacher-Pupil Transactions in Elementary Schools. U. S. Office of Education, Project #1352 (Urbana, Illinois: University of Illinois, 1963.

one teacher that a creative and disorderly pattern of planning and execution had a negative effect on pupil performance on measures of originality and flexibility. While Spaulding did not find many positive correlates with measures of creativity, the research lends evidence that a permissive environment, in the sense described earlier by Mitzel, is not conducive to optimal creativity for most children. Far from being uninvolved or non-directional, the teacher is a principal in providing an environment responsive to the interests and feelings of pupils and structured to the learning task. Yet, on the basis of a pilot study designed to help teachers treat pupils as "thinkers", Hutchinson observed:

- Teachers did not listen to pupils attentively as evidenced in the way they summarized pupil ideas.
- Teachers did not allocate time for the divergent ideas of pupils.
- In classrooms where teachers continually derived generalizations, pupils waited for the teacher's generalizations rather than produce their own.

Hutchinson elaborated on his observations to suggest that teachers in his study modified pupil ideas to conform with the teacher's preconceived idea. 72

Three of five principles proposed by Torrance to guide the planning of creative experiences relate directly to the use of pupil ideas. The teacher is asked to be respectful of (1) unusual questions (2) imaginative ideas and (3) to show

⁷²Hutchinson, op. cit., p. 36.

that their ideas have value. 73 And there is some evidence that teachers who follow these principles do facilitate creativity of pupils. Enochs recorded classroom sessions of two teachers with an audio-video recorder and held conferences with each teacher at the close of the school day. Teachers were encouraged to use more indirect influence, allow more pupil talk, listen and accept what was said. The results indicated a tendency for experimental teachers to allow more pupil talk and to accept more of their ideas. Direct influence behavior tended to decrease in frequency. Although the total use of indirect behavior did not substantially change in frequency, closer scrutiny suggests a change in the quality of teacher-pupil interactions. The use of pupil ideas increased from 3% to 7% of total classroom interactions. In addition, student talk increased 50% to nearly one-half of total classroom interactions. Pupils in the experimental classrooms were compared favorably by the author to control classrooms on measures of creativity. 74

Soar used Flanders System in a study of 57 classrooms, grades three through six. After rotation of variables, he found one factor of teacher influence related to measures of

⁷³E. Paul Torrance, "Creative Thinking Through School Experiences," <u>Explorations in Creativity</u>, ed. Ross L. Mooney and Taher A. Razik (New York: Harper and Row, 1967), p. 192.

⁷⁴ Paul David Enochs, "An Experimental Study of a Method for Developing Creative Thinking in Fifth Grade Children," (Unpublished doctoral dissertation, University of Missouri, 1964).

gain on the Minnesota Test of Creativity. This factor was termed "indirect" by Soar. But the factor was comprised principally of data indicating the frequency of teacher use of pupil ideas. He concluded that an, "indirect classroom, one in which pupil ideas are accepted, support growth in creativity and also produce a decline in the need pupils felt to describe themselves as conforming to adult norms." 75

While Soar found the frequency of teacher use of pupil ideas related to measures of creativity, frequency of asking questions may not be as important as asking the right types of questions. Rubin stated, "The crux of the method hinges on the selection of questions for self-directed inquiry which demand a respectable degree of preliminary information and which require the student to employ a number of diverse intellectual skills in reaching his conclusion." Unless teachers will ask questions that request or require divergent thinking operations on the part of pupils, there is not likely to be pupil-initiated expression of their ideas. Yet, Carner found teachers most reluctant to use "creative" questions as compared to the use of "concrete" and "abstract" questions.

⁷⁵ Robert S. Soar, An Integrative Approach to Classroom Learning (Philadelphia: Temple University Press, 1966), p. 184.

Teativity Its Curriculum Implications, ed. John Curtis Gowan, George D. Demos and E. Paul Torrance (New York: Wiley, 1967), p. 204.

^{7&}lt;sup>7</sup>R. L. Carner, "Levels of Questioning," <u>Studying Teaching</u>, ed. James Rath, John R. Pancella and James S. Van Ness Englewood Cliffs: Prentice-Hall, 1967), pp. 182-186.

Aschner and Gallagher developed an observation schedule based on the cognitive operations by Guilford (see page 32). The five major categories were: Routine, Memory, Convergent thinking, Divergent thinking and evaluation. 78 Gallagher observed that a slight shift in question type on the part of the teacher resulted in a relatively large increase in pupil participation. 79

Aschner and Wise found that four teachers identified as "indirect" used more divergent questions than a group termed "direct". In addition, pupils in the former group initiated a significantly greater number of their own divergent questions and statements. This finding was found appealing, logically and operationally, for it suggests a way for a teacher to encourage pupils to express their ideas and solutions to problems. 80

This review of research found few studies of teacher-pupil interaction effects with creativity. However, there was evidence of a tentative nature to suggest that divergent thinking

⁷⁸ Mary Jane Aschner, James J. Gallagher, Joyce Perry and Sibel Afsar, A System for Classifying Thought Processes in the Context of Classroom Verbal Interaction (Urbana: Institute for Research on Exceptional Children, University of Illinois, 1962) (mimeographed).

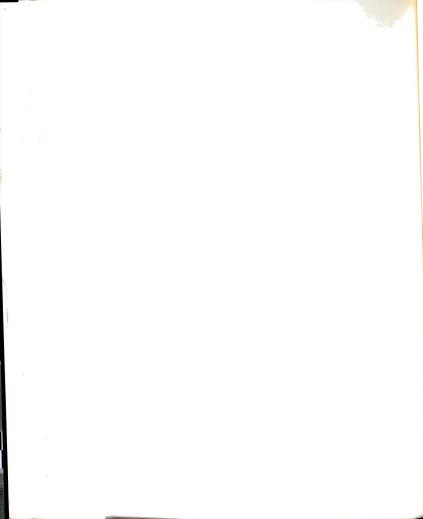
⁷⁹Mary Jane Aschner and James J. Gallagher, "A Preliminary Report on Analyses of Classroom Interaction," Merrill-Palmer Quarterly of Behavior and Development, 9 (1963), 193-194.

⁶ ⁰Mary Jane Aschner and A. E. Wise, Supplemental Materials for Factors Related to Intellectual Initiative in the Classroom: Teacher Influence, Sex Differences (Mimeographed). 1964.

questions could be used to encourage pupil expression of their ideas. Listening, acceptance and perhaps elaboration of the ideas of pupils were in part found related to creative performance. The evidence and opinion regarding the use of praise was found ambivalent, but the slim evidence pointed to a cautious approach to test its importance to creativity in this study.

This review included a survey of literature regarding the nature and characteristics of creative behavior. A process-product construct was adopted. Surprisingly, this was the first study to include a review of creativity prior to the conduct of tests of variables of teacher-pupil interaction. Sensitivity to problems, openness and awareness, and problemsolving activity were considered along with originality as facets of creativity as process and product.

In the next chapter, the criterion measures of creativity as a product are introduced. The teacher-pupil variables are identified by analysis within a 10 \times 10 matrix, using Flanders guidelines.



CHAPTER III

THEORY AND RESEARCH DESIGN

Knowledge is not a copy of reality. To know an object, to know an event, is not simply to look at it and make a mental copy, or image of it. To know an object is to act on it. To know is to modify, to transform the object, and to understand the process of this transformation, and as a consequence to understand the way the object is constructed. An operation is thus the essence of knowledge; it is an interiorised action which modifies the object of knowledge.

This chapter was divided into five parts. Part I included a resume of the pertinent ideas and findings of the previous chapter. In Part II, a construct of creativity was presented that suggested possible relationships between measures of creative performance (product measures), academic achievement, and classroom interaction (process measures). In part III, the creative performance measures of divergent thought and problem solving are described. Since the problem solving measure was developed for use in this study, a brief description of its development was also included in the third part. Part IV contained the rationale and preliminary

¹ Jean Piaget, "Notes on Learning," <u>Saturday Review</u> (May 20, 1967), p. 81.

definitions of classroom interaction variables. Finally, the population and statistical treatment are outlined in part V.

Part I

Review of Ideas and Reported Findings

In the previous chapter, creativity was considered as both product and process. The product was characterized by its uniqueness and its resolution of some worthwhile problem. The process was described by some as a series of steps, eg., Wallas' four stages: preparation, incubation, illumination and verification. But the process was also qualified to depict an active transaction and sometimes described to have quality of openness, self-direction and responsiveness.

Several studies of the possible effect of the classroom teacher on pupil performance on measures of creativity were reported. Torrance cautioned against the indiscriminate use of evaluation in the form of routine praise³ while Mearns forty years earlier described the need and the care to be exercised in teacher evaluation of pupils' creative endeavors.

²Graham Wallas, <u>The Art of Thought</u> (London: Jonathan Cape, 1926).

³E. Paul Torrance, Role of Evaluation in Creative Thinking, Cooperative Research Project #725 (Minneapolis: University of Minnesota Press, 1964).

Hughes Mearns, Creative Power (New York: Dover Publications, 1958).

Skill in listening, clarifying and elaborating on pupil ideas was suggested by the findings of Soar and Hutchinson in their studies of teacher influence. 5 The findings of Aschner and Wise demonstrated a positive relationship between the teacher's use of "open" or "closed" questions, the frequency of divergent pupil talk and pupil initiated talk. Finally, the conclusion of Flanders in his earlier study bears repetition. The flexible teacher, the one who modified his influence, direct or indirect, with pupil clarity of goals and procedures tended to increase pupil performance on measures of problem solving. It seemed that the freedom and the control that Johnson saw as part of the creative search could be encouraged and supported by patterns of classroom interaction that varied with the cognitive task. It is the purpose of this chapter to describe the theoretical construct, design and procedures used to test this idea.

Part II

A Theoretical Construct of Creativity

Creativity was defined for the purpose of this study as the problem solving performance of the pupil by which

⁵Robert S. Soar, An Integrative Approach to Classroom Learning (Philadelphia: Temple University Press, 1966); Eliot Dole Hutchinson, How To Think Creatively (New York: Abingdon-Cokesbury Press, 1949).

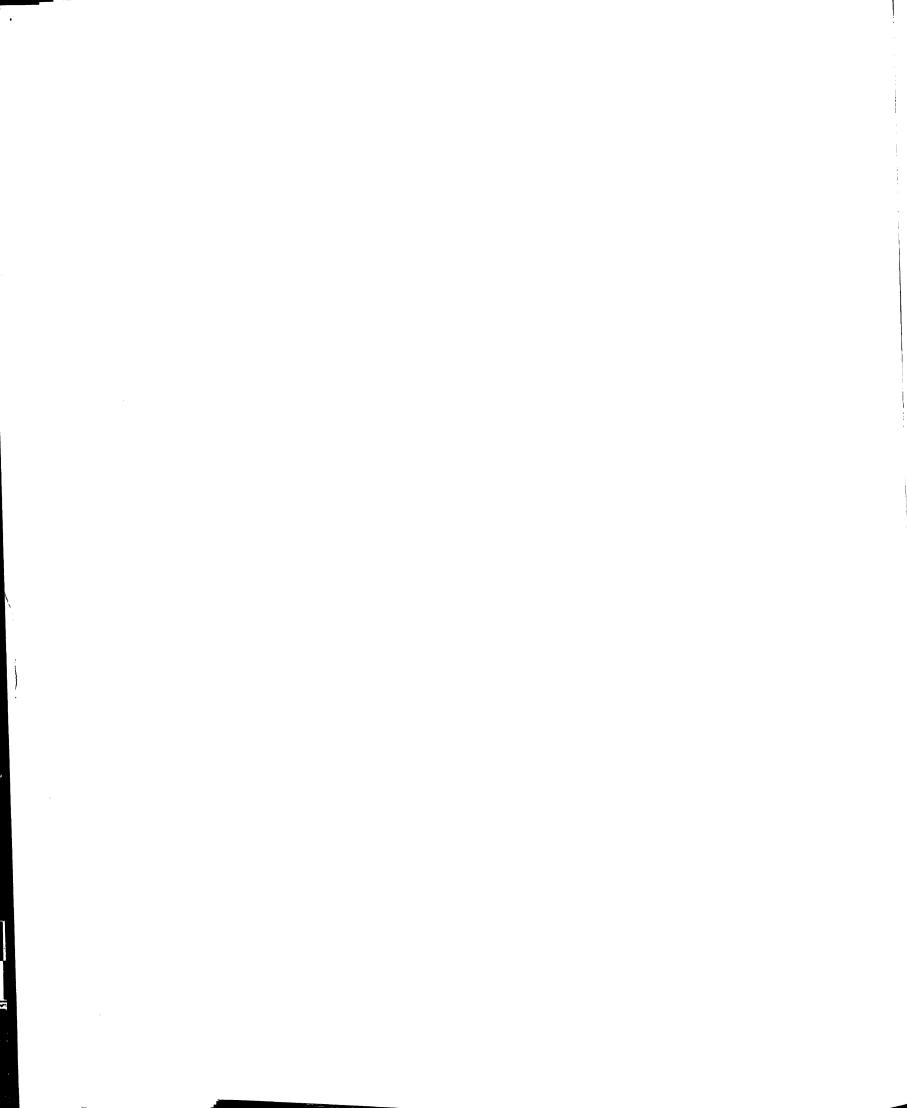
⁶Mary Jane Aschner and A. E. Wise, <u>Supplementary Materials</u> for <u>Factors Related to Intellectual Initiative in the Class-</u>
<u>Foom:</u> Teacher Influence, Sex Differences (Mimeographed).

solutions, unique among peers, are produced that meet the conditions of a task or goal. Explicit in this definition is the performance of the pupil as evidenced by a solution that is both unique and meets some requirement of the problem.

Three implications were drawn from a consideration of creativity to include problem solving activities. First, creativity was not viewed as a single act or moment, but a set of activities. Within the set, activities might differ both in immediate purpose and in behavior. Second, creativity would require, dependent in part on the problem, several intellectual or cognitive performance skills of the student. And third, different cognitive performance skills would require different patterns of interaction between teacher and learner.

For this study a construct* was developed to illustrate the organization and associations of ideas and measures of creativity. It is not an idealized model of creativity or of instruction. Rather, the construct was used in the joint consideration of problem solving activities, classroom verbal interaction, and measures of classroom interaction and pupil performance. Thus, the construct is descriptive of theoretical and behavioral concepts used in the study of relationships found between several measures of creativity and selected measures of classroom interaction. Two purposes are served: (1) To

^{*}Constructs are deliberate creations chosen to organize experience into general law-like statements. See Lee J. Cronbach, "Test Validation," Educational Measurement, 2nd Ed. Robert L. Thorndike, ed., (Washington: The American Council on Education, 1971), pp. 462-467.



present theoretical relationships between several measures of creativity, and (2) To present theoretical relationships between selected measures of classroom interaction and measures of creativity. Before detailing these relationships, the entire construct is presented for the reader.

Stages

To study creative performance and associated problem solving activities, a preliminary division was made following the lead of Wallas and Gallagher. Division of problem solving activities by stages is artificial in terms of sequence and continuity. Undoubtedly, the sensibility, organization and sequence of activities is peculiar to each individual and problem. Nevertheless, the four stages appeared basic to most if not all problem solving performance.

Added to the four stages of creative performance offered by Wallas, was a stage termed, <u>problem formulation</u>. The introduction of a Fifth Stage or division of creative problem solving was first suggested by the writings of Rossman and Dewey. Wallas apparently assumed the problem to be defined. However, Rossman included a step he called, "detection of a need", as part of problem solving. Dewey recognized that a

⁷Joseph Rossman, The Psychology of the Inventor (Washington, D.C.: Inventors Publishing Co., 1931; John Dewey, How We Think: A Restatement of the Relation of Reflective Thinking to the Educative Process (Boston: D. C. Heath and Co., 1933).

TABLE 7
A PROCESS-PRODUCT CONSTRUCT OF CREATIVE PERFORMANCE

STAGES	COGNITIVE OPERATIONS	CLASSROOM ATTITUDES BEHAVIOR	PERFORMANCE MEASURES	CLASSROOM INTERACTION	VERBAL INTER- ACTION MEASURES BY FLANDERS' CATEGORIES
		PROCESS	SS		
I Problem Formulation	Cognition		Asking Questions	Teacher asks	Ideas
A. Observation	Intuition	Suggestions Curiosity	about: Objects	open questions Pupil initiated ideas Teacher use of	Nines
B. Recognition	Comprehension	Sensitivity to defects Recognition of discrepancies	Discrepant events	pupil ideas and minority opinion Teacher adds ideas to pupil ideas	
C. Definition	Analysis	Establishing search selecting procedures Intellectualization	Not tested	Teacher seeks relationships of ideas	
II Preparation	Метоку	Studiousness Sustained attention Recognition of relevant information Reading	Academic achievement	Repetition Drill Practice Reinforcement Application	Drill Tens Indirect
Incubation III Illumination	Divergent Production	Intellectual Freedom Risk taking Tolerance for ambiguity	Restructuring (Picture completion) Transformation (Circles or squares) Freduct Improvement	Pupil initiated ideas Independent study and group work	Nines Tens

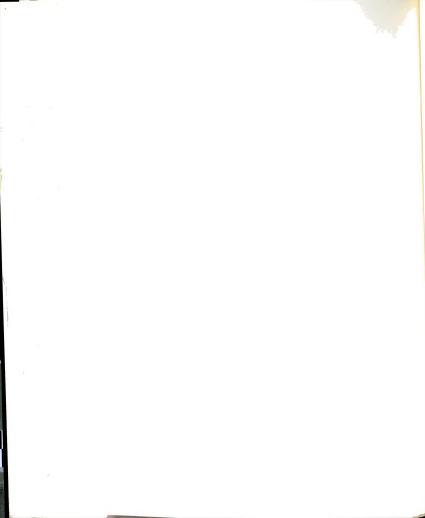
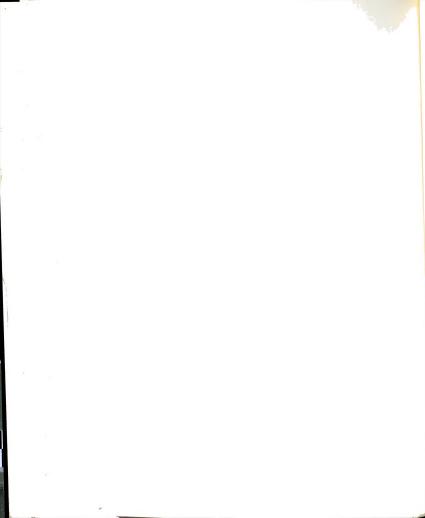


TABLE 7--Continued

STAGES	COGNITIVE	CLASSROOM ATTITUDES BEHAVIOR	PERFORMANCE MEASURES	CLASSROOM	VERBAL INTER- ACTION MEASURES BY FLANDERS' CATEGORIES
		PRODUCT	CT		
Review and IV Elaboration	Convergent	Accepting initial	Seeing Problems	Recognition and	Ones*
		redicting results Predicting solutions Withholding final judg-	Suggesting solutions	acceptance of feelings Feelings Feelings Feelings Feecher adding ideas Pupil explanation and prediction	Nines Eights Ideas
V Verification	Evaluation to include Affective Valuing	Intellectual responsibility Accepting results in perspective	Not tested	Shared responsibil- Nines ity for results, Eights conclusions Ideas Recomition	Nines Eights Ideas
		resting hypotheses Sensing gaps Judging with criteria Identifying personal Meaning and contribution		acceptance of feel- ones'	· ones*

*Not tested



period of doubt and search might precede deliberation of possible solutions. In addition, Dewey seemed to make allowance for intuition as a possible source of solution prior to formalized intellectualization of the problem.

Apart from the logical analysts, H. H. Anderson counselled attention be given a stage of problem formulation from pedagogical considerations. For it is often here in the early stages of problem solving that the interplay of teacher and pupil not only determine the existence of a problem but also who, teacher or pupil, shall have the opportunity of a creative solution. Without this stage, a goal may be so poorly defined as to result in an aimless pursuit, excessive anxiety and increased dependence upon the direction of others. Alternatively, goals or procedures may be described with such precision as to preclude variation in individual goal or procedures.

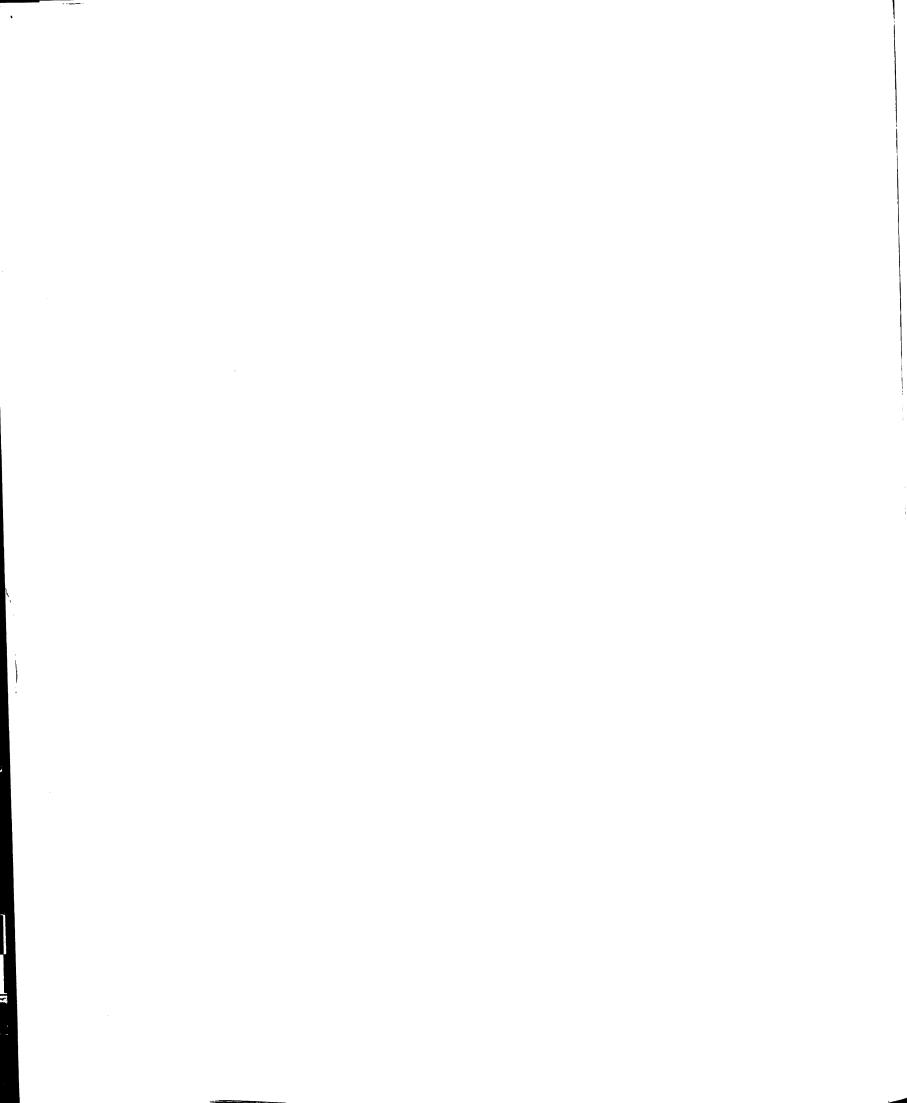
Cognitive Operations

Cognitive Operations after Guilford are included in the construct to indicate the predominate transformation of data and information to some idea production. Memory as a cognitive operation connotes minimal transformation of data. Evaluation as used here would result in an assessment of a judgment, choice or value to something. Convergent and divergent idea production refer respectively to transformations of information to anticipated answers or to alternative

answers. Answers and solutions to questions or problems in convergent productions can be reached by reasoning from the information presented in the problem. In divergent idea production, an individual is free to take a new perspective and to add his own ideas, associations and problem limitations. While creativity has sometimes been equated with divergency, it may be noted that each type of cognitive operation is represented in the construct used here. Each cognitive operation results in the production of an idea that can be assessed with evaluative instruments. Thus, each stage with its predominate cognitive operation can be considered and assessed separately or as a part of a total set of problem solving activities.

Classroom Attitudes and Behavior

The third column of the construct consisted of a list of suggested behaviors and attitudes associated with the stages of problem solving activities. While not essential to this study, this column does afford a transition between measures of creative performance and the covert mental operations that are assumed the basis of idea production. The list is not intended to be exhaustive, but is intended to suggest behaviors and attitudes believed supportive to cognitive idea production. The list also serves as a basis for an informal check of consistency between supportive behaviors and attitudes of pupils on the one hand and suggested classroom patterns of classroom interaction introduced in column five of the construct.



Performance Measures of Creativity

As indicated by column four, most tests of creativity may be categorized as measures of divergent idea production. In this study, however, assessment of a broader range of creative problem solving abilities was desired. Tate found that ideational tests, Seeing Problems (candle, pencil), Consequences (blindness, anarchy), Reasons (cities, trees) and Uses (brick, newspaper) did distinguish significant differences in scores obtained from a sample of seventh and eighth grade children identified as good and poor problem solvers. Perhaps just as revealing was the finding that fluency of responses did not distinguish between the two groups of problem solvers with one exception: Fluency scores with the ideational test, Consequences, favored poor problem solvers! But the scores obtained from the same test based on a criterion of quality did distinguish, as did the other ideational tests, two groups of problem solvers. Tate concluded that "poor problem solvers differ significantly in quality of response as elicited by our ideational-fluency tests."8

It also appeared desirable to present a task stimulus with a minimum set of restrictions or requirements to be met in formulating an answer. In particular, problem formulation

⁶Merle W. Tate, Barbara Stanier and Berj Harootunian, <u>Differences Between Good and Poor Problem-Solvers</u>, Project #368 (Philadelphia: University of Pennsylvania, 1959).

in this study was a stage during which discrepancies were recognized, gaps in knowledge identified and accommodation to elements of the problem occurred. The formulation of a problem could be based upon the then current observation and interpretation of events, background information, interest and the like.

A set of tasks of creative performance of interest to this study was the Ask and Guess Test, developed by Torrance. This test was developed from a rationale that curiosity is reflected in the number and type of questions asked. In one version of this test, a picture of a Mother Goose story (Tom, the Piper's Son) is displayed and children are asked to ask questions, state possible causes of depicted events and give possible consequences.

This study plus the gaps in measurement apparent from the construct presented earlier suggested tasks be developed that included conditions within the problem. These conditions would pose restrictions or requirements to be met while formulating an acceptable answer. It was found that problems, tasks and solutions could be broadly classified as:

- Open without restriction to acceptable, alternative answers
- (2) <u>Restricted</u> to judgment or choice among several preselected alternatives

⁹E. Paul Torrance, <u>Guiding Creative Talent</u> (Englewood Cliffs: Prentice-Hall, <u>Inc.</u>, 1962), pp. 222-223.

(3) <u>Closed</u> to alternatives: one answer is considered best.

Problems that require solutions in the form of facts, descriptions and rule-like statements tend to cluster at the "closed" end of an open-closed continuum. Adaptation of concepts to additional conditions and application of principles to new situations; evaluation, judgment and choice tend to center between the "open" and "closed" poles of the continuum. This is because the alternatives are usually known or the rules and criteria are predesignated by which alternatives are selected, but the specific response may be left to be determined by the student. At the other extreme of the continuum may be found problems, tasks or solutions with no restrictions to an acceptable answer. More frequently, "open" questions, tasks and problems do have at least implicit restrictions that permit some relationship to be drawn between a stimulus task and a response.

This classification, coarse as it may be, at once suggested that creative problem solving often includes more than one cognitive task. Further, creative problem solving often includes cognitive operations that tend to expand the number or choice of alternatives and also thought operations that are directed toward restricting the number or choice of alternatives. Indeed, a pattern of an alternating degree of restriction may be discerned from one stage to the next: open, restricted, closed, open, restricted, closed.

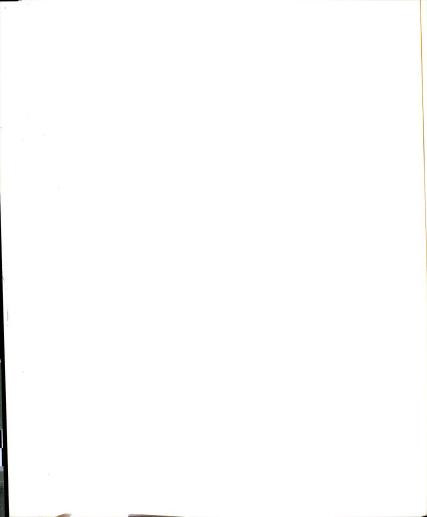
Closed	Restricted	0pen		
One acceptable answer.	Number of possible answers not known	All answers ac ceptable with- out (immediate evaluation.		
Criterion of accept- ability not known or imposed by rule.	Criterion found in whatever a solution must accomplish.	Criterion may not be known or recognized.		
Example: Tennis shoes must be worn on gym floor. Example: 6 x 7 = 42	Example: How can tracking on the gymnasium floor be prevented?	Example: The free associative response.		

Figure 1. An Open-Restricted-Closed Classification of Problems and Answers.

The alternating pattern of open-restricted-closed freedom (or its reciprocal, restriction) of choice of alternative
task or solution probably does not exist save in the model
construct above. Nevertheless, it is suggested that one or
more shifts in tasks along a continuum of degree of restriction seems probable if a unique, workable solution is expected. It is further suggested here that this construct with
stages that include tasks with varying degree of restriction
on alternative answers can be extended to a consideration of
classroom interaction between members of the classroom.

Classroom Interaction

Our theory suggested that pupils would engage in the task of Observing and formulating a problem sufficiently to seek and determine relevancy of information and to suggest procedures



to solve the problem. During a period in which these conditions were not met, the teacher might take an active stance with questions that encouraged pupils to identify gaps in information, to recognize the familiar and to test ideas with one another. The "open" question could be used to encourage pupils to offer opinion, to recount past experience, and to designate individual interest in certain facets of a problem or related problems. The teacher may well take an active part in clarifying pupils ideas, giving additional information that might lend support to pupil ideas and, if need be, protecting a minority opinion from dominance by a peer majority.

Until such time as pupils were oriented to the problem and requirements for obtaining a solution, the teacher uses control to manage class activities. For example, independent seat work or reading assignments might be given to pupils who from limited experience or background find it difficult to determine appropriate procedures. During periods in which pupils knew both goal and procedures and were problem oriented, the teacher might use a proportionately high frequency of directions and specific questions. This might be anticipated as the teacher facilitates pupil search for information and student judgment concerning alternative solutions. Finally, if pupils and teacher in reality shared responsibility for outcomes, pupil explanation and opinion contrasting results with the formulated problem could be expected. Thus, a

supportive climate was not seen to be a permissive climate. Rather in roles as manager, discussant and resource person, the teacher assumed an active stance that could be modified with goal clarity, pupil experience and problem solving activity.

Flanders in an earlier study formulated three hypotheses relating teacher influence patterns to goal clarity and pupil achievement. When goals were clear, Flanders found flexible teachers used a higher proportion of direct influence than they did when goals were unclear. In addition, Flanders also reported that flexible teachers tended to vary their verbal influence patterns with the learning task. More indirect influence was used during periods of planning and the introduction of new material.

Extending the Flanders' findings to this study, it may be expected that flexible teachers who support the creative problem solving activities of pupils will vary their patterns of verbal influence with the clarity of goals and with the cognitive task.

- Given that goals are unclear, a pattern of indirect influence will be found related to pupil achievement.
- Given that goals are clear, a pattern of indirect influence will support pupil formulation of a problem, and divergent idea production.
- Given goals are clear but information is insufficient to proceed, a flexible pattern of direct and indirect influence will support pupil achievement.

Flanders' second hypotheses relating achievement and goal clarity with a direct influence pattern is modified in this study. The reason, of course, is that information is not a sufficient goal when the objective is creative performance. The information must not only be acquired and perhaps reinforced, but comprehended to sufficient degree to permit translation to the student problem at hand. It would seem that some combination of directed teacher influence, pupil activity and pupil-teacher interaction is required to facilitate creative performance.

Flanders' hypothesis of direct influence with clear goals is modified when the cognitive task is either problem formulation or divergent idea production. Even with goal clarity, the cognitive task can be an overriding consideration in the designation of desired influence pattern.

It may not be sufficient, however, to use the measures of indirect and direct influence patterns developed by Flanders. The problem of course is that these measures include the frequencies of teacher talk to the total time in the classroom. If the student is to be creative, it is he who must contribute the ideas that are the mainstay of solutions to a problem. The teacher with planning and managerial control may facilitate pupil diversity with shared responsibility for the outcome. But indirect influence measures had to be identified that specified the type and quantity of pupil contributions as well as the influence patterns of the teacher.

These measurement variables will be introduced with measurement variables of creative performance of pupils in a later section and in Chapter IV.

Three implications drawn from the theoretical construct appeared tenable and instrumental for further study:

First, creative problem solving may often include more than one cognitive task, as for example, discrimination, definition, divergent idea production and assessment.

Second, creative problem solving includes both thought operations that tend to expand the number and choice of alternatives, and thought operations that tend to restrict the number of and choice of alternatives.

And third, patterns of verbal interaction "consistent" with desired cognitive operations will facilitate student expansion or reduction of number and choice of alternatives. That is, teachers who exhibit flexibility in management of pupil and teacher patterns of verbal interaction will use patterns consistent with the attendant cognitive operation of students or class.

Part III

Measurement of Creative Performance and Academic Achievement

Measurement of Creative Performance

An Instrument, Test Your Imagination, was developed as a part of this study. It consisted of four tasks of divergent

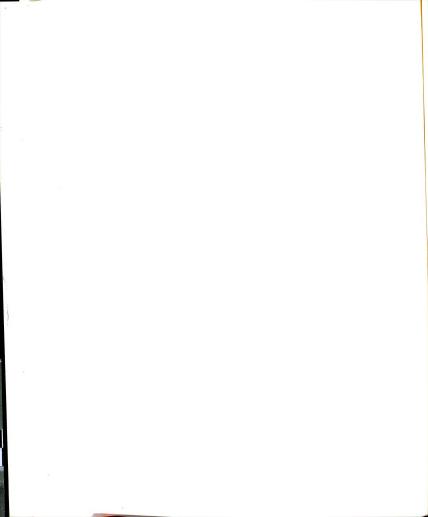
thinking from the <u>Minnesota Test of Creativity</u> (Torrance, 1960). Three additional tasks were developed to assess skills in "Asking" questions and sensing discrepancies, "Seeing Problems" and "Suggesting Solutions" to a problem situation.

The two figural tasks from the Minnesota Test of Creativity were selected to provide tasks that required a minimum of verbal skills. The Picture Completion Task presented a minimal stimulus line or curve. The student was asked to complete the picture by creating a new figure using the stimulus as part of the picture. The second figural task presented thirty-six regularly spaced circles. The subject was requested to draw objects or pictures using one or more circles as part of the drawings. The task required the subject to create a picture where one did not previously exist. In addition, it presented a test of subject flexibility or ability to respond differently to the same stimulus in a brief time period.

The two verbal tasks from the Minnesota Test of Creativity required the student to alter an existing object. Product

Improvement presented the task of improving a toy so that children may have more fun with it. The second task, Unusual Uses, requested the subject to list different uses for a cardboard box. The latter task had been used by Tate who found a significant correlation between scores of useful uses for the object and criterion scores of good problem solvers. A similar task was reported used as part of the A C Test of Creative

Ability. The latter test battery was found to distinguish by



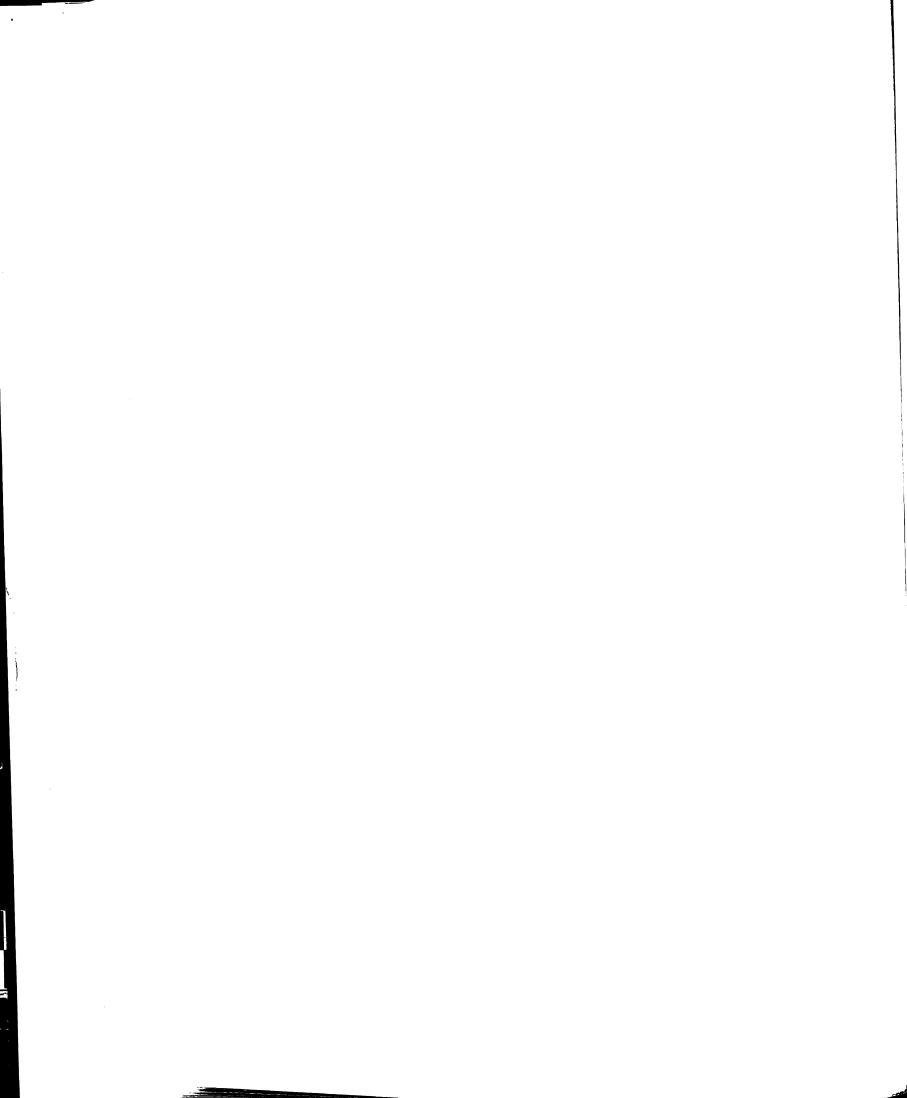
test scores eighteen engineering and technical staff personnel judged "high" and eighteen personnel judged "low" in creative ability. 10

Because of the emphasis of this study on creative problem solving abilities, the latter task had a particular appeal. But all of the four tasks from the Minnesota Battery were favored because multiple responses were encouraged, tasks had been developed particularly for elementary school children and each task had at least one constraint or rule.

In addition to the four tasks from the Minnesota Battery, three additional tasks were developed for purposes of this study. The first of the three tasks, Asking Questions, was designed to provide a measure of at least two subdivisions of the Stage of Problem Formulation from the construct presented earlier. An unfamiliar stimulus was presented that had an aura of incredibility. To respond, by asking questions about the objects and to note the discrepant events in the picture, the subject was considered to have displayed evidence of attitudes of openness and curiosity.

The next two tasks presented the subject with additional information about the unfamiliar stimulus that had to be taken into account. The information provided was designed to restrict alternatives that otherwise might have been available.

Test Administration Manual (Chicago: University of Chicago, 1959), pp. 13-15.



A measure of a population's ability to respond to a minimal set of constraints might then be compared to the ability of the population to respond to tasks with increasing number of restrictions and convergence to a single answer.

The second of the three tasks asked the subject to list the problems foreseen in using an object described in the task above. This task, <u>Seeing Problems</u> (Consequences) was of additional interest for variations with other stimulus objects had been favorably reported in the validation studies of Tate¹¹ and the A C Test of Creative Ability.¹²

The last task was designed to compare measures of pupil divergent idea production with measures of pupil ability to suggest solutions to problems. Again, information provided the subject about the stimulus figure had to be taken into account in the suggested solutions. But the task was made particularly difficult by adding the conditions that the solutions be fair and practical. In this way, the student was asked to evaluate his own responses or problem solutions.

The interview technique with three to six children was used to refine test items. Quite unanticipated, perspective and anxiety seemed to underlie two major difficulties in the refinement of the three tasks. With drawings of objects pupils had not previously seen, objects were not perceived as

¹¹ Tate, Stanier and Harootunian, op. cit., p. 40.

¹² Harris, op. cit., p. 13.

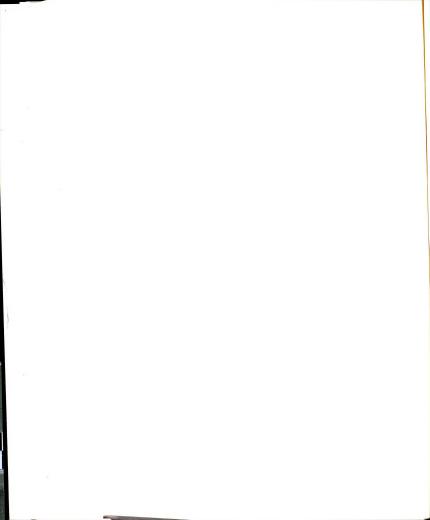
an adult thought they should. In an earlier version of a cloud, for instance, with a pull-down hatch, a rope was seen by some to be a toothpick. Hence, a loop handle was added to a later version of the cloud (Cream Puff). The second difficulty was evidenced by some pupils to be inclined toward calamity rather than problems. For illustration, one earlier test stimulus of children playing on a small satelite moon had to be discarded because pupils were more concerned with children falling off or being pushed off than with the problem presented in the test.

The last three tasks were pretested with 121 pupils from four classrooms. Different ages and socio-economic backgrounds were sought for this trial population since simple correlations between two forms were not the only concern. Readibility, two methods of test introduction, and cultural bias of rural, suburban and inner-city populations were also investigated. The four teachers were asked to observe and did give many helpful suggestions. A cover picture was added, eliminating the need to spend considerable time describing the nature of the test, the word, "imagination", substituted for the word, "creativity", and time limits set at a length at which children were still thinking but had stopped writing. Correlations of about .50 were set as minimal useful limits. The obtained correlations by task and factors for the group (n=60) receiving the "better" method are:

	Asking Questions	Seeing Problems	Solving Problems	Total
Fluency	.67	.59	.31	.69
Flexibility	.64	.50	.12	.61
Adequacy	.64	.64	.23	.59

Task 7, Problem Solving, proved too difficult for the trial population. It was retained to provide a higher upper ceiling should higher ability ranges be encountered in the larger test population.

The test administration procedures and time requirements were determined as part of trial tests (Appendix B). One additional problem of concern during trial use and refinement was with administrator influence on the examinee. The interest (or lack) and motivation of the examiner could conceivably negate a persistent, but less immediate teacherclassroom influence. Conversely, teacher influence that easily compensated should in some way be equalized. To adjust for such a contingency, a positive bias toward children's own creative ability and work was attempted as part of introductory instructions. However, in some instances, this resulted in lengthy unwanted explanations of creativity with dubious results. It was found that every child claimed to understand imagination. The title of the test was changed, a cover illustration, plausible but improbable, was added and the test administrator had only to ask, "Do you have an idea what this test of your imagination is about?" to obtain a positive



response (see Appendix A, B, for Examiner Instructions and Scoring Protocols).

Scoring Creative Performance with the Battery, Test Your Imagination

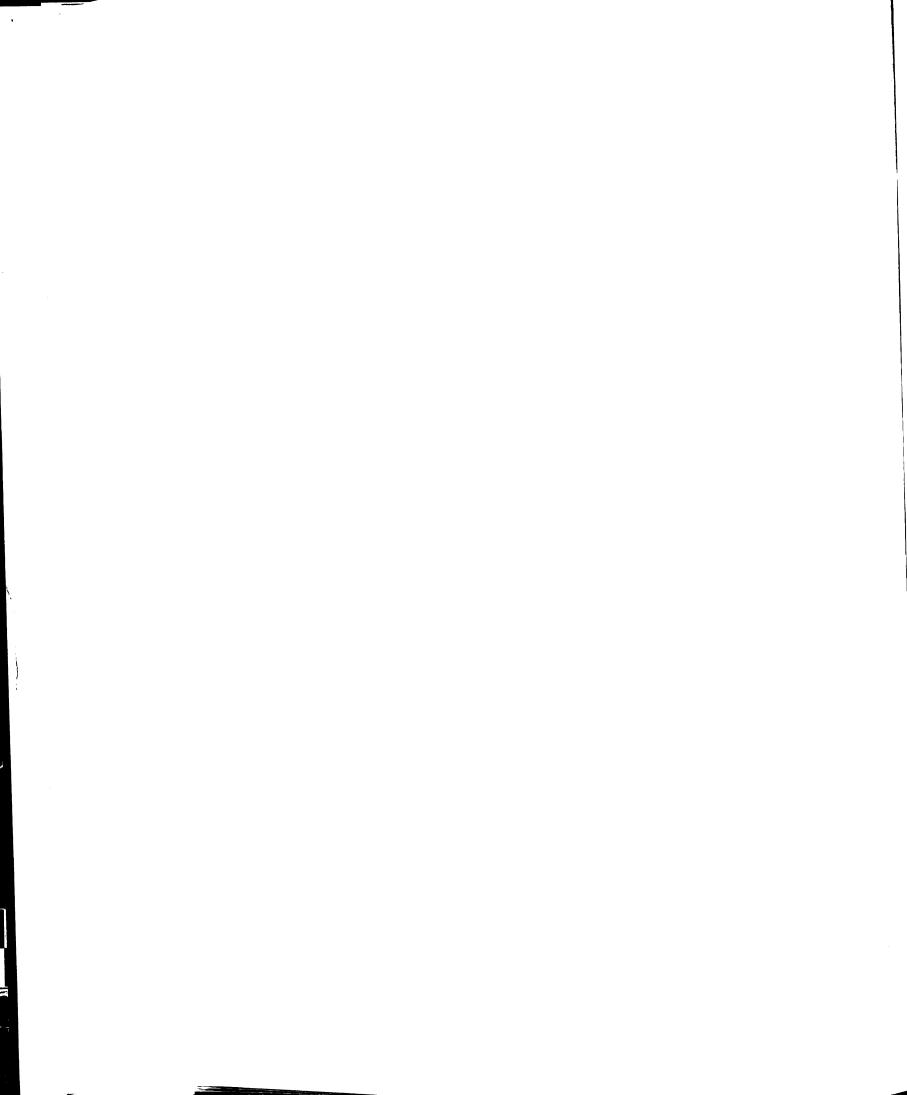
Separate tasks of the Minnesota Test of Creativity were scored according to instructions provided by Torrance in the Scoring Manuals, Forms A and B. Tasks were scored for Fluency, Flexibility, Originality and in the figural tasks, Elaboration. The three tasks of problem solving developed for this study were scored for Fluency, Flexibility and Adequacy. Total scores for figural, verbal and problem solving sections of the test battery were computed. By title and scored factors, the seven tasks are given in Figure 2 below.

<u>Title</u>	Fluency	Flexi- bility	Origin- ality	Elabor- ation	Adequacy
Picture Completion	Х	х	Х	Х	
Pictures from Circles	х	х	Х	х	
Product Improvement	X	X	X		
Unusual Uses	X	X	Х		
Asking Questions	X	X			X
Seeing Problems	X	X			X
Solving Problems	х	X			X

Figure 2. Schedule of scores by factors and tasks from the battery, <u>Test Your Imagination</u>.

Measure of Academic Achievement

In this study, the Metropolitan Achievement Tests (MAT) were administered to provide measures of academic achievement.



The Intermediate Battery for grades 5 and 6 consists of eight tests of which five were used:

- Test 4 Language--Usage, parts of speech and punctuation
- Test 5 Language Study Skills--Use of dictionary and information resources
- Test 6 Arithmetic Computation--Mathematical operations,

 fractions and graph interpretation
- Test 7 Arithmetic Problem Solving and Concepts--Concepts
 of numbers and application to word-numerical
 problems
- Test 8 Social Studies Study Skills--Interpretation of maps, scales, bar graphs and tables.

Test scores were converted to standardized scores and used for two purposes:

First, pre-test scores were used in analysis of covariance to equate classroom groups for initial academic achievement.

Second, post-treatment scores were used as a measure of academic achievement.

Part IV

Measures of Classroom Verbal Interaction

The variables of classroom verbal interaction selected for this study were defined after review of the suggestions and conclusions of the writers cited in Chapter II, plus the ideas in a theoretical context introduced in this chapter. Briefly, these suggestions bear repetition:

- 1. Give time to test ideas.
- 2. Introduce discrepant events.
- 3. Encourage children to find their own problems.
- Give children time to use their separate cognitive skills of problem sensitivity, intuition and evaluation.
- 5. Share evaluation and judgment.
- Distinguish between closed, restricted and open objectives.
- 7. Build associations with varied experiences.
- 8. Help pupils see the implications of their ideas.
- 9. Treat questions and ideas with respect.
- Allow for individual tolerance and skill in selfinitiated learning.

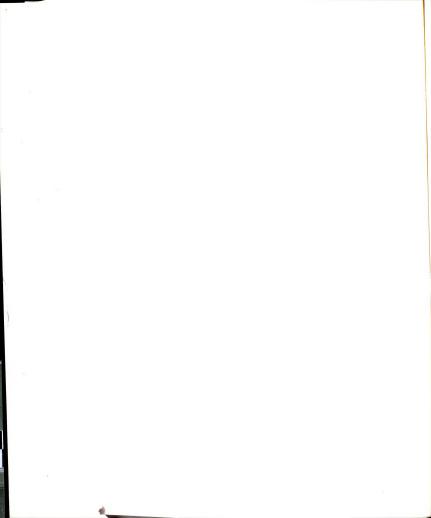
In addition, the claim by Rogers that creativity would be fostered in a climate of psychological safety was recalled. It was suspected that the points above might be conducive to psychological safety in the classroom. But a balance between the predictable and the unknown seemed a necessary condition at least for some elementary school aged children.

The interaction analysis variables were identified from a ten by ten matrix of the ten major categories of the Flanders Observation Instrument (see Table 8). The frequency of pupil initiated talk is found in the 9 x 9 cell. The frequency of Pupil talk directed by the teacher may be found in the 8 x 8 cell. Pupil talk directed by the teacher was interpreted to



COLOR CODE CLASSROOM INTERACTION BY CELLS WITHIN A 10 X 10 MATRIX OF VERBAL INTERACTION TABLE 8

10	Tens	Tens	Tens	Tens	Tens			Tens	8.8	Tens
6	EPI	EPI	EPI	EPI					Axides	
8	EPD	Drill EPD	Drill EPD	Drill EPD	Drill EPD	Drill		8×8		Tens
7	D	D	۵	Q	D	О	D			
9	Д	D	Д	Q	О	D	D			
2					Lec-	D2	D2	APD		Tens
4			104			D2	D2	APD	API	Tens
e						D2	D2	APD	API	Tens
2						D ₂	D2	APD	API	Tens
1						D2	D2	APD	API	Tens
	1	2	е	4	2	9	7	80	6	10



correspond to convergence and pupil initiated talk was interpreted as being divergent. Generally, 9's are not necessarily divergent, but divergent talk would be classified by trained observers as pupil initiated talk, Category 9. One additional measure of pupil performance may be obtained from the tenth category, silence or confusion. The frequency in the 10 X 10 cell was interpreted as pupil directed seatwork unless teacher directions or criticism followed. The frequency of directions or criticism following the tenth category was interpreted as a measure of confusion unacceptable to the teacher.

Category 10 was of interest for two reasons: First, the teacher that asks and expects pupil reflection will allow a modicum of reflective silence. Secondly, teachers who plan and schedule for individual or group project work will also tend to have a high frequency of Category 10.

The teacher who facilitated creative performance of pupils could be anticipated to Elicit Pupil Initiated ideas (EPI), Accept Pupil Initiated ideas (API), to Elicit Directed Pupil talk (EPD), and Accept Directed Pupil talk (APD).

Additionally, the frequency of teacher talk in rows and columns 2, 3 and 4, asking questions and accepting pupil ideas, was interpreted as Developing Questions and Ideas (DQI).

Since it had been suggested earlier that the teacher participate and contribute ideas with those of pupils, row and column 5 was included in the frequency of DQI variable. Note that

lecture, the frequency in the $5\ X\ 5$ cell was omitted from the DQI variable for cell teacher talk in that cell is not immediately preceded nor followed by talk addressed to the ideas of pupils.

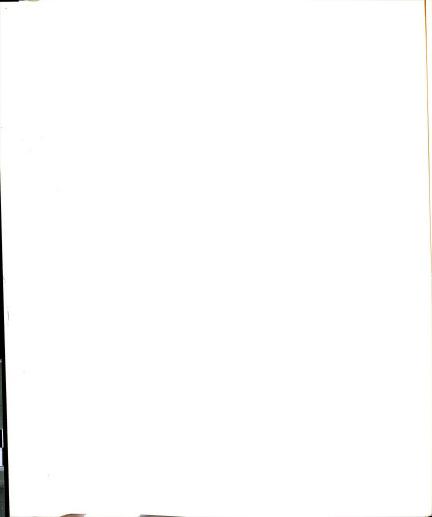
Category 1 was omitted from initial consideration.

Frequencies in this category are usually so low as to be masked by frequencies in other categories. Thus, no pretense was made that a variable measured teacher acceptance of feelings of pupils.

In constructing the variables of classroom interaction, two forms were available. The frequency in percentage of total time was one form the variable could take. A ratio of one type of interaction to another type could also be used. Both forms have advantages and disadvantages. Ratios parsimoniously combine positive and negative influence to one variable, e.g., the I/D ratio. Further, the ratio is preferred because the frequency terms of the numerator and denominator cancelled one another. Ratios, therefore, are not competitive measures of classroom time. However, the ratio by the same token does not indicate the frequency with which a variable is used. Additionally, few ratio combinations seemed universally appropriate for the cognitive operations under study. One would not, for example, want to create a ratio of pupil initiated talk to directed pupil talk because at times both types of pupil response may be found appropriate, Initially, the frequency of pupil directed talk, Category 8, and pupil initiated talk, Category 9, multiplied by the ratio of teacher acceptance to rejection were retained as separate variables. In addition, the frequency of talk by the teacher in developing questions and ideas of pupils, DQI, was retained as a separate variable.

Based upon concepts of acceptance and rejection, the i/d or I/D ratio would be appealing candidates as teacher variables. The former ratio is defined by the frequency totals of Categories one, two plus three; the latter by the totals of the first four categories. Both ratios are completed with a denominator that includes teacher talk believed to restrict pupil options by direction or criticism. Criticism that connotes negative valuing of pupil or his ideas was predicted to have a negative relationship with measures of creative production. Certainly advocates of brainstorming have established routines to eliminate criticism. Additionally, criticism might inhibit certain behavior, but could not be assumed to be a consistent stimulus to creative idea production. However, teacher directions can on occasion be facilitative. As for example, the child who needs scissors is directed to a specific drawer or storage area. Again as goals or procedures are clear to pupils, direct teacher influence may be as appropriate as indirect influence. A second problem with the i/d ratio was with the use of praise. A high frequency of praise might be symptomatic of uncritical, routine praise that Torrance found used by some teachers.

In summary, measures of classroom interaction were obtained from a 10 X 10 matrix of data from trained classroom observers who used the Flanders system of observation. Overall reliability among the eight observers during actual field tests of observer reliability was reported by Flanders to be 0.82. In addition to the indirect/direct ratio of teacher influence described by Flanders, frequencies of pupil response in categories eight, nine and ten were also defined for use in this study. Teacher participation in classroom interaction was included in the study as measured by frequencies of developing questions and ideas, drill and the elicitation-acceptance of pupil responses. The final inclusive variable of verbal interaction influence must await the results found in relationships between the initially defined variables and measures of creativity. It may then be feasible to find a ratio or combination of ratio and frequency variables that efficiently measures the effect of classroom interaction on pupil performance. That study was reported in the succeeding chapter.



Part V

Description of Statistical Treatment and Population Selection: Hypotheses Restated

Procedure for Statistical Treatment

Six hypotheses were enumerated in Chapter I (pages 5-6). To test these six hypotheses, a pre-post-treatment design was selected. Analysis of covariance in multiple regression was utilized to perform tests of significance of independent variables in accounting for variance in pupil performance measures. Three types of covariates (independent variables) were included in multiple regression:

- 1. Pre-treatment measures of pupil performance
- Demographic measures and indicators of sex, age and grade level
- Treatment measures of teacher-pupil classroom interaction.

The dependent variables in the analysis by covariance were pupil performance measures of creativity obtained post-treatment. The F statistic to test a null hypothesis that an independent variable, $X_{\underline{i}}$, does not account for a significant amount of variance in the dependent variable(s), above the variance accounted for by other independent variables, may be calculated as follows:

$$H_{O}: B_{YX} = 0$$

$$F_{K, N-K-1} = \frac{MS_{R}}{MS_{E}}$$
 $H_{T}: B_{YX} \neq 0$

	SUMS OF SQUARES	DEGREE OF FREEDOM	MEAN SQUARE
Regression	ss _R	К	$^{\mathrm{MS}}_{\mathrm{R}}$
Error	$ss_{_{\mathrm{E}}}$	N - K - 1	$^{ exttt{MS}}_{ exttt{E}}$
Total	$ss_{_{ m T}}$	N - 1	

Figure 3. Format for display of ANOVA in multiple regression.

ANOVA for Deletion of D Independent Variables

$$H_{O}: B_{YX_{1}} - B_{YX_{Delete}} = 0$$

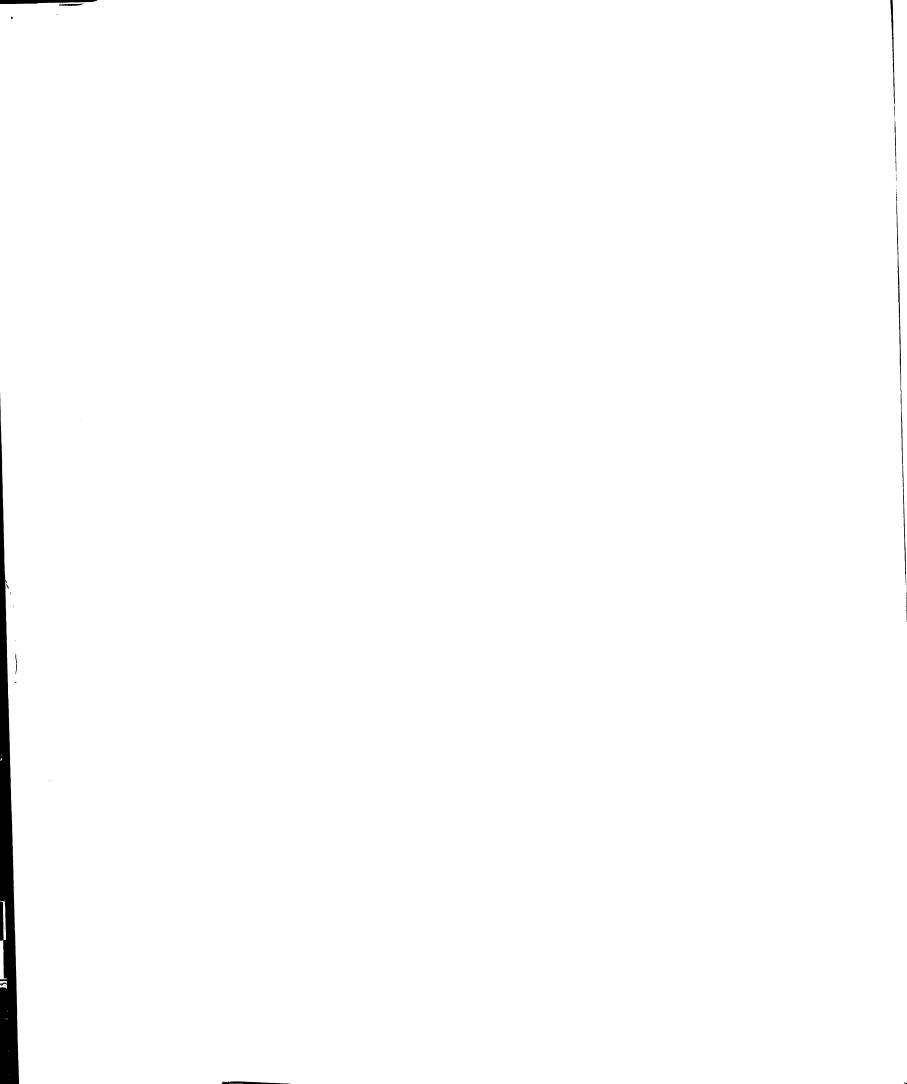
$$\mathbf{H_{I}} \ : \ \mathbf{B_{YX}_{1}} \ - \ \mathbf{B_{YX}} \ \neq \ \mathbf{0} \\ \mathbf{F_{D, N-K-1}} \ = \ \frac{\mathbf{MS_{D}}}{\mathbf{MS_{E}}}$$

	SUMS OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE
Difference	$ss_R - ss_D$	D	${\tt MS}_{ extsf{D}}$
Error	ss_{E}	N - K - 1	$^{ ext{MS}}_{ ext{E}}$
Total	$ss_T = ss_R + ss_B$	N - 1	

Figure 4. Format for display of ANOVA with deletion of variables.

The t-ratio to test the hypothesis that the regression coefficient, byx is zero, may be calculated with ratio given below with N-2 degrees of freedom.

$$H_0$$
: byx = 0
$$t_{n-2} = r \frac{\sqrt{N-2}}{\sqrt{1-r^2}}$$



A criterion probability level of p \leq 0.05 was accepted for a test of significance of variables in multiple regression. However, with an N @ 750 a correlation coefficient value of approximately 0.10 is all that is needed to obtain a statistically significant result between measures of pupil achievement. In that event a correlation coefficient value of 0.30 will be used as an acceptable criterion of significance.

Computations are made on the binary Control Data Computer, 3600. The standard STAT programs offered through the Computer Center at Michigan State University were used.

A program was written to permit the data from a consolidated interaction matrix for each teacher to be "read" by the computer. It was then possible to transform this data to any interaction variable that might be required. Pupil measures of creativity, academic achievement, and demographic data for each student were read into the computer before the next teacher's interaction matrix was "read". In this way it was possible to retain the correct student N when testing relationships between pupil measures without regard for classroom groups.

Selection and Description of the Population

Three middle-sized towns (100,000-200,000) with two land grant universities and the adjoining rural-suburban villages of South-central Michigan were the principle localities of the public school districts included in the study. A total of

101 teachers from 24 districts volunteered to participate.

Not included were supervisors, teachers with student teachers, or teachers formally organized in team teaching. All of the teachers held the B.A. degree, one-third reported to have had an additional thirty hours of coursework, and three also had the M.A. degree. The median age was 39, most were married and 80% were female. First year teachers were excluded from the study, twenty percent had only one year of previous teaching experience, while fifty percent reported five or more years of previous experience.

Pupils of the 101 classrooms were administered the Michigan Pupil Attitude Inventory, a revised form of the Minnesota Pupil Attitude Inventory. The Inventory asked pupils their opinions of the classroom and its activities. Average classroom scores were used to select thirty classrooms for further testing and observation: ten high scoring, ten middle, and ten low scoring classrooms in all.

Fifty-three percent of the 816 pupils available for both pre- and post-treatment testing were girls. The average age of the pupils was 11 with a range of 9-13. The population was classified as 83% Caucasian, 16% Black and 1% Oriental.

Morrison estimated an adjusted average IQ of the pupils of 29 of the 30 classrooms from cumulative record data to be 108-109.

¹³Betty Mae Morrison, "The Reactions of External and Internal Pupils to Patterns of Teaching Behavior," Unpublished doctoral thesis (Ann Arbor: University of Michigan, 1966), p. 53.

Absentees were encouraged to take the academic achievement tests upon return to school, but were not asked to complete the creativity test battery, Test Your Imagination. The slight drop in population to 769 pupils was accepted to insure that pupils responded to a novel test stimulus presented as a part of the problem solving tasks. Since no other systematic selection factor was revealed by school administrators or teachers, a random sample of pupils of the area was assumed. However, a systematic selection of classroom teaching was intended and assumed fixed by the results of the Inventory. A mixed design was therefore indicated.

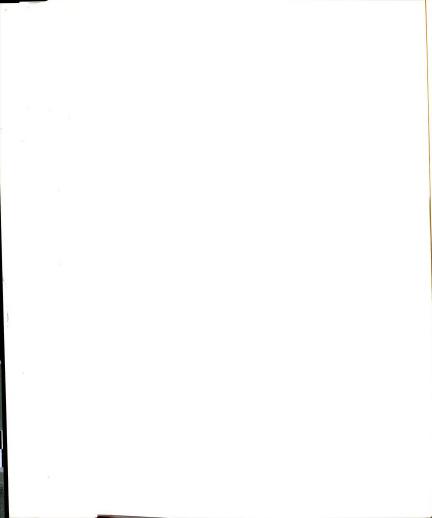
Hypotheses Restated In Experimental Form

Six experimental hypotheses were formulated in null form for the study.

1. There will be no statistically significant relationship found between scores obtained from non-verbal (figural) and verbal tasks from the Minnesota <u>Test of Creativity</u>, and scores obtained from problem solving tasks from the test battery, <u>Test Your Imagination</u>.

$$H_0: b_{yx} = 0, H_1: b_{yx} \neq 0.$$

2. No relationship of statistical significance will be found between scores of academic achievement, obtained from the Metropolitan Achievement Test (MAT Intermediate Form) and creative performance scores of: (1) divergent thought



obtained from the non-verbal and verbal tasks of the <u>Minnesota</u>
<u>Test of Creativity</u>, or scores of (2) problem solving from the test battery, Test Your Imagination.

$$H_0: b_{yx} = 0, \quad H_1: b_{yx} \neq 0.$$

3. There will be found no statistically significant relationship between the frequency of teacher-accepted talk initiated by the pupil, measured with the variable, pupil initiated mesh (PIM), and creative performance scores of divergent thought and problem solving.

$$\mathbf{H}_0 \colon \mathbf{B}_{\mathbf{y}\mathbf{x}_3} - \mathbf{B}_{\mathbf{y}\mathbf{x}_3}$$
 delete = 0, $\mathbf{H}_3 \colon \mathbf{B}_{\mathbf{y}\mathbf{x}_3} - \mathbf{B}_{\mathbf{y}\mathbf{x}_3}$ delete

4. No statistically significant relationship will be found between a measure of the frequency of teacher talk, giving praise, accepting pupil ideas, asking questions other than drill, and introducing teacher ideas in close (time) association with the use of the ideas of pupils obtained with the variable (IDEAS) and creative performance scores of divergent thought and problem solving.

$$H_0: B_{yx_4} - B_{yx_4} = 0, \quad H_4: B_{yx_4} - B_{yx_4} \neq 0.$$

5. There will be no statistically significant relationship found between the ratio of acceptable silence and seatwork to the total frequency of silence and confusion (10-ratio) and creative performance scores of divergent thought and problem solving.

$$H_0: B_{yx_5} - B_{yx_5 \text{ delete}} = 0$$
, $H_5: B_{yx_5} - B_{yx_5 \text{ delete}} \neq 0$.

6. There will not be found a statistically significant relationship between the ratio of indirect influence frequency of teacher talk to the total of direct and indirect influence frequencies of teacher talk (i/i+d or I/I+D), and creative performance scores of divergent thought as obtained from non-verbal and verbal tasks of the Minnesota Test of Creativity, or from problem solving tasks from the test battery, Test Your Imagination.

$$H_0: B_{yx_6} - B_{yx_6 \text{ delete}} = 0, \quad H_6: B_{yx_6} - B_{yx_6 \text{ delete}} \neq 0.$$

The six hypotheses were tested with the appropriate test indicated above. Where feasible, additional tests were conducted to obtain additional evidence concerning the hypotheses above. The report of the findings of these tests were included in the following chapter.

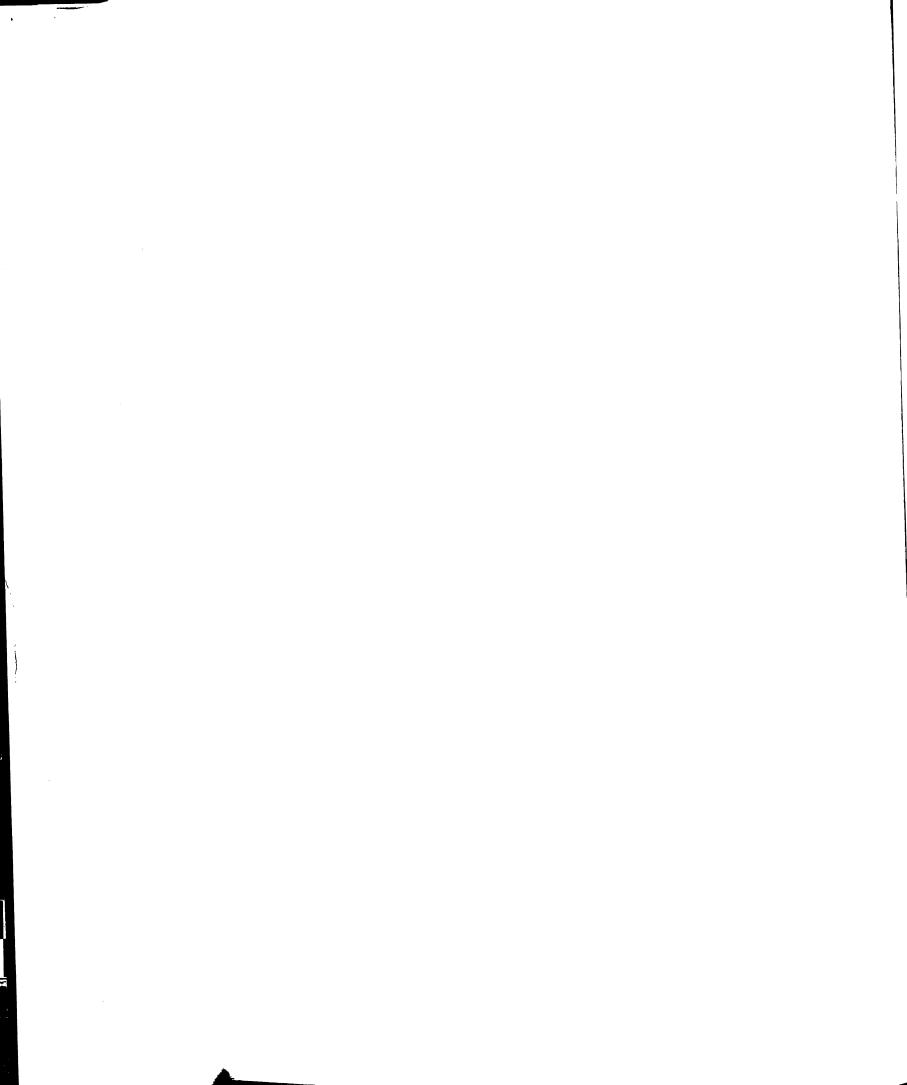
CHAPTER IV

FINDINGS

Scientific research is a sort of solving of puzzles, playing chess with nature, the grandest partner anyone could find. But solving puzzles or playing chess is not all there is to it, however fascinating this may be. There must be something afterward. A oreative scientist or artist must find satisfaction just having created something-something that was not there before, however small it may be.

Albert Szent-Gyorgyi Hungarian biologist and Nobel Prize Winner Montreal Speech

Creativity was viewed as a problem solving task in which something new or unique was produced in response to some perceived problem. In other studies, a solution was emphasized (Esin Kaya) in that the problem presented allowed only one correct response. In this study, the new and unique response was sought as well as a solution to a problem. In order to obtain both, there would need to be sufficient information to delineate limits of a problem and proposed solutions. It would also require a novel problem stimulus to minimize the likelihood that stereotyped or standard answers to standard problems would be obtained. Thus, the problem solving section of the Test of Your Imagination consisted of a picture that depicted a novel situation and three response sections. Section I,



Asking, requested pupils to ask questions about the depicted scene. Since almost no information was given pupils concerning the objects and people in the scene, pupils had a minimum of constraints as to the questions that might be properly made. Curiosity, ability to see gaps in information, exceptions and relationships might be used to raise numerous questions about the picture. In Section II, Seeing Problems, information concerning size and capability of an object in the stimulus picture was given. Students were then requested to project problems that might occur with the use of the identified objects. Finally in Section III, Solutions, students were asked to suggest possible solutions toward an equitable use of the object depicted in the picture. Multiple suggestions could be drawn from background experiences and probably required knowledge in science, sociology, experience in cooperative planning and work activities.

It was intended that no student would be penalized because the curriculum of any one classroom had not included a particular topic. Although unfamiliar with the setting and objects of the stimulus figure, students with experiences in providing tentative solutions to problems would, it was predicted, perform better than peers without those experiences because of (1) familiarity with problem solving operations, and (2) because of previous requirements to use background knowledge in a variety of settings.

The analysis of data obtained from the test battery, Test Your Imagination, and Classroom Interaction proceeded in three parts in this chapter. First, calculated correlations, contingency tables and factor analysis were used to determine the degree and type of relationship between parts of the test of creativity and problem solving tasks. Distribution of scores was also investigated prior to treatment as discreet or continuous data. In Part Two, selected measures of classroom interaction were tested for relationships with scores of creativity. Finally, in Part Three, a partial post hoc analysis of scores, grouped as "high", "middle", and "low" performance scores, is presented to ascertain whether the relationships found between teacher-pupil interaction variables and the total test population are also found with the three performance groups.

There were two broad hypotheses under investigation:

- the relationships between a test of problem solving developed for purposes of the study and tests of divergent thought, and
- (2) the relationships between measures of divergent thought and/or problem solving performance and measures of teacher-pupil classroom verbal interaction.

Estimates of scorer reliability were obtained from a random sampling of twenty-five test scores. The results of calculations of Pearson correlations are found in Appendix C, Table A-1. These scorer reliability estimates for the problem

solving tasks (Tasks 5, 6, 7) compare closely with the estimates obtained with the non-verbal and verbal creativity tasks.

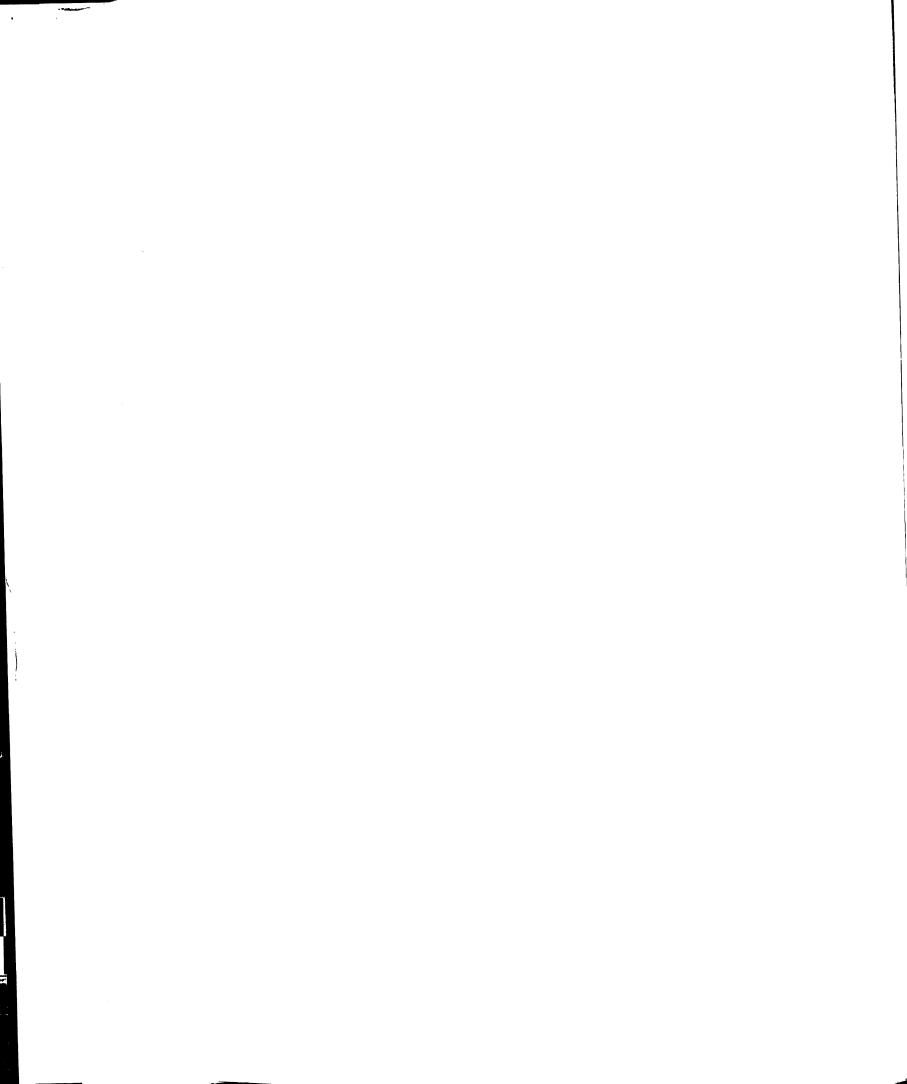
Means and standard deviations of task measures for a sample of 769 students were calculated and reported to indicate the numerical agreement in obtained scores. These are found together with reliability estimates (correlations) between task measures of Forms A and B in Appendix C, Table A-2, Relatively higher correlations were obtained between scores on the same task than between scores by factors of fluency, flexibility, or originality. For example, the correlational coefficients obtained between fluency, flexibility and originality of Task I were: 0.78, .65, and .57 respectively. However, the coefficients between Tasks I and II for fluency, flexibility and originality were respectively: 0.41, .26, and .37. The exception appeared with the factor of elaboration. A coefficient of 0.53 was obtained between elaboration scores on Tasks I and II. By contrast, the obtained coefficients between elaboration scores and the three factors of fluency, flexibility and originality within tasks was found to approach zero.

The correlational data lent only modest evidence to support the suggestion that the factors of fluency, flexibility and originality may be found across the four tasks from the Minnesota Tests of Creativity and to a lesser amount in the three tasks of problem solving. More evident from the data was the relatively high dependence between fluency, flexibility and

originality scores within tasks. This dependency is undoubtedly due in part to the use of the same tasks to obtain the three "factor" scores. For example, a response scored for originality must also be scored for fluency. Guilford et al., avoided this artifact of dependency by using separate tests for different factors. Factor analysis was employed to help resolve whether to retain factor scores, task scores or both. A verimax rotation was made with fifty task-factor variables of Forms A and B. With two factors (Appendix C, Table A-3), Forms A and B clustered into separate factors. With six factors (Appendix C, Table A-4), a non-verbal factor, an elaboration factor and a combined verbal and problem solving factor appeared with each form of the test. With an eigenvalue just above a value of 1, twelve factors were isolated. A separate problem solving factor was identified from a factor loading on verbal tasks. The factors of fluency, flexibility and originality did not appear. Accordingly, the non-verbal task scores were summed together, the verbal task scores were summed, and the problem solving tasks were summed. The factor of elaboration was retained as a separate score. However, the two elaboration scores from the verbal tasks were dropped due to low means and skewed distributions.

In general, the average scores for alternate forms were found comparable with the exception of the non-verbal task,

<u>Circles</u>. The use of the alternate form, <u>Squares</u>, resulted in an average score one point lower and a standard deviation ten



percent higher than obtained with <u>Circles</u>. The alternate use of <u>Squares</u> probably presented a more difficult task. It may be a reason the non-verbal A Form with <u>Circles</u> was aligned by factor analysis with the verbal tasks of creativity while the non-verbal B Form, <u>Squares</u>, tended to align more with the problem solving tasks. Wodtke¹ reported (Table 9) a total battery reliability of .75 with nine tasks compared to the reliability of .68 for seven tasks of this study. The reliabilities of task, subtotal and battery total scores compared favorably with reliabilities reported by Torrance. He reported reliabilities from scores of elementary school aged children ranged from the 40's to the upper 60's.²

A striking deviation from results obtained by Torrance may be noted in the mean score for elaboration on Task 11, Squares. Torrance reported a comparative study of mean, standard deviation and reliabilities obtained from 31 technical college students' scores of Circles and Squares. Fluency, Flexibility and Originality averages on the Form, Squares, were found to be one to three points lower with a higher standard deviation for originality scores. This would lend support to an observation earlier that the Form B alternative, Squares, <a href="may present a more difficult task. However, Torrance reported

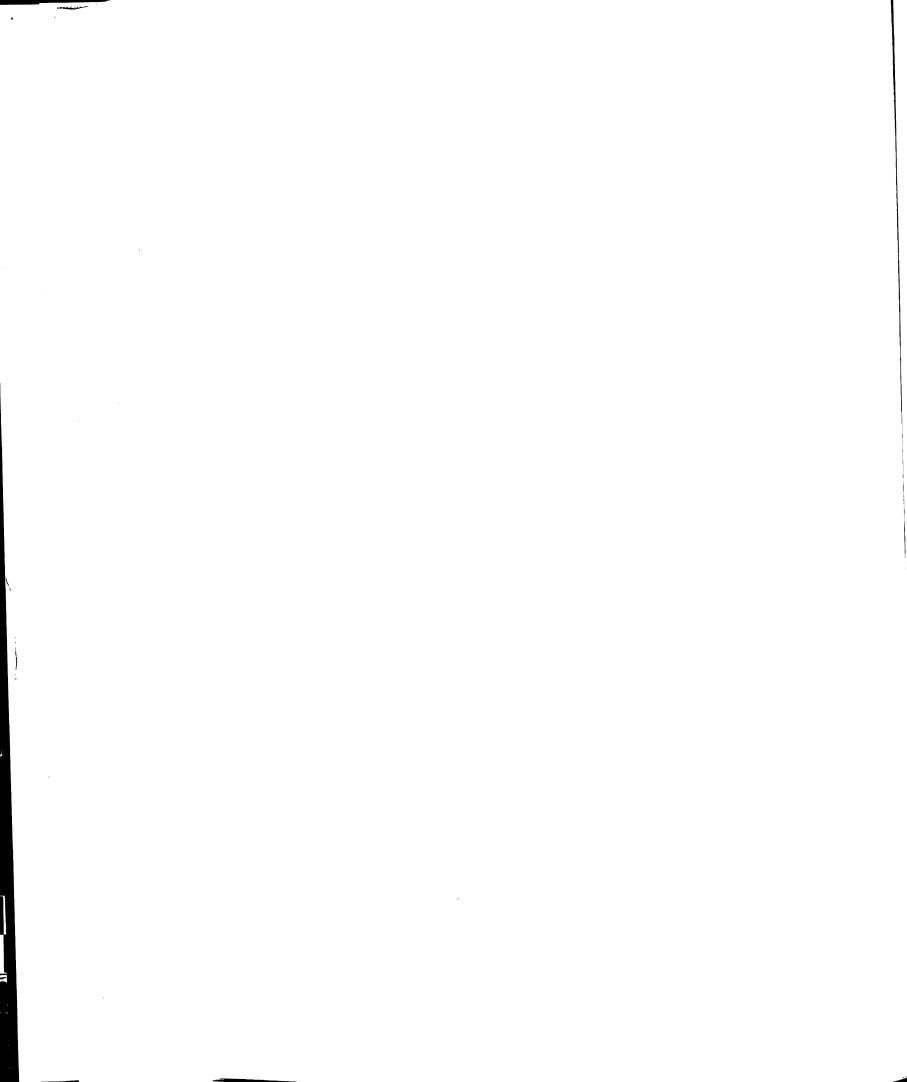
¹Kenneth Wodtke, "A Study of the Reliability and Validity of Creative Tests at the Elementary School Level" (unpublished doctoral dissertation, University of Utah, 1963), pp. 54-56.

²Ibid., p. 57.

TABLE 9

A COMPARISON OF RELIABILITY ESTIMATES OF MEASURES OF CREATIVE PERFORMANCE FROM THIS STUDY WITH ESTIMATES REPORTED BY WOOTKE ON THE TORRANCE BATTERY

Wodtke (5th Grade) Estimates	Anderson (6th Grade) Estimates		
0.20	0.31		
0.55	0.37 (alternate forms circles-squares)		
.47	.42		
.38	.39		
	Problem Solving		
.58	Tasks .57		
.66			
0.75	.68 (7 tasks)		
	0.55 .47 .38 .58		



the college student sample obtained an average elaboration score seven points above the average obtained with circles.
In sharp contrast, the sixth grade sample of this study obtained an elaboration average score thirteen points less on Squares than on Form A, Circles. It may be that elaborative drawings were sacrificed for more time to think of additional figures incorporating squares. Or it is possible that while Circles lent themselves to drawing faces of every conceivable form, Squares did not. Since a face is not a unique response, originality scores were not affected, but the imaginative details would be counted as an elaborative detail. One or both conjectures may be a source of the difference between the two alternative forms of non-verbal Task 11.

The values for skewness indicated small to moderate shifts from the idealized normal distribution. Frequency of scores were prepared and summary distributions by standard scores, Z, were reported along with median and range (Appendix C, Table A-5). The non-verbal tasks scores of "flux"* and originality for Form A and B were found to approximate a normal distribution. The distributions for problem solving task scores of flux and adequacy did not meet a chi-square test for normal

³E. Paul Torrance, Administration and Scoring Guide for the Squares Test (Minneapolis: University of Minnesota, 1963), Appendix, Tables 2 and 3.

^{*}Fluency and Flexibility were combined and the resultant score termed "Flux".

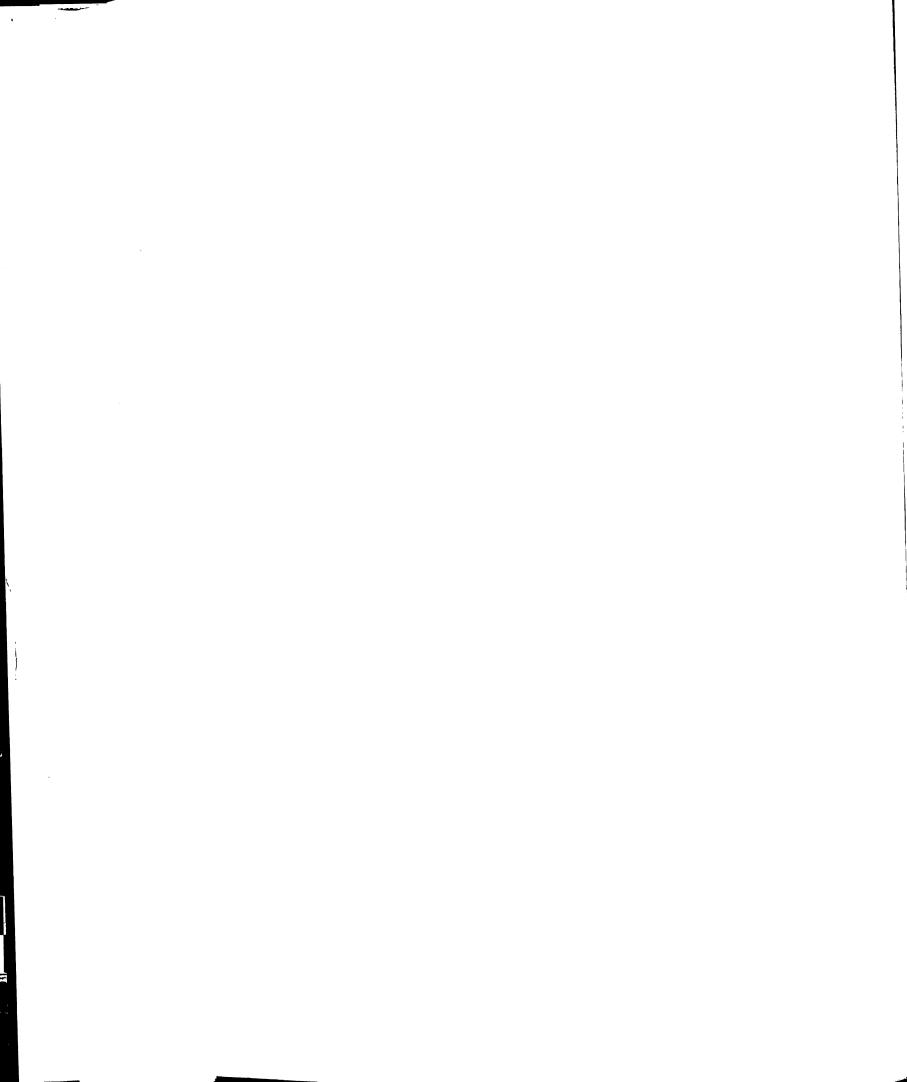
distribution. However, the distribution between Forms A and B are similar and found to be skewed in a positive direction. It may be noted that one student, in fifteen minutes, obtained 40 points for adequacy on Form B. It would have been considered a remarkable performance just to write that many responses in the limited time much less adequately respond to the three difficult tasks.

The verbal scores of flux and originality had pronounced skewed distributions such that the mean exceeded the median by twenty percent. Ninety-one pupils (12%) obtained scores of zero for originality on Task III B, Product Improvement (Monkey). One hundred and fourteen (15%) obtained identical originality scores of zero on Task IV A, Unusual Uses (Box). These percentages had an impact on the distributions. Task IV A, Unusual Uses (Box) often initiated the response of using the box as a container. Unless and until the pupil thought of another category of uses, the scoring protocols awarded zero credit for originality. It is also believed that the scoring protocol for Task III B, Product Improvement (Monkey), may have been a source of more zero credit responses than the A Form (Elephant). Nevertheless, the protocols were closely followed to maintain consistency in scoring across classroom groups. Put in another perspective, however, the protocols did work to exclude credit for the conventional answer. For one pupil in eight on two tasks it was, in a sense, too easy to make a conventional response. The result was a skewed distribution for the two task measures of originality.

Despite several differences between Form A and B, it was found that the distributions were remarkably similar between the non-verbal, verbal and problem solving scores. The range of scores for a test battery that had no limit to the number of possible responses, save for the limit of time, ranged from 28 to 455 or from Z scores -2.5 to +4.0. The test battery had tapped a performance ability that ranged widely among the sample of sixth grade children. Yet the total score approached a normal distribution with skewness of only 0.25 and 0.33 respectively for the two Forms, A and B.

Evidence to support the definition of creativity as a problem solving performance came from an inspection of correlation coefficients of task variables, factor analysis of the transformed task variables and from F-statistics tests of significance of measures of problem solving in multiple regression analysis. Correlational coefficients of non-verbal task scores, verbal task measures and problem solving measures, sub totals and battery total score for Forms A and B are presented in Appendix C, Table A-6. The Metropolitan Achievement Test (MAT) measure was included. The highest correlational values between the three subtotals and the Metropolitan Achievement Test (MAT) was obtained with the problem solving subtotal. This was not surprising and it does lend support to the theoretical position that background information and therefore academic achievement is important if the task presents a problem in which the student can "see" the relevancy of his information

to the problem. The table also includes the three separate measures from the problem solving tasks, Asking, Seeing Consequences, and Suggesting Solutions. The correlation coefficients of the first two part scores of problem solving were in close agreement with the other variables in the matrix. Task 7, Suggesting Solutions, tended to have a coefficient value about 0.1 less with the other matrix variables compared with Task 5 and 6 values. Attenuation may be part of the reason, but the nearly equal correlations of all three Task variables with MAT scores mitigates against that argument. Between Task 5 and Task 7, there is a 0.1 drop in value of the intercorrelation on Form A and again on Form B. On both Forms, Task 6 has essentially the same correlational values with Tasks 5 and 7. There appears to be a common attribute; differences, if any, are not as apparent. In general, correlational values obtained between Total Battery score and the sub-test scores were highest with the verbal creativity task scores, next with the problem solving task scores and last with the non-verbal creativity scores. The interrelations between the three subdivisions of the battery were consistent within the two forms of the test battery. Correlational values of non-verbal, verbal and problem solving subtotal scores were reported in Appendix C, Table A-7. The numerically similar values and the relative rankings of the correlational values between subtotals suggest that the problem solving scores have as much in common (or perhaps a bit more) with the two creativity task subtotals than



the latter have between them. Factor analysis was next employed to assist in verifying this observation (Table 10).

With 20 variables, ten from each Form, five factors appeared with an eigenvalue cut-off just below 1 (0.95). Two factors (2 and 3) were associated with Forms A and B: nonverbal and problem solving measures. Elaboration, factor 5, verbal tasks, factor 4 and a problem solving task, factor 1 were also identified. The problem solving task variables also had moderate loading with the verbal task factor and with the two non-verbal task factors. With the exception of elaboration, separate factors by fluency, flexibility or originality did not appear. Instead, factors could be identified by verbal, non-verbal and problem solving task measures. There was sufficient overlap across the principle non-verbal, verbal and problem solving subdivisions to warrant the use of a total score. Thus, for the remainder of the study, a non-verbal, verbal, and problem solving subtotal scores, elaboration and battery total scores were used. However, originality and adequacy scores were also carried forward in the analysis to insure the continued analysis of those performance measures.

A third test of the general hypothesis of creativity as a problem solving performance employed multiple regression analysis. The question tested whether problem solving variables would be significant "predictors" of creativity scores in addition to the predictors of academic achievement scores and pre-experimental creativity test scores. Results were

TABLE 10
A SUMMARY OF RESULTS OF FACTOR ANALYSIS WITH FIVE FACTORS*

		VERBAL & PROBLEM SOLVING	FORM A	FORM B NON-VERBAL & PROBLEM SOLVING	FORM B VERBAL & PROBLEM SOLVING	ELABORATION
1.	FLUE NV A		78			
2.	FLUE NV B		28	82		
3.	FLEX NV A		72	35		
4.	FLEX NV B		26	82		
5.	ORIG NV A		70			
6.	ORIG NV B		29	65		
7.	ELAB NV A					78
8.	ELAB NV B					75
9.	FLUE VB A	46	52		47	
LO.	FLUE VB B	30			78	
11.	FLEX VB A	49	41		42	
12.	FLEX VB B	33			67	
13.	ORIG VB A	38	45		54	
14.	ORIG VB B				83	
15.	FLUE PS A	74	38			
16.	FLUE PS B	69		37	37	
17.	FLEX PS A	77	25			
18.	FLEX PS B	67		39	28	
19.	ADEQ PS A	80	27			
20.	ADEQ PS B	68		38	28	

^{*}Pactor loadings below .30 were omitted except in a few instances of multiple loadings.

reported in Table 11. The partial correlational values reflected a moderate relationship between pre- and post-test creativity measures as expected. The non-verbal measures were not significant predictors of verbal creativity scores or problem solving measures. But the problem solving measures on the dependent variables of non-verbal and verbal creativity scores were significant at the .02 level or better. The verbal creativity measures were also significant predictors of nonverbal and problem solving scores. The MAT total score did not reach significance in predicting originality on verbal tasks, but was a highly significant predictor for non-verbal and problem solving measures. The increased dependence of problem solving measures, compared with the non-verbal and verbal creativity scores, on academic achievement measures was demonstrated with partial correlational coefficients of .3. The value nearly equals the obtained pre-, post-test partial correlations of the mid -.30's.

In this first section, were reported the results of an investigation of correlation coefficients that included factor analysis, and a F- statistic test of significance of partial correlations above pre-test partial correlations. It was demonstrated that measures of problem solving of a type that permits an undetermined number of acceptable answers were consistently related to creativity measures from the Minnesota Test of Creativity. In the next section, creativity as a problem solving activity is investigated with measures of classroom interaction.

PARTIAL CORRELATION COEFFICIENTS AND SIGNIFICANCE PROBABILITIES FROM MULTIPLE REGRESSION ANALYSIS

TABLE 11

DEPENDENT VARIABLE	PRETEST CREATIVITY VARIABLE	FIVITY	ACADEMIC ACHIEVEMENT VARIABLE	HIEVEMENT BLE	PROBLEM SOLVING VARIABLE	SOLVING
	PARTIAL CORR COEF	SIGNIF	PARTIAL COEF	SIGNIF	PARTIAL	SIGNIF
FLUX NV B	0.33	.0005	.10	900.	- 13	100
ORIG NV B	.31	.0005	.15	.0005	14	1000
SUB TOTAL NV B	.34	.0005	.13	.0005	.15	.0005
ELAB NV B	.56	.0005	.19	0000°	.10	.0005
FLUX VB B	.43	.0005	80°	.03	9	2000
ORIG VB B	.37	.0005	.05	N.S.	80	
SUB TOTAL VB B	.39	.0005	90.	*08	.14	.0005
	PRETEST PROBLEM SOLVING VARIABLE	EM SOLVING SLE			CREATIVITY	
FLUX PS B	.34	.0005	. 29	5000		000
ADEQ PS B	.37	.0005	.31	.0005	. F	5000
SUB TOTAL PS B	.36	.0005	.30	.0005	.14	.0005
TOTAL B	TOTAL NV A	A .07	.07			
	ELAB NV A		.0005			
	TOTAL VB A	A .32	.0005			
	TOTAL PS A		.0005			
	ACHIEVEMENT	ENT				
	TEST A	.21	.0005			

Prior to initiating an analysis of teacher-pupil classroom interaction variables in multiple regression, an analysis of variance of classroom average score for each of the principle measures of creativity to test the null hypothesis of equal means. In both A and B Forms, the eleven task variables failed to support the null hypothesis. A summary of F-statistics calculations was reported in Appendix C, Table A-8. Homogeniety of variance was accepted from inspection of the classroom summaries of means and standard deviations.

The summary data provide an insufficient picture of the distribution of creative abilities in the classroom as judged by the performance measures. Using medians of subtotals of non-verbal, verbal and problem solving measures as criteria, scores were divided into two groups for each subtotal. Group one was composed of frequencies by classroom of scores above the median on all three subtotals. Group three, by the same token, was composed of frequencies below the median on three subtotals. Group two was compiled from frequencies in which at least one subtotal was above and one subtotal score below the median. Seven classrooms were found to have two children or less that were below the median on three subtotals. Seven other classrooms had less than three children above the three medians. The remaining classrooms also varied in distributions of scores, but with at least three children on either side of the median for the three subtotals (see Appendix C, Table A-9). Before becoming enmeshed in teacher-pupil interaction variables, a moment for perspective is worthwhile. It is intended that classrooms shall not be reduced to a common denominator of the teaching variable or the average score. Rather, that from measures, differences can be noted.

An analysis of summary interaction analysis data was conducted with the aim of constructing variables that would be tested in multiple regression equations. It had been postulated that there were six, possibly seven, loci of interest within the ten by ten matrix of interaction variables. These loci could be associated with matrix cells, frequencies and with teacher-pupil use of ideas.

Pupil-initiated talk	nines	PI
Teacher-directed pupil talk	eights	PD
Pupil-teacher silence	tens	Tens
Teacher explanation, lecture	fives	Center
Teacher use of pupil ideas	two & threes	TI
Teacher criticism & directions	six & sevens	TD
Teacher response to feelings	ones	Not used

There was also considered the possibility that teacher criticism might well be separated from teacher direction. And, the teacher recognition or acceptance of pupil feelings was another possible locus considered, but later rejected. While a classroom observer, this writer remained within hearing distance of five or six selected teachers and their pupils enroute to the gymnasium, lunch or outdoor recess areas. The unrecorded

conversations have been convincing: the recorded instances of teacher acceptance or sensitivity to feelings (Category One) do not adequately represent some teachers' use of Category One talk. Rather, at least some teachers choose to use the more informal and a more private setting found outside the classroom but still within the school. Typically, these teachers make just a few remarks, perhaps with a bit of humor, to "tide over" the situation and then return to the lesson. However, the matter often does not end with the episode; they often check with the student later to determine the extent of emotional residual and to work with the learning difficulty. These teachers seem to handle the immediate situation as it occurs in the classroom. But they do not end the matter; it is deferred for a quieter time. Therefore, a locus of pupil feeling and teacher acceptance was discarded in favor of combining the observed frequency of acceptance of feelings with teacher acceptance of pupil ideas. It will be readily recalled that Flanders also has included Category One frequency with teacher praise and acceptance frequencies to obtain the variable of indirect teacher behavior. The analysis proceeded for the purpose of verifying the existence of the proposed loci, or alternatively providing evidence that might have led to (1) the reduction in loci variables and (2) the treatment of transitional areas that exist between loci. That is, it may be clear from the literature and classroom experience that use or acceptance of pupil ideas presents a different classroom procedure

and climate from that classroom climate associated with the use of teacher-presented ideas as with a lecture or directed discussion. But questions can be used during teacher-directed discussion, drill and invitations for pupil initiated ideas. Questions, Category 4 of the Flanders System, was regarded as transitional; that is, Category 4 frequencies might have been added to several variables. Correlations were used as an aid in placing the transitional frequencies of the matrix with the variables with the higher inter-relationships.

The 10 X 10 matrix of cell frequencies was first divided by pupil talk and teacher talk. After all, the pupil to be creative would need at times to initiate his own ideas. The type of pupil talk was also deemed important. Pupil initiated talk (the nine cells) was predicted to be related to pupil performance on measures of originality while pupil-directed (by teacher questions and directions) was predicted to be related to pupil performance on measures requiring an element of evaluation (Tasks 6 & 7). Reflective silence (Category 10) was predicted to be related to total creative performance measures.

The teacher, it was predicted, would affect pupil performance by his skills in recognizing the contributions of pupils, adding ideas of his own and helping to build concepts incorporating the ideas stemming from the class. The mnemonic, IDEAS, was coined for the activities of Identifying, Developing, Extending and Encouraging, and Accepting Student ideas. of critical importance was whether column and row four would correlate with the Teacher Indirect (TI) corner of the matrix. The notion that the teacher may contribute his ideas along with the ideas of pupils could be tested in part by the correlation frequencies of row and column five with the first four categories of the matrix. The 5 X 5 cell, lecture or other teacher talk followed by additional teacher talk, was not included because pupil ideas are not necessarily incorporated into teacher steady talk.

The use of criticism had been distinguished from evaluation in the previous chapter. Category 7, criticism, was predicted to have a negative relationship with pupil performance. Relationships between teacher use of directions, Category 6, and pupil performance on creativity measures are complex. Originally, it had been thought that teacher direction would curb or restrict pupils to standard questions and answers. However, once in the classroom, directions could, at times, be observed to facilitate pupil progress. For example, a steady flow of directions may often be heard just prior to a field trip or during the construction of a class or group project. "Where are the scissors? Look in the drawer. Where do I go for a permission slip? Betty is team captain." are but a few examples of Category 6 that are missed in the "well regulated" classroom. Eventually, teacher use of directions, Category 6, was considered together with teacher use of criticism because of an over-riding need of the study to ensure that pupil-initiated ideas and silence met with teacher approval. Otherwise, the Categories, nine and ten, could have been suspected of being representative of frequencies of abusive pupil behavior.

Clearly, the ideal variable of pupil talk would be responsive to the frequency of talk and to the quality of that talk. Quality can be established with a ratio. For this study, the ratio of approval to disapproval was used. Not termed "indirect" or "direct" in the sense of extending or restricting pupil initiative as used by Flanders, the ratio did employ Categories 1, 2, 3, 4, and sometimes 5 in the numerator and Categories 6 and 7 as additional categories in the denominator.

But the ratio does not reflect frequency of pupil or teacher talk. To complete variables of pupil talk, the frequency of "steady state cells", 8 X 8 and 9 X 9 were multiplied by the ratio of teacher acceptance. For example, if criticism preceded or followed pupil talk once in ten events, the value of the pupil talk variable would be 90% of the observed frequency. The variable precluded a high value for unapproved pupil utterances, and also precluded a high value in the classroom in which little time was afforded for pupil expression of ideas.

The two pupil measures of pupil talk, employing the combination of ratio and frequency, were termed pupil-directed mesh and pupil-initiated mesh. The word "mesh" meant more than a mesh of ratio and frequency. It was to be a mesh of pupil idea

and teacher acceptance. And, it was to be a mesh in cognitive consistency between pupil and teacher. Hardly formalized to a concise statement, it nevertheless seemed inconsistent to elicit pupil-initiated talk with a demand or an opinion as to the answer on the part of the teacher. Conversely, it seemed cognitively consistent for the teacher to elicit directed pupil talk with an exchange of opinion or request for additional information. The pupil-directed mesh (PDM) was defined as $(1, 2, 3, 4, 5, X 8/1, 2, 3, 4, 5, 6, 7, X 8) \cdot (8 X 8)$. The variable, pupil-initiated mesh (PIM) was defined as $(1, 2, 3, 4, \times 9/1, 2, 3, 4, 5, 6, 7, \times 9)$ $(8, 9, 10 \times 9)$. It can be noted that PIM had the additional constraint that pupil initiated ideas shall be immediately preceded or followed by praise, acceptance or a question, but not with teacher opinion. In effect, PIM was designed to reflect the frequency of pupil-initiated talk in which the focus of the moment (three seconds) was upon the idea of the pupil rather than the teacher. These definitions were subject to review after a study of correlates between selected segments of the 10 X 10 matrix and defined variables.

In order to test and check proposed interaction variables, a correlational matrix was prepared composed of three tiers. The first tier consisted of segments of a 10 X 10 matrix believed to be basic units of interaction. Interspersed were individual cell frequencies of those cells that were believed to be in transitional areas between loci. Finally, cells

thought to represent the focal points of loci were included. It was anticipated that some variable would be used that included the frequency of pupil-initiated ideas (Category 9) and teacher elicitation and response to those ideas (the ninth column and ninth row of the matrix). But one question specific to that eventual variable was whether the use of teacher lecture or explanation was compatible with frequency of pupil-initiated ideas. The 5-9 cell frequencies were included in the matrix to determine the correlation with 9-9 cell frequency and the 3-9 cell frequency. In a similar way, the 6-8 cell frequency was included to determine by correlational analysis if that cell represented something different (Directed drill) from the 4, 5, X 8 frequencies (Review and evaluation).

The second tier began with the same cluster of cells as the first tier, but titled Teacher Indirect (TI) and closed with Flanders' variable of direct teacher talk (d). Finally, the third tier of interaction variables began with the TI Ratio and ended with PI Mesh. In this fashion, the correlations of matrix cell frequencies could be checked for relationships with six loci of the second tier. And the combination of loci, as found in the third tier, could be also checked for agreement with the basic units and larger frequency combinations.

As expected, the block of cell frequencies, 1, 2, 3, X l, 2, 3, or TI was found positively correlated with teacher frequency of use of questions. Teacher directions were found to have essentially a zero correlation with TI; criticism was

negatively correlated with TI. Teacher continuous talk was borderline with TI (0.18). Quite unexpectedly, TI was negatively correlated (-.36) with pupil-directed talk, 8 X 8 frequency. By contrast, TI was positively correlated (0.30) with the 8, 9 X 9 cell frequencies. It had been anticipated that TI would be positively correlated with both types of pupil talk frequencies.

The negative values for coefficients of correlation between TI and the 7 X 7 cell frequency, and direct teacher talk (Flanders direct influence variable), demonstrated two separate loci of interaction as anticipated.

The use of Category 10, silence or confusion, was found to have an essentially zero correlation with TI. This is in agreement with the notion that some teachers use silence for moments of reflection and independent seat work. Other classrooms obtain increased frequencies of Category 10 through confusion. The 10 Ratio variable appeared to resolve the problem of separating approved silence from confusion that met teacher disapproval. The 10 Ratio was found to be positively correlated (0.64) with TI and pupil-initiated talk (0.40). The negative correlation between the 10 Ratio (-0.42) and teacher use of criticism contrasted with the +.30 correlation between the use of criticism and the total unmodified frequency of "Tens". That is, the ratio of the frequency of silence with teacher approval or acceptance to the frequency of silence in all row and column cells including silence (or confusion) that

received teacher disapproval appeared to satisfactorily divide silence from confusion. The ratio would approach a value of 1.0 as the use of approved silence increased and/or the use of unapproved silence or confusion decreased. A comparison of correlations of the 4 X 9 cell, 5 X 9 cell, 6 X 9 and 7 X 9 cells with the 8, 9 X 9 indicated the 5 X 9 cell as transitional or borderline in interrelationship with pupil initiated talk. Because the 4 X 9 cell obtained a considerably higher coefficient values with the 1, 2, 3, X 9 cells (0.44) than with the 5 X 9 cell (0.29) and a higher coefficient value with (8, 9 X 9) cell frequencies than did the 5 X 9 cell frequency, the PI Ratio was later defined as: 1, 2, 3, 4, X 9/1, 2, 3, 4, 5, 6, 7, X 9.

It was intended that teacher-pupil interaction variables be summed to present as parsimoniously few variables as possible. The first attempt was labeled simply Total 1 and Total 2. Total 1 was obtained from the sum of the PI Ratio and PI Mesh. PI Mesh, pupil initiated talk accepted or elicited by the teacher, plus the teacher ratio of encouraging pupil initiated talk to disapproval were summed to reflect the performance of both teacher and pupils in sustaining pupil ideas.

Unfortunately, the value of the ratio is much larger than the use of student initiated talk. Consequently, the latter variable was masked as indicated by the decreased correlational value (0.22) of Total 1 with the 8, 9 X 9 frequency as compared with the PI Mesh correlation coefficient of 0.96 with the

8, 9 X 9 frequency. Totals used in multiple regression were revised by normalizing each variable before summation. It was not clear what Total 2 represented since it was formed with the addition of TI-R, 10-R, PD-R and PD-M. The negative correlation of pupil-directed talk (PDM), with the use of teacher praise and encouragement, TI, and the use of silence was simply not anticipated. It appeared however, from the correlations obtained from the 1, 2, 3, X 8 cell frequencies, the 4, 5, X 8 and 7 X 8 cell frequencies and the 8 X 8 cell frequency that pupil-directed talk included a moderate proportion of drill. The variables of interest for the remainder of the study are found in Table 12. The corresponding areas of a 10 X 10 matrix are shown in Figure 5.

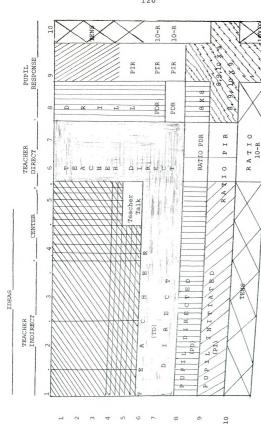
The correlational coefficients obtained from creative performance measures and classroom interaction measures were of considerable interest. If the values were moderate (above .3 or .4), the independent variables in multiple regression would not be independent, reducing the probability of obtaining acceptable values with an F-test statistic.

But beyond the immediate statistical consideration was the question of relationship between creative abilities of pupils and classroom patterns of interaction. Specifically, pupils who produce an above average number of unique ideas might also be found to initiate pupil talk (Category 9) with above average frequency. In turn, the pupil-initiated talk could be followed by teacher criticism or increased use by the teacher of student

TABLE 12

A SUMMARY OF CLASSROOM INTERACTION VARIABLES

NAME	SYMBOL	MATRIX DEFINITION
Teacher Indirect	TI	1,2,3, X 1,2,3
Teacher Direct	TD	1,2,3,4,5,6,7, x 6,7
Teacher Indirect Ratio	TIR	TI/TI+TD
Developing Questions and Ideas	DQI	(1,2,3,4,5, x 1,2,3,4) - (1,2,3,4,5, x 7)
Drill	DRILL	1,2,3,4,5,6, X 8 (column 8 only)
Developing Broad Ques- tions and Ideas	DBQI	DQI - Drill
Pupil-directed talk	PDT	8 X 8
Pupil-initiated talk	PIT	8,9,10 X 9
Pupil-directed Ratio	PDR	1,2,3,4,5, X 8/1,2,3,4,5,6,7 X 8
Pupil-initiated Ratio	PIR	1,2,3,4 x 9/1,2,3,4,5,6,7 x 9
Pupil-directed Mesh	PDM	PDR X PDT
Pupil-initiated Mesh	PIM	PIR X PIT



Designated areas of a 10 x 10 matrix of verbal interaction. Figure 5.

ideas. The correlational values suggested a relationship near zero between the observed pupil-initiated talk and creative performance. The correlation between teacher use of pupil ideas (TI) was negative in arithmetic sign for all creativity measures. In contrast, the teacher use of student ideas increased with an increase in academic achievement scores. The correlational value of ± 0.19 was statistically significant at the .0005 level. It was also found that there was a decrease in teacher use of directions and criticism with creative and academic performance. However, the value of ± 0.23 with the academic achievement measures (MAT) was twice the values found with the creative performance measures.

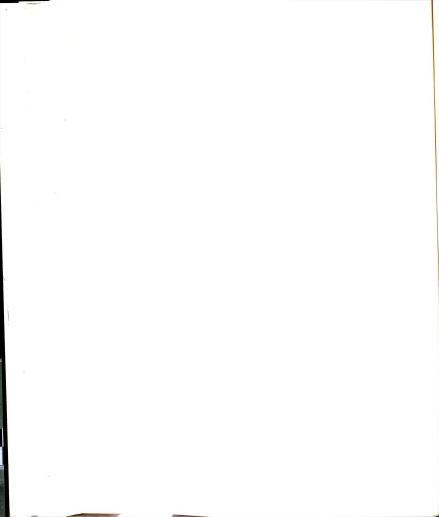
While the frequency of pupil-initiated talk (Category Nine) was found to approximate zero correlation with creativity measures, a positive correlation was found between directed pupil talk (Category Eight) and creative performance measures. Again, by contrast, this relationship did not appear with the academic achievement measures. This corroborates a subjective observation that some teachers would respond to divergent pupil ideas with tightly controlled discussion. Other teachers would respond by using the pupils' ideas as part of the on-going work at hand. Thus, while the frequency of pupil-initiated talk did not correlate significantly with creativity measures, it will be noted that the PIM measure of "mesh" of pupil and teacher interaction did correlate in a positive direction. Teachers may have reacted in one of two ways to divergent pupil talk:

(1) by using the ideas as measured by PIM or (2) by switching the pupil talk from divergent to convergent, predictable talk.

The correlational values of statistical significance between classroom interaction variables and post-treatment measures of creativity (Form B) were also reported in Appendix C, Table A-10. The coefficients between the measures of creativity and pupil talk (Category 8 and 9) were substantially reversed in values. The directed pupil talk measure correlate of 0.04 with the Form B Total Battery Score was statistically not different from a value of zero. The pupil-initiated talk correlated 0.15 with the same Total Score. While the relationship between the type of pupil talk and measures of creativity had changed, the relationship with academic achievement scores (MAT) and pupil-initiated talk remained moderately positive (0.24).

The change in coefficients of correlation from pre- to post-treatment forms of creativity measures were small albeit significant. Whether the post-treatment correlations were associated with the mutual correlate of academic achievement could best be determined in multiple regression analysis.

A series of preliminary analyses in multiple regression had established the academic achievement score, MAT Form A, pre-treatment measure of creative performance, and the sex of the pupil to be significant "independent" variables in predicting post-treatment measures of creative performance. The average scores of girls on the subscores of the test battery were



consistently higher than the average scores obtained by boys (Appendix C, Table A-11). Next, measures of classroom interaction were introduced into the multiple regression equations. A summary of results are reported in Table 13.

The indirect/direct teacher influence variable was found to be a statistically non-significant correlate in regression on measures of creative performance. However, the problem solving task measures were significantly dependent on the measure criticism and direction, observed in the classroom. The direct influence, d, pupil-directed ratio and the pupil initiated talk ratio were found significant predictors of problem solving measures. The latter two ratios had as denominators the frequency of directions and criticism associated with pupil-directed talk and pupil-initiated talk. There is therefore the possibility that negative criticism, as differentiated earlier from evaluation, may be a deterrent to evaluative performance. It is noteworthy that the Task 5 measure. Asking Questions, did not pose constraints to foreseen diffir culties or to be fair to affected people, and was not dependent on the frequency of directions, criticism or the ratio of acceptance/criticism of pupil talk. Indeed, aside from the frequency of silence or confusion, Category 10, there was no success in predicting the adequacy measure on Task 5 from the classroom interaction variables. A lame guess is that the procedure of applying a criterion of acceptability without making the criterion manifest to the respondent may have run counter to

STATISTICALLY SIGNIFICANT RELATIONSHIPS BETWEEN CLASSROOM INTERACTION VARIABLES AND THE DEPENDENT MEASURES OF CREATIVE PERFORMANCE TABLE 13

CLASSROOM INTERACTION	NV	ORIC	. 5	SUB	NV ELAE	VB FLUX	VB X ORIG	B IG T	SUB	ASK	SUB ASK ASK OTAL FLUX ADEQ	EVAL	ADE	EVAL EVAL SUB FLUX ADEQ TOTAL	B P	PS FLUX A	PS	SUB	NV NV SUB NV VB VB SUB ASK ASK EVAL EVAL SUB PS PS SUB IB FLUX ORIG TOTAL ELAB FLUX ORIG TOTAL FLUX ADEQ FLUX ADEQ TOTAL FLUX ADEQ TOTAL TOTAL MAT B	MAT.	щ
8 X 8					ì	_														-	×
8,9,10 X 9		+	*	*	+	+	+	*	*									+	*		×
1,2,3,4,5, 8,10 X 10 TENS	+	+	*	*	+	+	+	*	* +	+	+	+	+	+	+	*	*	*	+		×
FLANDERS indirect, i						1	*		0	+	0									+	*
FLANDERS direct, d												*	1	! *	*	*	о 1	*		1	*
FLANDERS																				+	*
1/d KATIO				*	+							+	+	+	+	*		*	+		×
PD RATIO	+			-	. 1							+	+	+	*	*		*			×
PI RATIO					1																
PD MESH					1								4	+	*				+	+	*
PI MESH		+	*		+	+	+	*	* +				+	-		4				4	*
TOEAS	*			*	+		+	*	e) +						+	к .			+ -	+ -	
	9	+	*	*	+	+	+	*	*	+		+	+	+	+	*	*	+	+	+	k
10 RATIO	* -	+		*	+	+	+	*	* .			+	+	+	+	*	*	*	+	+	*

* p < .. 05; @ .05 < p < .10; x not tested.

the task requirement as perceived by the pupil. The last three variables, PIM, IDEAS and 10 Ratio, plus the sum of these variables, TIPI, were found to be significant predictors of Task 6 and 7, evaluation.

Three measures of teacher and pupil classroom interaction were found statistically significant in predicting Total Battery Score and Sectional Scores of Originality and Problem Solving. The PIM variable was the strongest predictor of verbal creativity performance, while IDEAS accounted for a higher amount of regression sum of squares with non-verbal and problem solving measures. The 10-R variable faltered only with the Task 5 measure (see Table 14).

The variable, PDM, failed to be a significant predictor of Task 6 measure of problem solving. It had been predicted from the construct presented in Chapter III, page 62, to be a significant correlate. PDM was, however, found to be statistically significant in predicting scores of Task 7, Suggesting Solutions. The shift in arithmetic sign from negative and non-significant for measures of non-verbal and verbal creativity, and for the Task 5 measure, to positive and approaching the level of acceptance with Task 6; and then to positive and at an acceptance level of significance was conspicuous in its parallel with the increase in constraints from Task 5 through Task 7. The evidence that evaluation can be considered a different cognitive task, sensitive to different interaction variables would be found credible save for the nagging

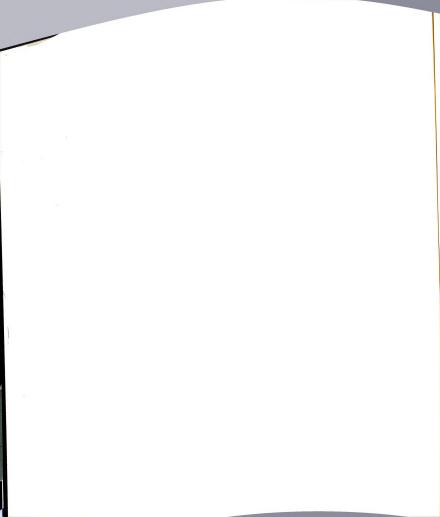
TABLE 14

RESULTS OF AN ANALYSIS OF COVARIANCE DEPENDENT VARIABLE:*

TOTAL SCORE I B

CLASSROOM INTERACTION VARIABLE	DEGREE OF FREEDOM	MEAN SQUARE		F-STATISTIC	SIGNIFICANCE
PD MESH	5	REGRESSION	7803.8		
	1	RESTRICTION	44.0	0.92	0.34 (N.S.)
	759	ERROR	47.8		
PI MESH	5	REGRESSION	7859		
	1	RESTRICTION	319.9	6.7	0.009
	759	ERROR	47.4		
10 RATIO	5	REGRESSION	7957.3		
	1	RESTRICTION	811.5	17.35	0.0005
	759	ERROR	46.8		
IDEAS	5	REGRESSION	7930.3		
(DBQI)	1	RESTRICTION	676.4	14.4	0.0005
	759	ERROR	46.95		
TIPI	5	REGRESSION	8011.9		
	1	RESTRICTION	1084.3	23.4	0,0005
	759	ERROR	46.4		
SMALL D	5	REGRESSION	7811.5		
	1	RESTRICTION	82.3	1.72	0.186 (N.S.)
	759	ERROR	47.7		
ID RATIO	5	REGRESSION	7795.5		
	1	RESTRICTION	2.492	0.052	0.80 (N.S.)
	759	ERROR	47.83		

 $^{^{\}star}\text{With Pre-treatment Academic Achievement}$ and Creative Performance Measures, Age and Sex Covariates.



correlation of PDM with the area of the matrix termed Drill.

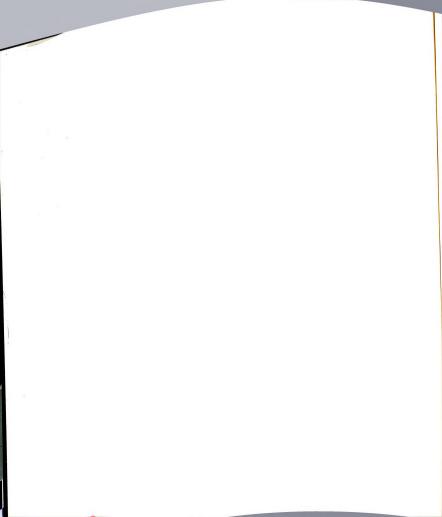
A conclusion with a ring of finality must await a better

measure of evaluation as it occurs in classroom interaction.

The term, "Flexibility," was introduced by Flanders to mean the modification of teacher influence, direct and indirect, with a change in classroom activity. In this study. no injustice is meant to the original meaning to include the modification of classroom interaction with a change in cognitive task. That is, the concept of teacher flexibility was extended to include different patterns of interaction with different cognition tasks. Then it might be expected that the sum of classroom interaction variables would account for more regression sum of squares than the most significant single interaction variable. Inspection of the mean squares for restriction and mean error sum of squares (Tables 15 and 16) indicated that the regression accounted by three separate covariates is not significantly different from the regression accounted by the single variable formed by the sum of the three normalized variables

From the results above, there emerged a problem solving pattern of teacher-pupil classroom interaction.

- If there is occasion for continuous pupil initiated talk that is accepted for the ideas expressed, creative performance is enhanced.
- (2) And if with an increase in pupil initiated talk there is an increase in teacher statements in which the





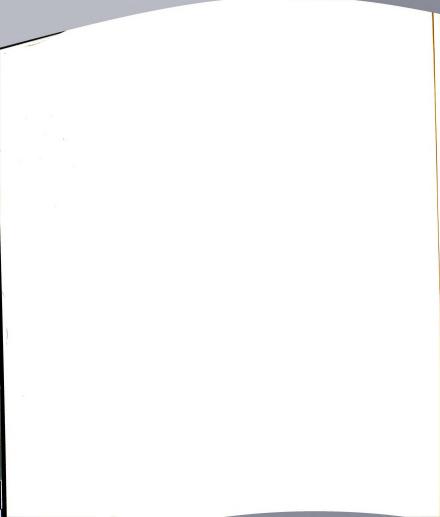
RESULTS OF ANALYSIS OF COVARIANCE WITH THREE INTERACTION VARIABLES* TABLE 15

TEST	CLASSROOM INTERACTION PARTIAL VARTABLE	PARTIAL r	Ω	MULTIPLE R	DEGREES OF FREEDOM	MEAN SQUARE		F-STATISTIC	Д
	DTM	.04	. 29	. 55	13	REGRESSION	854.7		0
CDTGC	10-R	90°	80.		3	RESTRICTION	105.2	3.05	170.
NV	IDEAS	.03	.35		751	ERROR	34.4		
	MIG	0.	.92	5.5	13	REGRESSION	4953.67		;
gillo	10-8	90.	,12		m	RESTRICTION	9 * 095	3,44	910.
TOTAL	IDEAS	.08	.03		751	ERROR	163.0		
NV									
	PIM	0,	,713	.68	13	REGRESSION	5974.6		
FT.AR	10-R	.02	.53		٣	RESTRICTION	857.1	7.18	.0005
	IDEAS	.15	,0005		751	ERROR	119,4		
	MIM	.07	.05	.53	13	REGRESSION	5385.2		
ORIG	10-R	90.	0.08		3	RESTRICTION	1446.5	6.13	.0005
VB	IDEAS	*08	* 08		751	ERROR	236,1		
	MTd	.05	.17	.62	13	REGRESSION	30674.2		
SIIB	10-R	.08	.03		Э	RESTRICTION	4728.4	5.53	.001
TOTAL VB B	IDEAS	90.	.11		751	ERROR	855.2		
ADEQ	PIM 10-R	02	9.8.	. 58	13 3 751	REGRESSION RESTRICTION ERROR	239.4 7.20 8.07	68.	.45
ASK	TOPEN								

	.11				.02			.003			,10			.01			,0005		
	1.97				3.44			4.84			2.12			3.83			8,68		
0 2021	87.7	44.5		346,4	34.57	10.08	3148.9	371.8	76.76	1149.3	52.82	24.93	9319.9	668.4	174,45	3669.2	402.6	46,38	
NOISSARDAG	RESTRICTION	ERROR		REGRESSION	RESTRICTION	ERROR	REGRESSION	RESTRICTION	ERROR	REGRESSION	RESTRICTION	ERROR	REGRESSION	RESTRICTION	ERROR	REGRESSION	RESTRICTION	ERROR	
13	2 0	751		1.3	3	751	13	m	751	13	8	751	13	e	75L	11	m	753	
63				, 61			.64			.67			69°			.73			
7.7	.57	.03		.7	900°	ů,	.62	.003	.51	.94	.10	.20	6,	.03	.10	.57	.004	800°	
00	+.02	+.08		10.	.10	. 20	+.02	.11	.02	0.	90°	• 05	0.	80.	90.	.02	11.	OT.	
ME	10-R	IDEAS		PIM	10-R	IDEAS	PIM	10-R	IDEAS	MIG	IO-R	IDEAS	PIM 10-p	Theye	20774	PIM	IDEAS		
	SUB	TOTAL	ASK		ADEQ	EVAL		SUB	TOTAL		ADEQ	2	SUB	TOTAT.	PS B	TOTAL.	SCORE	I B	-

* Three Classroom Interaction Variables: PI Mesh, 10-Ratio, Ideas

Sex, High, Middle and Low Academic Achievement intercepts Age, High, Middle and Low Creative Performance intercepts Mat A High, Middle and Low Slopes of Creative Performance





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RESULTS OF ANALYSIS OF COVARIANCE WITH ONE CLASSROOM INTERACTION VARIABLE* TABLE 16

NOTE 1		TIPI SUM PARTIAL Y	MULTIPLE R	DEGREES OF FREEDOM	MEAN SQUARE		F-STATISTIC	ρι
0.11 REGRESSION 5833.6 753 ERROR 1339.7 754 ERROR 156.9 11 REGRESTION 1503.8 753 ERROR 120.51 11 REGRESSION 6963.3 12.48 753 ERROR 120.51 11 REGRESSION 6390.9 11 REGRESTION 4577.68 19.47 753 ERROR 14457.4 16.96 753 ERROR 14457.4 16.96 753 ERROR 2253.0 0.02 .58 11 RESTRICTION 14457.4 15.96 753 ERROR 2253.0 0.02 .58 11 RESTRICTION 14457.4 15.96 0.02 .58 11 RESTRICTION 152.53 0.31 0.03.0	RIG	0.11	,56	11 1 753	REGRESSION RESTRICTION ERROR	1016.0 313.0 34.26	9.135	0.003
11 REGRESSION 6963.3 12.48 1	UB-TOTAL	0.11	. 59	11 1 753	REGRESSION RESTRICTION ERROR	5833.6 1399.7 162.9	8,59	,004
TOTAL 11 RESTRICTION 4577.68 19.47 TOTAL 15 .62 1 RESTRICTION 4577.68 19.47 TOTAL 15 .62 1 RESTRICTION 4577.4 16.96 1 RESTRICTION 14457.4 16.96 1 RESTRICTION 14457.4 16.96 1 RESTRICTION 15.246 1 RESTRICTION 15.25 1 RESTRICTION 276.6 1 RESTRICTION 276.6 1 RESTRICTION 276.6 1 RESTRICTION 27.53 1 RESTRICTION 2.53 2.53	SLAB	0,13	89,	11 1 753	REGRESSION RESTRICTION ERROR	6963.3 1503.8 120.51	12,48	.001
TOTAL 15 .62 1 RESTRICTION 14457.4 16.96 753 ERROR 852.46 11 RESTRICTION 276.6 13 RESTRICTION 276.6 753 REPRORMANCE 2.53 0.31 0.	RIG	0.16	. 53	11 1 753	REGRESSION RESTRICTION ERROR	6390.9 4577.68 235.1	19.47	,0005
11 REGRESSION 276.6 1 RESTRICTION 2.53 0.31 753 ERROR 8.14	UB-TOTAL BB	.15	.62	11 753	REGRESSION RESTRICTION ERROR	36281.9 14457.4 852.46	16.96	. 0005
	NDEQ ASK	0.02	. 58	11 1 753	REGRESSION RESTRICTION ERROR	276.6 2.53 8.14	0.31	0.31

SUB-TOTAL			11	REGRESSION	1969.64		
ASK	90"	.63	1	RESTRICTION	113,85	2.54	0.10+
			753	ERROR	44.84		
ADEO			11	REGRESSION	403.46		
EVAL	0.10	.61	1	RESTRICTION	80.65	7.95	0.005
			753	ERROR	10.14		
SUB-TOTAL			11	REGRESSION	3667.9		
EVAL	0.11	.64	Т	RESTRICTION	767.76	9.93	.002
			753	ERROR	77.3		
ADEO			11	REGRESSION	1345,85		
PS B	.08	99°	1	RESTRICTION	111.8	4.47	0.03
			753	ERROR	25.04		
SUB-TOTAL			11	REGRESSION	10916.58		
PSB	0.11	69.	٦	RESTRICTION	1530,00	8.72	0.003
			753	ERROR	175.42		
TOTAL			o	REGRESSION	4466.47		
I B	0.17	.73	1	RESTRICTION	1101.3	23.54	0,0005
			755	ERROR	46,48		

High, Middle and Low Academic Achievement intercepts High, Middle and Low Creative Performance intercepts High, Middle and Low Creativity Slopes *Covariates: One classroom interaction variable, TIPI SUM,

- ideas of pupils are identified, developed, elaborated and accepted, creative performance is increased.
- (3) And if the teacher allows time for independent study, group work or reflective thought accompanied with a minimum of pupil behavior that evokes teacher criticism, creativity is enhanced.

The evidence, in addition to the positive correlation reported earlier between PIM, 10-R and IDEAS, suggested that pupils in classrooms in which at least two of the three classroom interaction variables are used with increased frequency will increase in performance on measures of creativity performance.

In this section, the development, test and use of classroom interaction variables was described. Pupil initiated talk
that received teacher approval, teacher talk that used the
ideas of pupil and teacher, and silence that met with approval
were found to be significant correlates in analysis of covariance with measures of creative performance. In addition, these
interaction variables were found to be significant correlates
of academic achievement in regression with pre-treatment scores
of academic achievement. The compatibility of these three
interaction variables to both academic and creative performance
measures suggested that it is possible to foster creativity
without being a detriment to academic achievement. One major
difference in the predictive significance of classroom interaction measures was noted: the ratio of indirect to direct

teacher influence, i/d, was found to be a significant predictor of academic achievement, but not creative performance. The academic achievement scores were found to be dependent upon the praise and teacher acceptance cell frequencies, that had little predictive relationship with creativity measures. But both academic and creativity measures were found to be dependent upon the frequency of pupil-initiated contributions and pupil-teacher exchanges of ideas.

As part of the study, it was determined that separate slopes and means for high, middle and low creative performance scores and separate intercepts for academic achievement were significant correlates of creativity measures. A post hoc investigation of the student populations formed by the separate intercepts was reviewed in this final section of the chapter. In addition, summary data of interaction from each of the thirty classrooms were reviewed in an attempt to "explain" what occurred in designated classrooms.

In brief, the population was divided by the criterion of total score on the Metropolitan Achievement Test (MAT), into high, middle and low groups. Since the distribution of scores is normal, the 25% in the high and low groups could be closely approximated with the use of a table of standard scores. In a similar way, the high, middle and low groups on creativity were determined by total score from the instrument, Test Your Imagination. (The elaboration score was deleted.) Table 17 was presented with summary tables of the six groups. In addition,



TABLE 17

A COMPARISON OF ACADEMIC AND CREATIVITY PERFORMANCE SCORES FOR SIX GROUPS DESIGNATED HIGH, MIDDLE, LOW ACADEMIC; HIGH, MIDDLE, LOW CREATIVE

					A. A. STATE OF THE PARTY OF THE				
	TOTAL	HI AC	MD AC	LO AC	HI CR	MD CR	LO CR	S,D.	2 Z
				The state of the s	And the second s				
ď	100	26.7	48.9	24,4	24.7	49.0	26.3		
% Z	738	197	361	180	1.82	362	194		
N N N	50,21	62.2	50.04	37.51	54.676	50.76	45.11	9.64	
MAT B	52,615	64.1	53,22	39.27	56,63	53,45	47,65	14:36	
MPAT	170	178	170.	165	173	172	167	30,349	+4,3
ORTG NV A	18.80	20.8	18.23	17.0	25.08	18,77	12,34	7.1.7	1,03
S TOTAL NV A	55.43	59,1	54.05	52,25	71,02	54.85	40.13	16,00	2.26
	48,70	55.3	47.82	42.57	58,57	50,29	35.90	20,43	2.90
ORIG VB A	22.03	26.3	22.70	14.23	38.69	19,33	08.6	15,81	2.24
S TOTAL VR A	67.49	76.3	68,84	49.61	105.77	62.46	35,845	33.12	4.68
	11.28	13.8	11.63	7.63	16.43	11.18	6.44	5.15	.728
	39,13	46.2	39,87	28,69	55.79	38.62	23.345	15.32	2.16
	50.00	53.9	50.01	44.22	63.01	49.098	38.03	10.06	1.42
a mu ordo	17.54	20,3	17.17	14.96	22.30	17.19	13.43	96.9	0,985
5	71.77	60.2	55.03	49,58	67.35	54.70	44.304	15.64	2.21
S 'IO'I'AL NV B	4.00	36.4	31.80	24.23	37.27	32.35	23.31	14.80	2.10
ELAB NV B	30.16	24.2	19.02	13.33	29.35	18.754	9.825	18.00	2.55
ORIG VB B	64.14	75.5	64.07	48.82	91.43	62.624	38.60	36.9L	•

5 B ASK	6.088	7.771	6.341	3,75	8,31	6.044	4.088	3,465	0.49	
6, 7 B EVAL	6,446	8,477	6.643	4.02	8.98	6.525	4.093	3.976	0.57	
ADEQ PS B	12.53	16.2	12,98	7.77	17,30	12,57	8,180	6,638	0.938	
S TOTAL PS B	40.01	49.6	41.16	27,19	54,48	39,70	27,03	18.17	2.57	
TOTAL I B	50.00	54.7	50.21	44.0	59.41	49.64	41.45	9.93	1.40	
TENS	.1743	.167	.177	.1706	,1756	.1732	.16955	.0579	0.00820	
IQU	20.00	90.09	51,16	47.279	47.53	50.447	51,181	10.00	1,41	
DRILL	50,00	49.675	49,30	51.70	50.37	49,635	49.786	10.0	1,41	
8 × 8	.1156	,1196	.1138	.1192	.1404	.1129	.1014	.0802	0.0113	
8,9,10 X 9	.0788	.0904	.0791	.0658	.0817	.0805	.0732	.0416	,00585	
5 X S	.1791	.1811	.1835	.1810	.1645	,1836	.1964	.0763	0.0108	
I/D	.5252	.5518	.5444	,4645	.5177	,5387	.5134	.1288	0.0184	
PDM	.1009	.10607	,1006	.1008	.1213	9660°	.0888	,0686	0.00970	1.
PIM	50,148	53,739	199°05	45,15	51,295	50,638	48.120	9.845	1.39	,,
10-R	50.00	51,43	51,62	45,553	49.80	50.678	49.256	10.000	1.41	
IDEAS	50.00	50.34	51,44	47.07	48.00	50,641	51.00	10.0	1.41	
TIPI SUM	50.067	52.486	57 674	74 790	79 597	50 883	790 267	10.06	1,42	

an estimate of standard error (N=200) was entered as an aid to ready estimation of a significant difference in means between any two groups.

It was possible for an individual to be classified in any of the nine combinations of the six groups. However, of the 197 pupils identified as "high academic", only 100 were also identified as "high creative" by a computer tabulation. The correlation between academic and creative performance measures is more than random as can be visualized from the scores reading left to right. But the source of the moderate to low values obtained from correlational coefficients can be appreciated from the scores obtained in the groups selected by the creativity criterion. The difference in verbal sub-total scores between high creative and high academic groups equals the difference in scores between high and low academic groups.

The increased correlation between academic and problem solving scores reported earlier can perhaps be better appreciated with the use of data from Task 5, Asking and Task 6 plus Task 7, Problems, average scores of adequacy. About one-half a point difference approaching significance between group means, was obtained between high creative and academic groups. The close numerical similarity in average scores across the high, middle and low groups was undoubtedly reflected in the increased values of the correlations between academic and problem solving scores. Perhaps overlooked in noting the similarities in problem solving scores is that up to one-half of the

top scoring problem solvers would not have been identified by academic achievement criteria.

Two differences in high classroom interaction measures are related to earlier remarks with regard to the teacher and the creative child. The frequency of pupil-directed talk in the 8 X 8 cell is highest in the high creative group. The frequency of pupil-initiated talk is highest in the high academic group. The teacher who feels threatened can exercise control to switch from the less predictable pupil-initiated talk to the directed pupil talk of Category 8. However, the high academic might be found by the teacher to be more reliable and permitted a higher frequency of Category 9, pupil talk. This is also in evidence from the relatively high i/d ratio obtained from the high academic group.

Are these differences noticed by the teacher? Informal observations suggested that the teacher who used small groups or individual project work was aware of differences in children's ability to offer different ideas. But the teacher who worked by total classroom more often than not, perceived a problem of control rather than individual differences.

For example, the children in one group were assigned to tables on the basis of the teacher's observations of their creative and academic abilities. That teacher sought a "good mix" to help the creative evaluate his ideas and to encourage others to consider additional ideas. The ideas that passed the scrutiny of small groups could later be presented to a larger

sized class group. It is little wonder then that pupil-initiated talk in the first group exceeded teacher lecture, for it was the children that had much to explain to the class. By contrast, a comparable class had a different interaction pattern.

In the second class group, different or unexpected ideas were presented to the entire class. Usually the ideas were met with immediate acceptance or rejection by the teacher.

In the course of the year, classroom criticism was observed approximately one percent of the total time, while observed one-tenth as frequently in the first group.

The second part of the post hoc study was anticipated. A computer program was used to enter each classroom group into an analysis of covariance on each measure of creative performance. In addition, frequencies in selected cells of the interaction matrix were calculated. A problem of unity developed when interaction variables and classroom variables were entered into the covariance matrix. A least square addition program (LSADD) was used together with least squares regression program without classroom variables. Table 18 presents the significance level of classroom groups below p = 0.05 obtained with the latter program. The probability entry was underlined if corroborated from the results of the LSADD computer program.

Another table, Table 19, was prepared with a brief summary of classroom interaction data. Simple in form, "tens", "nines", "eights" were sub-totaled to present pupil participation.



TABLE 18

MILTIPLE REGRESSION OF CLASSROOM GROUPS IN REGRESSION WITH PRE-TEST ACADEMIC AND CREATIVITY SCORES LEAST SQUARE ADDITION OF CLASSROOM GROUPS IN REGRESSION WITH PRE-TEST SCORES AND CLASSROOM INTERACTION VARLABLES *

	6		Δ	V-E-R-B-A-L		P-R-(P-R-O-B. S-O-L-V.	-0-L-V.	
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16	18	13	21	22	23	24	25	56	27	28	29	30

*Underline denotes significant relationship also indicated from LSADD computer program.

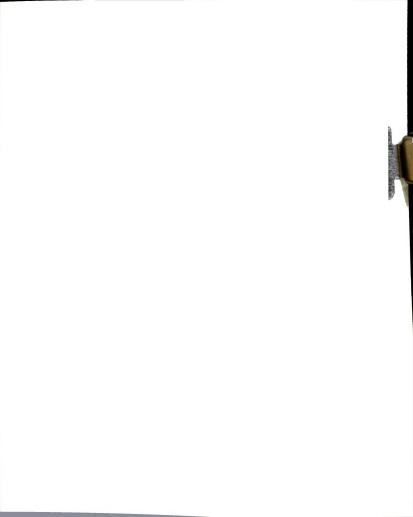


TABLE 19

A COMPARISON OF SELECTED MEASURES OF CLASSROOM INTERACTION FOR 30 CLASSROOMS (Percentage)

	I/D	10	თ	∞	SUB TOTAL	5 x 5	4,5,6 x 8	SUB TOTAL	4x9	7×7	1,2,3x1,2,3
	,63	90°	90°	,10	, 22	, 26	.07	, 33	.01	, 004	0.0
1 ~	55	,07	.08	, 06	, 21	. 28	,07	,35	03ء	,02	03،
	44	ť	90,	17.	. 28	, 18	,11	, 29	,01	,01	,01
	. 51	60°	8	.12	39	,15	60°	, 24	,016	003	,01
	, 62	, 05	, 16	Ę,	, 32	, 18	, 11	,29	,02	, 003	,026
	,44	,16	, 065	, 04	,27	, 27	, 07	, 34	.01	, O i	.02
	555	91,	90 ³	0.08	30	ŢŢ,	, 1.5	, 26	.017	003	.02
	, 65	,12	03	90°	, 23	,15	,13	. 28	.01	.002	,02
	, 67	. 14	, 04	,16	, 34	80,	,13	,21	.01	.001	, 03
	99°	.10	90°	90,	, 26	,17	60°	, 26	.01	.005	,04
	.60	90.	.095	, 065	.22	,21	.14	,35	.01	.003	.03
	.42	، 80	.04	, 25	, 37	.05	.18	.23	.01	.01	00.
	.47	.04	.02	.38	, 44	90°	.19	.25	.005	.001	.01
	.67	,04	90°	.20	, 30	.18	,15	,33	.01	.01	.016
15	48	.14	.03	.07	, 24	.17	.12	.29	.01	.01	*000
9	.47	.14	60.	, 18	.41	.10	.115	.22	.01	.007	.01

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	.02	.01	.02	.02	.004	900.	.002	.007	.01	.02	.027	.01	.01
00.	.01	.002	.005	.001	.04	900.	.03	.002	.01	.001	.001	.04	.01
20.	.01	.003	.02	.016	900.	.02	.01	.004	.01	800.	.007	*000	.02
0.	.31	.44	.39	.38	.36	.26	.25	.52	.22	.27	.31	.22	.22
07.	.12	.19	.15	.08	.095	.14	.14	.14	.14	.10	.11	.04	.13
44.	61.	. 25	.24	.30	.26	.12	.11	.38	80.	.17	.20	.18	60.
77.	.26	.13	.15	.22	.19	.38	.41	.12	.32	.18	.27	. 28	.25
00.	.11	.05	.07	.04	.11	.24	.18	.08	.17	.05	.14	00.	60.
000	.08	10.	.05	.105	.03	80.	90.	00.	.07	.03	90.	.07	90.
	.07	.07	.03	.08	.05	90.	.17	.035	.08	.10	.07	.21	.10
0/.	.55	.46	. 56	.70	. 25	.39	.22	.41	.43	.45	.76	.31	.48
, ,	18	19	20	21	22	23	24	25	56	27	28	29	30

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Classroom gro significant group. ::hievement of the s found to be a ispendent measures Tiese two classroom ble in academic a the pupils in both reatives. And wh zill as evidence class group 23 st Finitiated t otal for pupil p a group 22, wher diticism was obs Ntime, but used

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Teacher control of talk, "fives" and "drill" were sub-totaled. Finally, contrasting measures of teacher use of questions followed by pupil-initiated talk and criticism were presented. The familiar i/d ratio was added as another summary of class-room interaction.

Classroom group 23 was found to be a statistically nonsignificant group. That is, the group generally paralleled the achievement of the 29 other classroom groups. But group 22 was found to be a statistically significant group on the dependent measures of creative performance (see Table 18). These two classroom groups from the same community were comparable in academic ability and schools. Sixty-five percent of the pupils in both classrooms were identified with the low creatives. And while there appears to have been considerable drill as evidenced by the frequencies in the 4, 5, 6 X 8 column, class group 23 still managed an above average frequency of pupil-initiated talk and seatwork (nines and tens). The subtotal for pupil participation was double the frequency observed in group 22, where teacher participation was the rule. Criticism was observed to occur four percent of total classroom 22 time, but used sparingly in class group 23. It appeared that the expectations and abilities of group 22 were never reconciled. But group 23, with pupil participation that included a high frequency of pupil-directed recitation, not at the expense of pupil initiated talk and seatwork, and with a

minimum of critic pre-experimental It cannot be this study whether teacher lecture f composite of the teasures of creat response not dire tive performance the teacher in the are but a few of resentment or an witches and other irequency with se In other cl than close upon :esponses was ma depict an eskimo erent stimulus sponded to a sti ^{©n musical} score the flag up the Not all chi But at the concl

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minimum of criticism, performed as expected on the basis of pre-experimental test scores.

It cannot be ascertained from the evidence available from this study whether the low frequency of pupil ideas, high teacher lecture frequency or the use of criticism, or the composite of these, contributed to a negative effect on post-measures of creativity. But a negative effect on a quality of response not directly assessed by the test measures of creative performance could be readily noted. Responses as, "Put the teacher in the box," or "Use the monkey for our teacher," are but a few of the responses that suggested a thinly veiled resentment or antagonism for some classrooms. Pictures of witches and other fantasy characters occurred with startling frequency with some classroom groups.

In other classrooms, some children seemed to expand rather than close upon the stimulus. One of the most remarkable responses was made by a sixth grade girl who proceeded to depict an eskimo seal hunt, scene by scene, using seven different stimulus figures in the process. Or the boy who responded to a stimulus figure, somewhat like the symbol found on musical scores, by depicting a lad pulling a rope, hoisting the flag up the staff.

Not all children made one of a kind responses, of course.

But at the conclusion of scoring the tests of ten classrooms,
the children of the eleventh classroom still averaged one
unique drawing per student on the first task, Picture Completion.

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By contrast, the variability in some classrooms seemed narrow or curtailed by a common theme of aggression or hostility.

Classroom 4 and 16 were consistently designated as significant groups in predicting creative performance. Was there something in common between these two groups? First, the classrooms excelled in creative and academic ability. The i/d ratios were at the .5 mark, not high by the standards of the thirty classrooms. But the two classrooms had the highest percentage of pupil participation as indicated by the first sub-totals percentages of 0.39 and 0.41 respectively. Perhaps as important, there were relatively high frequencies in all three forms of pupil participation, eights, nines and tens as compared with other classroom groups. The steady teacher talk and drill sub-totals are near the lowest obtained by the thirty groups. Both groups, 4 and 16, used criticism sparingly.

Twenty-five percent of Group 4 had shifted from the middle creative to the high creative groups in the pre-, post-period. Group 16 had little opportunity to shift because forty-three percent of the pupils were classified as high academic, high creative at the time of the pre-treatment test. Another thirty percent were classified in the middle academic group and high creative group. Only eight percent were classified in a lower creative group than academic group. Does there have to be a discrepancy between creativity and academic achievement? In some classroom groups it does not appear inviolable.

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CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

In the present study, creativity was defined as a problem solving activity in which solutions, unique among peers, are produced in response to given conditions. From a construct of creativity as a product of problem-solving activities measures of classroom verbal interaction and terminal measures of creative problem-solving performance were developed. Six hypotheses were tested by determination of relationships between measures of classroom interaction and creative performance measures of divergent thought and problem solving.

For the purposes of this investigation, consideration was limited to creativity as a problem solving process and the product of problem solving. Other forms of creativity were neither denied nor included in the present study in order that a definitive statement of the term could be made.

Two questions served as a focus for the investigation of the problem. $\label{eq:two-problem}$

1. What relationships exist between measures of divergent thought and measures of problem solving performance?

2. What relating measures of and creat

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2. What relationships are there between different measures of teacher and pupil classroom interaction and creative performance measures of divergent thought and problem solving?

Conceptualization

Creativity, in this study, was viewed as problem solving. This focus on creativity as a problem solving activity and product did not detract from the personal quality of the creative process. Creativity, in concept, was viewed as a product of problem solving activities that not only presented a solution to a problem, but was also identified as the unique contribution of the originator(s).

A construct of problem solving was formulated after Dewey, Rossman and Wallas. With the personal urging of H. H. Anderson, problem sensitivity was added to stages of information, incubation, insight and evaluation. These stages were not considered as fixed in order of use or in priority of importance, but were found helpful in formulating a construct used in this study.

Creativity was seen to have several cognitive requirements from the perspective of a multi-staged process. Cognition, translation, convergent and evaluative thought operations seemed to interplay with the divergent thought operations in parallel with the stages of problem solving. Along a continuum

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of degree of restriction, both tasks' measures and activities could be categorized as open, restricted or closed to alternatives or choice. There was no preferred degree of restriction; rather, the need for factual information, evaluation and original ideas implied that the degree of restriction would vary with the cognitive task at hand. Together, the argument held that the creative performance of children would be facilitated by a flexible classroom interaction of pupils and teacher. The interaction would offer pupils opportunity to introduce their ideas, and for the teacher to identify, develop, encourage and accept those ideas together with pupils. The shared development and evaluation of ideas could be complemented with individual seat work and time for reflection.

Product and Process Measures

Additional measures of creative performance and measures of classroom interaction were developed from the above concept of creativity and construct of the creative process-product. Three tasks of problem solving were developed and tested prior to this investigation. The pupil was requested to respond by "Asking Questions," and to "Seeing Problems" in regard to an unfamiliar scene depicted in a drawing. He then was requested to "Suggest Solutions" that are fair and reasonable. As the Pupil proceeded from the task of reacting by asking questions,

the two succee additional constr mfamiliar scene that may resolve cluding non-verba iron the Minnesot moblem solving, sips between seve Four verbal . the study of relat nteraction v i obtain a measur and classroom mik was combined non of that talk. essure was predic erformance. A si irected by the te is measure was p Mormance of pup latio of percent is confusion reje ithe use of seat Ratio (10-R), issures of diverg

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to the two succeeding tasks, he was requested to respond to additional constraints of using information given about the unfamiliar scene to predict consequences and offer solutions that may resolve a conflict in an equitable manner. By including non-verbal and verbal measures of divergent thought from the Minnesota Test of Creativity with the three tasks of problem solving, it was possible to investigate the relationships between several measures of creative performance.

Four verbal interaction variables were defined to permit the study of relationships between different measures of classroom interaction with different measures of creative performance. To obtain a measure of pupil-initiated contribution to the verbal classroom interaction, the frequency of pupil-initiated talk was combined with the ratio of teacher acceptance to rejection of that talk. Termed pupil-initiated mesh (PIM), the measure was predicted to be related to measures of creative performance. A similarly constructed measure of pupil talk, directed by the teacher, was termed pupil-directed mesh (PDM). This measure was predicted to be related to the convergent performance of pupils as measured by the problem solving tasks. A ratio of percentage of silence acceptable to the teacher to the confusion rejected by the teacher was employed as an index of the use of seatwork, reflection and small group work. Ten Ratio (10-R), was also predicted to be related to the measures of divergent thought as well as the measures of problem solving. Finally, the frequency of the use by teachers of

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pupil ideas to Identify, Develop, Encourage, Elaborate and Accept Student ideas (IDEAS) was used as a measure of teacher participation to the classroom interaction. It was predicted that IDEAS would be found related to several measures of creative performance. Together, the measures of classroom interaction and the measures of creative performance permitted a study of a construct of creativity as a product of problemsolving activities.

Sample

From 101 teachers who volunteered to participate in the research study, thirty classrooms were selected for classroom observation and administration of measures of academic achievement and creative performance. A second form of each measure was administered at the close of the school year. During the interim period, the Flanders system of classroom observation was used to record the classroom verbal interaction. A mixed design analysis of covariance was adopted with the assumptions of a fixed teacher population and a randomly selected population of pupils from an area of south-central Michigan.

Pre- and post-treatment data were obtained from 769 pupils in thirty classrooms of 24 schools.

Findings

Six experimental hypotheses were formulated in null form for the study. The results of the tests of the original hypotheses were:

1. There wil ship found between and verbal tasks sores obtained f battery, Test You Hypothesis 1 mefficients, fac miques were utili masures of diver he results of th mlving were posi mi verbal task se Elated. It was Tere significant egression with pr mic achievement 2. No relation between scor Metropolitan I Reative performan ained from the no ist of Creativity attery, Test Hypothesis 2 Tes of academic

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1. There will be no statistically significant relationship found between scores obtained from non-verbal (figural) and verbal tasks from the <u>Minnesota Test of Creativity</u>, and scores obtained from problem solving tasks from the test battery, <u>Test Your Imagination</u>.

Hypothesis 1 was not rejected. Pearson correlation coefficients, factor analysis, and multiple regression techniques were utilized to determine relationships between measures of divergent thought and problem solving scores. The results of these analyses indicated that scores of problem solving were positively related as closely to both non-verbal and verbal task scores as the latter two were found interrelated. It was further found that problem solving measures were significant predictors of originality scores in multiple regression with pre-test scores of divergent thought and academic achievement.

2. No relationship of statistical significance will be found between scores of academic achievement, obtained from the Metropolitan Achievement Test (MAT Intermediate Form) and creative performance scores of: (1) divergent thought obtained from the non-verbal and verbal tasks of the Minnesota Test of Creativity, or scores of (2) problem solving from the test battery, Test Your Imagination.

Hypothesis 2 was not rejected. Correlations between scores of academic achievement and creative performance scores of divergent thought and problem solving were found positive

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and significant with values of .30 or higher the general rule. In multiple regression the scores of academic achievement were found to be significant predictors of non-verbal and problem solving scores, and approached a statistically acceptable level of significance with scores of verbal creative performance.

3. There will be found no statistically significant relationship between the frequency of teacher-accepted talk initiated by the pupil, measured with the variable, pupil initiated mesh (PIM), and creative performance scores of divergent thought and problem solving.

Hypothesis 3 was not rejected. An examination of Pearson correlation coefficients between pre-treatment measures of creative performance and classroom interaction variables disclosed a positive correlation between scores of creative performance and the frequency of pupil-directed talk (category eight). However, with the post-treatment measures of creativity, a positive and significant correlation was found with frequency of pupil-initiated talk (category nine). In other words, the pupil population under study did not start with a statistically significant correlation of measures of creative performance with the frequency of pupil-initiated talk. But six months later at the completion of the classroom observation and testing a positive correlation was noted between the creative performance of pupils and classroom frequency of pupil-initiated talk. In regression, the variable, pupil-initiated

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mesh (PIM), was found a significant correlate of post-testscores of creative performance in multiple regression with pre-experimental scores of academic achievement and creative performance.

4. No statistically significant relationship will be found between a measure of the frequency of teacher talk, giving praise, accepting pupil ideas, asking questions other than drill, and introducing teacher ideas in close (time) association with the use of the ideas of pupils obtained with the variable (IDEAS) and creative performance scores of divergent thought and problem solving.

Hypothesis 4 was not rejected. The frequency of teacher praise and use of student ideas, questions that lead to pupil-initiated talk and the introduction of the ideas of the teacher in close association with the ideas of pupils (IDEAS) was found a significant correlate in multiple regression with pre-test scores of academic achievement and creative performance. A second variable, teacher indirect (TI), that was obtained from the frequencies of praise and teacher use of pupil ideas only, was found to be statistically non-significant as a correlate in multiple regression. From the positive and significant test obtained with the variable IDEAS and non-significant results obtained with TI, as used to monitor results with IDEAS, the hypothesis that teacher use of pupil ideas and the ideas of the teacher in association with pupil ideas was not rejected.

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5. There will be no statistically significant relationship found between the ratio of acceptable silence and seatwork to the total frequency of silence and confusion (10-ratio) and creative performance scores of divergent thought and problem solving.

Hypothesis 5 was not rejected. The ratio of silence and seatwork accepted by the teacher to the frequency of silence and confusion was found a significant correlate of creative performance scores of divergent thought and problem solving. This classoom variable was a significant "predictor" of all but one factor score (Task 5 Asking) of creative performance as well as total battery score.

6. There will not be found a statistically significant relationship between the ratio of indirect influence frequency of teacher talk to the total of direct and indirect influence frequencies of teacher talk (i/i+d or I/I+D), and creative performance scores of divergent thought as obtained from non-verbal and verbal tasks of the Minnesota Test of Creativity, or from problem solving tasks from the test battery, Test Your Imagination.

Hypothesis 6 was rejected. The i/i+d ratio of indirect to direct teacher influence was not found to be a significant correlate of creative performance. However, the direct influence measure alone was found a negative correlate with problem solving scores. It was recalled that the teacher indirect (TI) measure of teacher use of praise and acceptance

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Results of Post-

A post-hoc roups associated of creative performant groups for evidence of

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was also found to be a statistically non-significant correlate of creative performance. While rejecting the hypothesis with reference to the ratio of indirect to direct influence, evidence to reject a separate hypothesis concerning a relationship of negative affect (direct influence) was found inconclusive.

Results of Post-hoc Analysis

A post-hoc study was designed to identify classroom groups associated with a positive or negative effect on scores of creative performance. Once identified as a statistically significant group, classroom interaction data were examined for evidence of teacher flexibility.

Teacher flexibility was expanded from the term as used by Flanders to include the changes in teacher classroom interaction with changes in cognitive tasks. Evidence of teacher flexibility was obtained from two sources of data:

- From the three measures of classroom interaction found to be significant correlates of pupil creative performance measures.
- (2) From an examination of classroom groups found to be significant correlates of creative performance.

Briefly, the three and IDEAS were no leacher Ideas-Pur was found to acco by the total of ation. Since th ive coefficients injued that some lassroom intera mat is, some te the three classr ine to time. I maccounted f in three separa iore, the freque manined by clas tomparison. Daitive directi Toup was found iound to be stat As contrasts # the frequenci itected talk (E ompared to the ietermined that

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Briefly, the three classroom interaction variables, PIM, 10-R and IDEAS were normalized and summed to form one new variable, Teacher Ideas-Pupil Initiated Ideas (TIPI). This variable was found to account for nearly as much variance as accounted by the total of the three separate measures of classroom interaction. Since the three classroom variables had modest positive coefficients of correlation between one another, it was arqued that some teachers might be using a flexible pattern of classroom interaction as indicated by the sum of the variables. That is, some teachers might be using not one or another of the three classroom interaction variables, but all three from time to time. Increased reliability could have been one reason TIPI accounted for nearly as much variance in regression as the three separate measures of classroom interaction. Therefore, the frequency of teacher and pupil participation was examined by classrooms. Five classroom groups were selected for comparison. Two groups were found to be significant in a positive direction as correlates of creative performance; one group was found to be a negative correlate and two groups were found to be statistically non-significant correlates, but useful as contrasts to the three groups above. The examination of the frequencies of pupil initiated talk (Nines), pupil directed talk (Eights), and silence/confusion (Tens), were compared to the frequencies of teacher participation. It was determined that the classroom groups that were related to creative achievement in a positive direction had nearly twice

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the amount of pupil classroom participation as teacherdirected talk. In addition, the frequencies tended to be
divided among the various types of pupil participation (Eights,
Nines, Tens). By contrast, the class group that was related
to creative achievement in a negative direction had more
teacher-directed talk than the combined participation of
pupils in all categories of pupil talk and silence. Further
examination of summary data from the latter group revealed
that the frequency of directed pupil talk (Eights), exceeded
the total of frequencies of pupil-initiated talk and silence
(Nines and Tens).

From the results of the follow-up test of the sum of three measures of classroom interaction and the comparison of selected classroom groups, a problem solving pattern emerged. That is, the classroom groups that facilitated creative performance used pupil initiated ideas, and teacher ideas in support of pupil ideas, and time for individual work.

One additional note on the flexibility of some classrooms.

The two classrooms identified as groups related in a positive direction with creative performance were observed to use an average amount of drill (4,5,6 X 8), and pupil directed talk. Yet, a below average percentage of questions elicited an above average frequency of pupil initiated talk. These two teachers interacted in a different way with the use of pupil-initiated talk than they did with pupil directed talk. All together, the evidence suggested that in some classrooms there was a

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Conclusions

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variation in the quantity and quality of classroom interaction. The flexibility involved not just the teacher, but all classroom members. Whether the flexibility was the effect of good teaching or good teaching in effect was not clear. But the differences in the classroom and on measures of performance could be duly seen.

Conclusions

Four conclusions were supported by the findings reported earlier.

First, creative performance as measured in this study, can be consider a product of problem solving. The correlations between the problem solving tasks introduced in the study by multiple regression, simple correlational coefficients and factor analysis point to that conclusion. Additionally, pupils selected by total scores of creative performance averaged slightly higher on the problem solving tasks than the pupils selected on the basis of total scores of academic achievement.

Second, creative performance of pupils can be facilitated by the quality of the verbal classroom interaction. Three hypotheses relating three measures of classroom interaction with creative performance were not rejected. Pupil initiated ideas, constructive silence and teacher support of pupil ideas were found to be significant correlates of creative performance measures.

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Third, the promotion of creative performance does not detract from a support of academic achievement. The findings presented in the previous chapter demonstrated that the three measures of classroom interaction found to be significant correlates of creative performance were also significant correlates of academic achievement.

Fourth, the classroom that exhibits flexibility in the use of pupil initiated ideas, individual work, teacher support of pupil ideas and teacher influence, both direct and indirect with a minimum of criticism, will facilitate academic and creative performance.

Implications and Suggestions to Teacher Educators and Curriculum Specialists

1. Creativity Can Be a Planned Part of the Curriculum

The evidence presented in this study would suggest that

creativity, at least in some forms, may be considered a

product of problem solving that may be facilitated in the

classroom. This implies that creativity may be a planned part

of the curriculum, anticipated, sought and evaluated. The

teacher who plans to enhance creative performance should plan

and construct opportunities for children to sense, identify

and work with problems that afford the possibility of alterna
tive solutions. While it would be beyond reasonable expecta
tion to demand a novel solution from each child on every such

occasion, the evidence would suggest that the teacher can

reasonably anticipate that children in the classroom will be

Creative if opportunities are presented.

Further, solving activit the development himself with d: and expectation teacher pre-pla ance should be occur daily. H haps days, dur Since it is the the teacher nee with pupils dur sary facts and know when to in respond less to core to the der tion, therefore planned part of tunity is affor allow the teach changing requir

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Further, the teacher who wishes to facilitate problem solving activities for pupils, to afford opportunities for the development of the creativity of pupils, needs to provide himself with direction as to what to anticipate. Anticipation and expectations are contagious and so often the result of teacher pre-planning. It is doubtful that creative performance should be planned as a daily occurrence although it may occur daily. But the curriculum should include times, perhaps days, during which creativity is decidedly an objective. Since it is the child's creative performance that is sought. the teacher needs to include in the plans shared experiences with pupils during which problems are delineated, and necessary facts and information are obtained. Teachers need to know when to intervene and what children are to do as they respond less to the immediate direction of the teacher and more to the demands of the problem. The two-pronged implication, therefore, is that creative performance must be a planned part of the curriculum, not only to insure that opportunity is afforded the pupil to be creative, but also to allow the teacher to anticipate and share with pupils the changing requirements of creative problem solving.

2. Evaluation and the Creative Product

The evidence presented in the study would suggest that creativity may be considered a problem-solving performance of pupils as they attempt to meet the criteria implied in the problem. It is suspected that thematic forms of creativity, as

found in litera considered as therefore be de the requiremen that shared be members, can b tions. But ev to go beyond t tions. It aff contributions as a product c novel and acce selected probl 3. Object

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found in literature and the fine arts, may also at times be considered as a problem-solving performance. Creativity should therefore be defined in terms of pupil performance in meeting the requirements of some problem. Evaluation, particularly that shared between the pupil and teacher or other classroom members, can be used to assess the merits of alternative solutions. But evaluation of creativity affords the opportunity to go beyond the assessment of the merits of alternative solutions. It affords the opportunity to recognize the unique contributions of each individual classroom member. Creativity as a product can and should be evaluated for what it is: a novel and acceptable solution or alternative to a previously selected problem made by an individual or group.

3. Objectives and Classroom Interactions Patterns

The findings suggested that additional classroom interaction patterns are needed to facilitate creative performance. Educators should consider a multiplicity of classroom patterns to facilitate the diverse requirements of a broad band of objectives. As the objectives and expected pupil performances are expanded to include "open" and "restricted" as well as closed objectives the dominant classroom pattern of interaction must also change. Educators should be prepared to relate appropriate classroom interaction patterns to the cognitive requirements of the classroom objective. To do so, educators must look deeper, beyond the apparent atmosphere of warmth, friendliness and business-like organization of the classroom.

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basic skills r tion. It would The combined evidence of Soar, Hutchinson and the present

study suggest that "action speaks louder than words." In this instance, it is not enough to praise the contribution of the pupil. The idea is not seen to be accepted until it is used with the developing theme of the classroom. It is not sufficient to ask questions or in other ways solicit the ideas of pupils. Pupil exchanges must also be in evidence if teachers are to show they value the ideas of pupils. Finally, it is not enough to entertain the novel idea in the classroom. If ideas are to be tested and evaluated, different individual and small group activities must also take place from time to time. A warm supportive classroom climate appears to be a necessary but insufficient requisite in facilitating creative performance. Attention must also be directed to the cognitive processes by which children come to know.

 Creativity and Differences Between Classrooms and Individuals

While creative performance should be a part of the planned curriculum of the school, there seem to be differences in individual and classroom capacities for creativity. There may be differences between individuals and between classrooms in their tolerance for ambiguity and shifts in teacher control.

Educators should be prepared for the possibility that sufficient numbers of pupils in a classroom have adjustment needs or basic skills requirements that should receive immediate attention. It would be premature to impose an excessive load of

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sative performance expectations on pupils before a psychogically secure climate is established. It is recommended at the teacher tailor the problem-solving opportunities and sks to the emotional and intellectual capacities of pupils. tentative "hierarchy" of creative performance levels is fered as a possible guideline to teachers who would modify jectives according to the apparent capabilities of pupils.

Level One: To rearrange objects and/or ideas to different patterns, often requires a minimum of background information and time.

Level Two: To view and express reality in a different perspective, as in relating an event to a model, may require a moderate amount of time, study and intellectual understanding.

Level Three: To synthesize ideas to a new concept or model, may require the on and off efforts of an entire year's work. It may not even occur within the stated time limit.

Within each level problems could differ or be modified as

complexity, length of time and amount of requisite backpund information. By varying the time between periods of
dividual work and reinforcement, the immediacy of recalled
et and information, and the number of parameters to be jointly
asidered it should be possible to present problem situations
at conform to the emotional and intellectual capacities of
pils. Under these conditions creative problem-solving
tivities would be expected to be a supportive, rather than a
supptive, experience to the child.

 Classroom Interaction and Teacher Preparation Programs

Teacher preparation programs have traditionally emphasized

study would sure of the teacher pupils. Teach give the teach several cognit

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- 6. Limit Creat

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the teaching task of imparting facts. The evidence in this rudy would suggest that there are additional skills required the teacher to facilitate the creative performance of upils. Teacher preparation programs that would strive to the teacher the necessary tools to facilitate learning at everal cognitive levels can instruct the teacher to:

- Plan for problem-solving activities and anticipate creative performance.
- (2) Provide for individual work on the pupil's own problem.
- (3) Allow for small group activity and responsibility for production and evaluation of creative performance.
- (4) Recall the ideas of pupils and suggest the relevancy of pupils' ideas to a larger concept or problem at hand.
- (5) Offer pupils the opportunity to respond and elaborate on the ideas of others in the classroom.
- (6) Teach children to be aware of their own feelings so that they may be sensitive to the feelings of others.
- (7) Share responsibility for evaluating work compatible with the capabilities of pupils.
- (8) Provide practice in relating facts to different situations and using factual information as one basis in formulating alternatives.
- (9) Adjust to pupils so as to provide different levels of problem-solving objectives.
- Limitations in Teaching Skills and Knowledge of Creative Processes

The evidence presented in this study suggested that creativity can be and sometimes is demonstrably affected by several atterns of classroom interaction. But teachers in these classrooms did not take problem-solving for granted. Their curricula

included short vidual variation in modifying th with changing a what pupils nee provide the tim may possess the ways classroom tion. A prescr likely to frust Surthermore, th 30 as to allow direction that can be expected must be skille of the cogniti and adjustment to make little problem-solvin

Recommendation

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This investment interaction value tivity as a pro-

ided short and long term projects that permitted indial variation in problem and objective. Their flexibility bdifying the predominant classroom interaction pattern changing activities suggested they had a clear idea of pupils needed to be productive and were determined to ide the time and resources to that end. Not every teacher possess the requisite skills or come to understand the classroom activities may be related to creative produc-. A prescriptive approach to a creative process is quite ly to frustrate the creativity of many pupils and teachers. hermore, the teacher must be able to manage the classroom s to allow for individual work yet retain a focus and ction that pupils can clearly recognize. Not all teachers be expected to achieve this skill. The successful teacher be skilled in the management of communication, recognition he cognitive development of a problem and its solution, adjustment to the individual. These skills are likely ake little sense until they are related to manageable lem-solving activities of children and to creativity as a uct that is dependent upon the problem, how children come earn of a solution and the evaluation of the result.

mmendations for Further Research

This investigation of measures of creativity and classroom raction variables was predicated upon a construct of creaty as a problem solving activity. It is recommended that:

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- 1. A classroom verbal interaction measure of constructive valuation needs to be developed. This measure will likely equire a concurrent training program for teachers to insure ts use in the classroom. It is suspected that constructive valuation may be one purposive means of increasing teacher ecognition and acceptance of pupil feelings (Category One).
- 2. The present study was limited to patterns and freuencies of verbal interaction as observed in the classroom
 ithout any attempt to modify the patterns or frequencies.
 ased upon the results reported here and elsewhere, a study of
 hat teachers should, can and are willing to do to facilitate
 reative performance is needed. The problem of recognizing
 reative talent, as creative performance is facilitated, needs
 o be a part of the study.
- 3. Additional problem solving tasks should be developed to rovide a further test of the construct of multiple cognitive asks. The several cognitive skills and cognitive tasks inolved in sensing, identifying and organizing the elements of problem would probably provide the necessary variation in cognition to test one part of a construct of creative problemolving in detail.

roblems and Recommendations to the Classroom leacher

Attention needs to be focused on three questions that can Perhaps be best answered by the experienced classroom teacher.

 The first of these is the question of the identification of a creative performance. Considerable effort has been

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rended in the identification of the gifted creative indiidual. But the classroom teacher needs to recognize the
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ambers. Reliability coefficients of approximately 0.75 do not
ermit interpretation of scores to the individual student with
ponfidence. But the classroom teacher can be alert to incients of creative performance, particularly if anticipated.
t is possible that the combination of observations and test
core can serve to identify individual differences in creative
coility and performance.

- 2. Opportunities for children to extend factual information to applications in new or different situations are often argely dependent on teacher decisions. The classroom teacher an make a decided contribution, not only in the extension of the curriculum, but in the enhancement of the creative perparance of pupils. Creative problem-solving tasks can be evised by teachers for classroom use. These tasks would have a advantage over creative test items now found on the market ince they could be closely related to the classroom experince. Certain information could be assumed and required by the problems presented at the classroom level. Thus the eacher may be central to the development of creative pupil erformance in the school as a curricular experience.
- 3. Finally, the classroom teacher can try several ways of rganizing the classroom and its members for different learning ctivities. Creativity will probably require a teacher to be lexible in classroom management as well as in verbal interaction patterns. For example, the "when" and "how long" of

individual work present study for interaction and of each that co The classroom t topic, must dec with the establ This study that makes a di and in summary, ioing to furthe Creativity iome teachers, single process series of steps solving seems reative perfor the schools. [™] attempt to the skilled, e $^{\mathrm{objective}}$ may what works wit where there is and where the expectations g Solving tasks a flexible cla

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lividual work needs to be carefully examined. While the sent study found that a balance of individual work, pupil teraction and teacher coordination was desirable, the amount each that constitutes a balance has not been demonstrated. It classroom teacher, experienced with his pupils and the pic, must decide how to relate problem solving activities the the established curriculum.

This study began with observations of what teachers do at makes a difference in the creative performance of children. It in summary, it ends with what teachers may and perhaps are ing to further the creativity of their pupils.

Creativity as used here is not an educational panacea. me teachers, by temperament, may seek the simplicity of a ngle process of problem-solving. No single order, no fixed ries of steps nor even a uniform process for all problemlving seems likely to exist. In the judgment of some teachers, eative performance is not even an appropriate objective for e schools. It would seem inappropriate for these teachers, attempt to implement the findings of this study. But even e skilled, experienced teacher who accepts creativity as an jective may need to experiment on a small scale to determine at works with him and his particular group of children. But, ere there is warmth and humor, a business-like atmosphere, d where the teacher is willing to extend the curriculum, and pectations go beyond the information level; where problemlving tasks are part of the classroom experience; and where flexible classroom organization is employed, there a difrence should be found.

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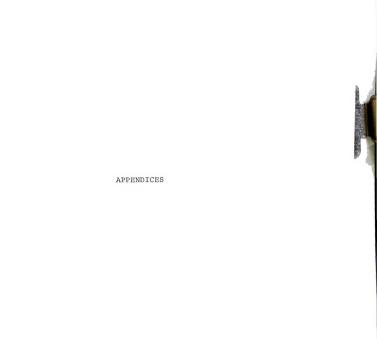
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APPENDIX A

SCORING PROTOCOLS FOR PROBLEM SOLVING TASKS 5, 6, 7

This pape obtaining scor Adequacy for T Test Your Imag

Fluency is defined task. A releve to the picture

Plexibility is the relevant r

Adequacy is decreased all of the

- Non-ar
 Non-gl
- 2. Non-gl
- 3. Not ar
- 4. Not resp. "Floods mais scored once
- 5. Not in showing cause. Is that the rother question, bility, but not the cloud droot the question last example in

The following the response:

tude given be

- 1. Relate 2. Indic
- 3. Indic
- capab 4. Refle

Occasion
Two categorie
Sested. The
Slexibility s
The tyet been
The asterisk (

On the f sponses illus for Adequacy. exhaustive. tinuity exist This paper briefly describes the scoring procedures in staining scores on measures of Fluency, Flexibility and dequacy for Tasks five, six and seven of the instrument, set Your Imagination.

luency is defined as the number of relevant responses to each ask. A relevant response must be related in some way either to the picture, conditions or events presented in each task.

lexibility is defined as the number of categories into which
he relevant responses are classified.

dequacy is defined as the number of relevant responses which eet all of the criteria listed below. Adequate responses are:

- 1. Non-anthropomorphic.
- Non-global. An example of a global question might be, Is the grass green?"
 - 3. Not answerable from the picture.
- Not repetitious in idea or approach to the problem,
 "Floods may wash out houses, crops, stores, trees, etc.,"
- s scored once for Adequacy.
- 5. Not in violation of an assumption of the scorer without howing cause. For example, one assumption made by the scorer s that the rope is identifiable as a rope or string. Thus, he question, "Is that a rope?" is scored for Fluency and Flexi-ility, but not for Adequacy. However, the question, "Why is he cloud drooling?" is scored for all three measures because he question indicates the rope is not perceived as such. The ast example may also serve to indicate the considerable latiude given before a question is considered anthropomorphic.

The following rule has been found constructive, stated in ositive terms. Arbitrate in favor of an Adequacy score when he response:

- 1. Relates objects, time and/or function.
- 2. Indicates a discrepancy is discerned.
- Indicates a question of potential function, purpose or capability.
- 4. Reflects more than "idle" curiosity.

Occasionally a response may be classified equally well into wo categories. More rarely, an additional category is sugested. The general rule in these cases is to maximize the lexibility score either by selecting that category which has ot yet been utilized, or, as in the second case, indicating by a sterisk (*) an additional category.

On the following pages are listed the categories with reponses illustrative of those receiving scores of zero and one or Adequacy. The lists of sample responses are by no means xhaustive. It would be well to point out here that a disconinuity exists between the sample responses. On a test, most

responses flow clues. The generally disce

esponses flow one from another providing important contextual lues. The general orientation and approach of the testee is lenerally discernible from context.

Assumptions: Cre

Category

1. Cream Puff and C.P. either as ject or a pers

inge, eyes, on top, rope,

Farm Buildings
Fence, content
silo, etc.
Not proximity

Farming
Type of farm,

i Nown Building

Cream Puff Task 5

sumptions: Cream Puff (C.P.) is a cloud. Droplets, rope and parts of a reseasinable but not reseaseavil

•	are recognizable,	but not necessa	iriry as	a rope,	eyes, a	JOI, etc.	
		Adequacy					
	Category	Zero	Point		One	Point	

Cream Puff and Contents C.P. either as an object or a personage.

What is it doing? What does it do? How old is it? Where does he live? How is it made?

Does it cry? Is it alive?

(Potential) Does he like people? Why does it have a face? Does it have tonsils? Where did it come from? How does it operate? Does it make noise? Is it smog? Is it safe to climb? Is it really a blanket

of smog? How large is this?

Cream Puff Parts

Hinge, eyes, door, rain What color are eyes? Do eyes operate? on top, rope, etc.

Why is mouth open? Why is mouth square? pulled?

Why is tooth being

Why is it raining on top? Will door open when rope is pulled?

Farm Buildings and Layout Fence, contents of barn, silo, etc. Not proximity to town.

Where is the farmhouse? Is the silo leaning? Is the hay spilling out? Who owns the farm? Why a fence if no animals?

Farming Type of farm, crops, etc .

What type of farming? Are cows in the barn? Does the farm need rain?

Town Buildings

Why are buildings striped? What are some of the buildings?

Are buildings substantial? Why are doors so small? What is in drugstore? Do people live in the other buildings? Where are the chimneys?

6. Community Structure Location, size to farm, absender, absender.

. Time and Cond

i. Children

3. Vegatation

Animal
Outside farm

Relationships C.P. with oth

nomenclature

 Community Structure Location, size, proximity to farm, absence of street, absence of people, etc.

Where are puddles? Where are other people? What is the name of the town? Why so close to the farm?

7. Time and Conditions

What season is it? Is it cold? Is it a pleasant day? What time of day is this? Where is the sun?

8. Children

Why are they standing there? Why are they there? What color is hair; dress? Are they talking to C.P.? Why do they have different clothes?

What are they looking at? Are they an official greeting party? What are their names? Why are arms dark; muddy; marked? How old? Are they related? Where are their coats? Will they pull the rope? What do they think of C.P.?

9. Vegatation

Why is the tree there? Why is the tree in the middle of the street? What kind of tree? Why aren't there leaves? Is that grass or snow on the ground?

10. Animal Outside farm context Did their dog run away? Are there horses they ride? Are animals hibernating?

11. Relationships
 C.P. with other features.

Why is C.P. caught in the tree?
Why is C.P. so low to the ground?
Is it clouding the sky?

12. Nomenclature

What is the artist's name?
Why isn't there any color?
Who made this silly picture?

1. Cream Puff

1. Flood
 Flood and eff
 (See also rul

i. Storm

Storm and ef

: Inconvenienc

Cream Puff Task 6

1. Cream Puff

He might fly away.
May rain cream.
May get mad; get bigger;
explode; disintegrate.
Anything may come out.

May come down.
May hit other cloud;
buildings.
May fill up with water.
May get large enough to
cover state.

Flood Flood and effects (See also rule 4.)

People, animals, trees, crops, houses, buildings roads, bridges, cars, clothing, belongings lost or destroyed. (Count once.) Get hurt.

Water polluted for drinking. Wells flooded. Lake formed. Evacuation, panic, stranded. Need to rebuild Money to rebuild Need for additional help. Power and communication failure. Schools close. (If a problem.) Dams break Breed mosquitos Survivors homeless; need a place to stay or live. Will have to relocate. Increase accidents

3. Storm Storm and effects (See also rule 4)

Lightning, thunder, hail, Start fires. snow, rain too hard, blow Freeze after raining. hurricane, tornado, wind. Rain all the time. (Count once.)

5. Inconvenience

Diapers wet.

Get wet; catch cold. Have to swim to get around. Muddy, foggy, colder. Have to use boat transportation. Overflow swimming pools. Can't go out to work; play. No sunlight.

6. Mechanical

. Control

i. Supply

in Distribution
Limited to the sovement and tion of water

Allocation
Distribution
due to diffe
at different
places.

i. Conservation

6. Mechanical

7. Control

8. Supply

- Distribution
 Limited to the physical
 movement and distribu tion of water.
- 10. Allocation Distribution problems due to different needs at different times and places.
- 11. Conservation

May not open; nothing happens. The rope may break. Rope may be too short. May rust.

Keep on raining (see also Flood) How to turn it off. People keep pulling the rope. May come in one big blob. May move too high; too low. May hurt or crush operator,

Too much, too little, May only sprinkle. May move or be moved away. May evaporate, disappear, vanish. May not obtain enough to live. May not come often enough.

How to move it around? Suppose it stays in one spot? How to move water (not C.P.) to city.

Different amounts needed elsewhere. Different for different seasons. Who is going to decide? Not needed here anymore, but sommewhere else.

Prevent wastate. Storage; dig holes. Erosion control.

2. Follution and

: Evaluation

Legislation

: Communication

E City Routine

. Vegetation

12. Pollution and quality

Rain may be poisoned

Will it be tasteless?
Will it be pure?

13. Evaluation

People will get mad; angry, People will get that operator. Crowds will form. Kids pulling rope will be punished. Committees will have to he formed.

14. Legislation

Need for new laws. Law enforcement regulating use.

15. Communication

No time for weather reports. No warning for flash floods. Have to tell everyone about schedule.

16. City Routine

Shopping decreased, Plumbers overtaxes. People unresponsive to world times. May have accidents with airplanes.

17. Vegetation

Plants flooded or washed Plants growing too tall; away (see Flood). too fast.

Plants growing too tall; too fast. Could have a jungle rainforest.

Inferred or of motorized transfer water.

The controllowater through
closed system

A Conservation Inferring the of the total quirements o or the city.

Sources of w than C.P., plants.

Water substi Revisions wh Water.

Cream Puff Task 7

- Transport
 Inferred or described
 motorized transportation
 of water.
- Pipe
 The controlled flow of
 water through open or
 closed systems.
- Conservation
 Inferring the minimizing of the total supply requirements of individuals or the city.

- 4. Additional Sources
 Sources of water other than C.P., wells and plants. (too general)
- Water substitutes Revisions which "replace" water.

Truck water to town.
Buy or borrow water
from farmer.
Have two houses.
Have a bucket brigade.
Use a plane (But not
for rain).

Pipelines, irrigation ditches, rivers and streams, and conveyor belt systems. Water pumps. Pipe in from Lakes Michigan or Huron or other lake source.

Rationing, self discipline. Suck stones. Refrain from running and exercise. Keep clean to eliminate baths. Eat a salt-free diet. Take washing to country. Eliminate watering qrass; plants.

Use melted snow, desalted ocean water, outof-state water, dew, mud, mountain snow, air moisture, radiator water. Run a lot of air conditioners.

Drink milk, pickle juice, pop, etc. Use chemical fire extinguishers. Use flour for fires. Have clothes dry cleaned instead of washed.

6. Substitutes
Revisions wh
need for wate

. Storage

: Wells

: Vegetation

... Chemical

... Re-evaluatio

Using C.P. a

Substitutes
 Revisions which reduce the
 need for water and/or rain.

Throw away clothes.
Use plastic dishes and clothes, synthetic grass.
Use perfume, lots of it.
Use gas instead of steam.

7. Storage

Freeze water for later use. Use dams, water towers, storage tanks, pools, excavations. Flood basement.

8. Wells

Use wells, springs, dig for water.

Vegetation Put plants in moist place.

Put plants in moist Grow cacti, place. Grow watermelons. Stop growing crops. Keep plants cool.

(too general)

10. Chemical

Combine H and O. Make a water factory.

ll. Re-evaluation

(See also Alter Problem) Revote; discuss problems. Call in scientists. Remove city limits zone. Quit as city manager.

12. Cream Puff Using C.P. as a machine.

Locate over a reservoir. Rent for emergency service.
Store water for appointments.
Build wall to retain C.P. Make more C.P.'s for distribution.
Make more for each farmer.
Make him smaller to keep

out of way.

]3. Cit

H. Alt

13. City Routine

Use washing machine.
Use fire hydrants.
Use city hountains.

Have a milk and water man. Stop smoking to reduce fire hazard. Use city water over and over. Stop using fireplace.

14. Alter Problem

Bring C.P. back.
Use C.P. on certain days.
Seed clouds.
Do a rain dance; pray.
Get rid of C.P.
Move out of city.
Move city.

esessari

Cate

Corn E C B.

: Corn

Corn Ball Task 5

Assumptions: Corn Ball (C.B.) is a machine. Chain, wheel, hose, switch, lights and buttons are recognizable, although their functions may not necessarily be understood.

Adequacy

Category

Zero Point

One Point

Why is C. B. there?

1. Corn Ball and Contents

C. B. either as an object or a personage, that?

Why is it shaped like

Is it alive? What is it? Why is it round? Does it think?

Why is it in the sky? Why is it turned off? What happens when it overheats? Does it compute? Does it have eyes, ears? Where will it go? Are there many C.B.'s? Does it make a noise? Why chained to stand; to ground? Does smoke come out? Is it for publicity? Is it a robot?

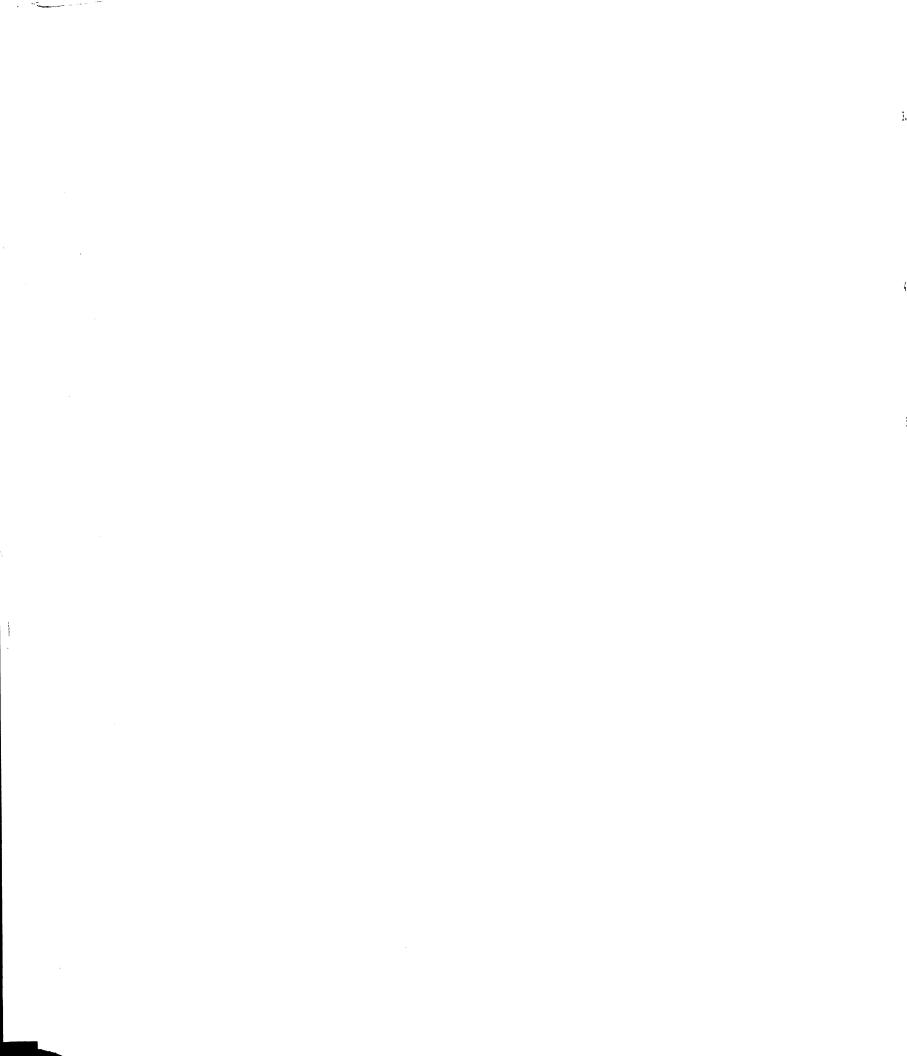
What is its rate of production? Did it drop that corn

on the ground?

2. Corn Ball Parts

What is that hanging down? What are buttons for? What are lights for? What is the steering wheel for? What is the smokestack for?

Where does corn come out? Why so many buttons? What is the hose used for? What is the wheel used for? What are eye-like parts for? What are those feathers for? Do parts operate together? Why is switch on "off"?



3. Farmer and Stand

Is that a man? What is he doing? Why is he there? Why is there a stand? Does the fence go all away around. Why is the farmer so tired? Is that a scarecrow? Does he sell much corn? Is he sleeping? Who is he; what is his name? Does he know that C.B.

is there?

Does farmer grow other crops? Where is his farm? Is there other farm machinery? Is the farm going out of business?

5. Town Houses

4. Farming

What is in the background? What are in those pails? Who lives in the houses? What is in the shed? Is this house typical?

6. Community Structure

Is this s town or part of country? Why aren't others around looking? Where is this; what is the name? Where does the path go?

7. Time and Conditions

Where is the sun?
What are they looking at?
What are their names?

8. Children

Why are children there? What color shirt has he? What kind of shoes are those?

Are they talking (not to C.B.)?

those? Why are they looking at

Why don't they run; or do something? Have they seen C.B.

Why are hands in pockets?

C.B.?

before?

9. Vegetation

Is that corn?

Why is the corn on the ground?
Is the corn good?
Why isn't corn picked that is still on the stalks?
Who is going to husk the corn?
Why is corn growing right

in the stand?

10. Animal

Where are farm animals? Do animals eat this corn?

11. Relationships C.B. with other features

Why is C.B. located over corn stand? What is the cost of the corn? Is C. B. in competition? Why is it in the middle of road? How does the man reach the switch?

12. Nomenclature

How did they draw this? Is this to be our imagination? What is this about? Who drew this?

l. Cor

2. Sur The sul

]. Mag

4. In

Corn Ball Task 6

1. Corn Ball

He might make popcorn He might make popcorn halls.

It might sell product.

Might fly away.

It might fall or crash. May damage buildings (once).

It might be stolen. Might blow corn away.

It might have a hard time picking corn. It might start a fire in

the cobs.

2. Surplus

The creation or result of a surplus

Eat fresh corn (general) May make too much. May rain corn.

May ruin houses (general) corn.

May have a house full of

Have to live with corn

all around.

Have to even sleep with

corn.

People may refuse to eat

corn. (See also Inconvenience)

3. Market

May not be able to sell corn.

May eliminate corn stands. May eliminate jobs.

Farmers will need to find

new jobs.

4. Inconvenience

People rushing to collect corn.

It will block traffic.

People may not like corn to begin with.

Will have to pick up all

that corn. Too much corn to peel and

shock.

Will have corn coming out

of our ears.

Will need a huge supply

of butter.

5. Mech

å. Con Reg

. Sup

i. Dis Lim pac tic

3. All Pro inq

: Co1

:2. Qu

il. St

5. Mechanical

It will go batty.

Chain may break.
May rush and stop production.
May be too noisy.
May blow one of those fuzes.
May overheat; catch fire.

6. Control

Regulation of C.B.

May not make enough. May keep on running. May drop corn all over. Will require an operator. The operator may fall out. May pull chain too hard to shut it off. How to pull chain without getting hurt. May bury people in corn.

7. Supply

Might not make enough. (Score 1 if reason given.)

May float away.
Will need different kinds
of corn.
The state may become

Distribution
 Limit to the physical
 packaging and distribution.

Need people to pack it. People to sort it. Have to pick and collect corn.

overpopulated.

 Allocation Problems with equalizing needs.

Who plans the amount needed?
How much to make at a time?

10. Conservation

May waste seeds. May waste corn.

11. Storage

Need room for storage.

12. Quality

Might not be as good.
Might be bad for people.
May get damp.
May have mold.
Might rot.
May be too small.
May drop corn on dirty
ground.
May overheat and make
popcorn.



13. Evaluation

Kill C. B.

People may try to stop or break C.B. People may fight and divide state.

14. Legislation

15. Health and Safety General health due to a diet of corn.

16. Animals

Some may not be able to digest corn. May overeat; get too fat. Die of overeating.

May eat too much corn.
May be overrun with
crows.
May be a shortage and
none for wildlife.

May eliminate effort; the will to work. People may be afraid of disaster. People rely too heavily on a machine.

17. City Routine

Corn Ball Task 7

1. Transport

Use C. B. to transport corn.

2. Market

Sell corn.

Buy corn (too general)

Give other foods to city people.

Farmers buy the city

corn.

Advertise C.B. corn. Increase the number

selling.

Have a corn festival.

3. Conservation

Use less corn (general).

4. Crops

Grow other crops. Change foods; eating

habits.

Grow small patches in

the city.

5. Food uses

Burn food.

Use food for corn bread.

Use the corn cobs. Use for seeds. Use for livestock.

Eat as much as possible.

6. Additional Uses

Additional uses for C.B. or for farmers other

crops.

7. Storage

Make dinners in the

country.

Have C.B. make more crops.

Send corn to starving

nations.

Set up a restaurant chain.

Store different foods. Have central storage

places.

8. Control and regulation

Stop making corn

Regulate production.

Use as a supplementary

source.

Use only during the inbetween seasons.

Have a Governors Commission. Grow less.

Country stop growing corn.

Grow just enough for the

family.

9. Quality

Change the taste, size. Use C.B. for better freshness.

10. Mechanical

Build a reserve supply of C.B.'s.

11. Evaluation

Evaluate needs and markets each week. Plan and weigh consequences before building or using C.B. Compromise with a system.

12. Corn Ball
Using C.B. as a machine Turn it off.

Take it apart for other uses. Have $C_{\circ}B_{\circ}$ bounce and rattle corn off.

13. City Routine

Have nutrition courses.

14. Alter Problem

Don't eat corn.
Move to the city.
Ship C.B. away.
Go live on the farm.
Give it away.
Get rid of it; destroy
it.
Take it apart.
Move to another place.

APPENDIX B

INSTRUCTIONS TO EXAMINERS

Directions to Test Administrators

The Test of Imagination consists of seven tasks:

Task I	Picture Completion	2 pages	10 minutes testing time
Task 2	Circles	2 pages	10 minutes plus short guiet rest break

Task 3 Product Improvement 2 pages 10 minutes

Task 4 Unusual Uses 2 pages 10 minutes plus a break for stretching

Task 5 Asking 1 page 5 minutes
Task 6 Seeing Problems 1 page 5 minutes

Task 7 Solving Problems 1 page 5 minutes

Every reasonable effort should be made to provide good testing conditions—comfortable room temperature, adequate lighting without glare, and a pleasant, calm, business—like psychological climate. Children should be given an opportunity, so far as is feasible, to arrange themselves for comfort and privacy.

Inform the teacher that the test today will utilize fiftyfive minutes of actual testing time with an additional twenty minutes required for instructions and short rest periods. Ask the teacher where she may be contacted and procedure for excusing a child during a break, should the need arise.

Explain to the class that the test today is a test of their imagination and ability to think of new ideas and new ways of doing things. Distribute the test booklets with the instructions to look at the drawing on the cover sheet, but to keep

their questions and comments to themselves, since this is a test of their own imagination and abilities to think of new ideas and ways of doing things.

Tell the class that they are going to fill out their name and the other blanks on the next page and then read the general directions.

Ask the children to read the general directions on page one to themselves and determine if there are any questions. Restate that this is a test in which there is an opportunity to think of new ideas and ways of doing things and is not, therefore, a usual test with one "right" or "wrong" answer. There may be many answers.

Turn to Task 1, Picture Completion, and read the directions silently to yourselves as I read them out loud.

Tell class to write "ten minutes" after the instructions:

write "turn to next page" at the bottom of the first page

write "stop" at the bottom of the second page
Any questions? Begin. Time each task carefully with a sweep
second watch or clock.

Task 2 Read directions with the class.

Note that there are two pages and ask the class to write "stop" at the bottom of the second page.

Time: 10 minutes

If a question arises whether to use more than one circle in a drawing, simply state that this is possible with a non-committal

tone of acceptance but lack of encouragement.

Let the children rest a minute after Task 2, but discourage discussion of test, perhaps by introducing a neutral topic.

Tasks 3 and 4 follow the same format. Ten minutes each. After Task 4 permit a standing break while the administrator passes the picture of Cream Puff face down on each desk. Simply inform children that this will be used once we begin again.

Tasks 5, 6, and 7 are five minutes each. Look at picture quietly for a few moments and then read directions while class reads silently with you. Write "stop" at bottom of page and begin. The picture may be used as often as the pupil wants for each of the Tasks 5, 6, and 7.

Collect the picture first and then the sheets. Send for teacher.

Directions to Test Administrators

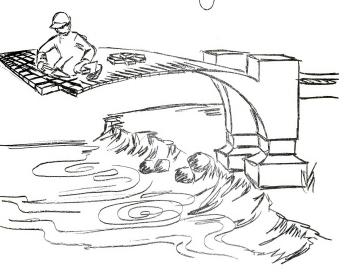
The alternate form of the Test Your Imagination consists of seven tasks:

Tasl	: 1	Picture Completion	2	pages	10	minutes testing time
Tas	2	Product Improvement	2	pages		minutes plus short stretch break
Task	3	Squares	2	pages	10	minutes
Tasl	4	Unusual Uses	2	pages	10	minutes plus a stand-up break
Tasl	5	Asking Questions	1	page	5	minutes
Tasl	6	Seeing Problems	1	page	5	minutes
Tasl	. 7	Solving Problems	1	page	5	minutes

It is important that we know that each child's attention has been directed toward both pages of the first four tasks. Therefore, each child should be asked to write, "Turn the page," at the bottom of the first page of Task 1, and the word "Stop," be written at the bottom of page two of Tasks 1, 3 and 4! Before the children begin writing their responses to Task 2 and 4, include the following ideas:

- 1. You may use more than one line when necessary.
- You do not need to write complete sentences--just enough to tell your ideas.
- Don't worry about so many lines, we just wanted to be sure everyone has enough.
- I can be of help to you with very hard words if you need me.

Test your imagination

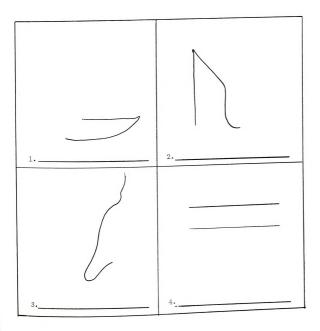


TEST YOUR IMAGINATION

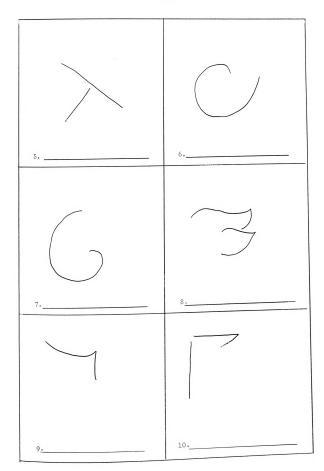
Name							
Date:// Ag	ge (last	birthday): 📙	10 11	12 13	Birth (Mont	date:
	umber of					-	
The tasks in imagination in the are no "right" on think of as many ing, and clever	ninking u r "wrong" ideas as	p ideas answers you can	and putt in the . Try t	ing them usual se o think	into wo nse. We of unusu	rds. Th want yo al, inte	ere u to rest-
You will be one, so make good rushing. If you instructions are	d use of . run out	your tim of ideas	e. Work before	as rapi time is	dly as y called,	ou can w	ithout
Do not pay a	ny atten page unt	tion to il told	the rest to do so	of this	page, b	ut do no	t
******	******	*****	*****	****	****	*****	*****
Scoring Category	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7
Fluency							
Flexibility							
Originality							
Elaboration							
Adequacy							
****		.eeeeee.	*****	*****	*****	******	*****

TASK 1: PICTURE COMPLETION

By adding lines to the incomplete figures on this and the next page, you can sketch some interesting objects or pictures. Again, try to think of some picture or object that no one else will think of. Try to make it tell as complete and as interesting a story as you can by adding to and building up your first idea. Make up an interesting title for each of your drawings and write it at the bottom of each block next to the number of the figure.

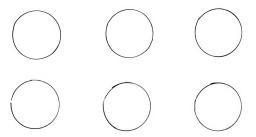


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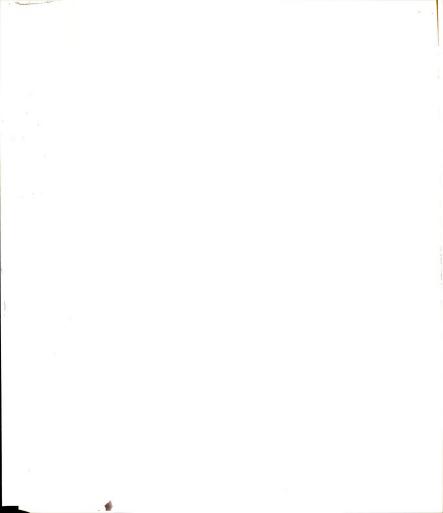


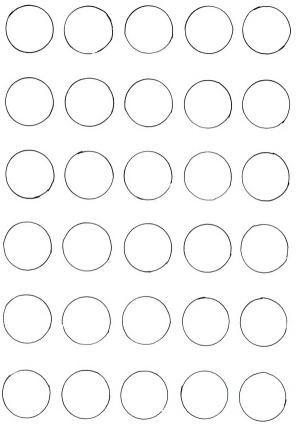
TASK 2: CIRCLES

In ten minutes see how many objects or pictures you can make from the circles below and on the next page. The circles should be the main part of whatever you make. With pencil add lines to the circles to complete your picture. You can place marks inside the circles, outside the circles, or both inside and outside the circles -- wherever you want to in order to make your picture. Try to think of things that no one else will think of. Make as many different pictures or objects as you can in each one. Make them tell as complete and as interesting a story as you can. Add names or titles below the object.



Turn to the next page.





TASK 3: PRODUCT IMPROVEMENT

In the middle of this page is a sketch of a stuffed toy elephant of the kind you can buy in most dime stores for a half dollar to a dollar. It is about six inches tall and weighs about a pound. In the spaces on this page and the next one,list the cleverest, most interesting and unusual ways you can think of for changing this toy elephant so that children will have more fun playing with it. Do not worry about the cost of the changes. Think only about what would make it more fun to play with as a toy.



Turn to the next page.

6.	
7.	
20.	
20	

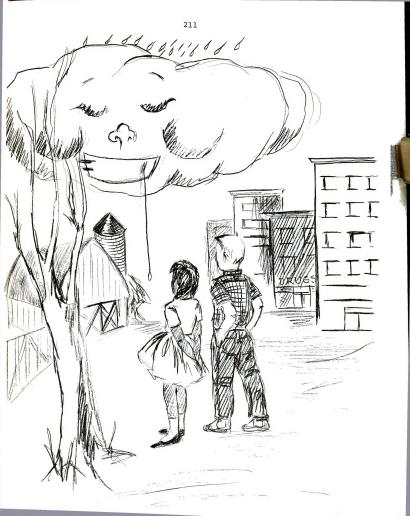
TASK 4: UNUSUAL USES (Cardboard Boxes)

Most people throw their empty cardboard boxes away, but they have thousands of interesting and unusual uses. In the spaces below and on the next page, list as many interesting and unusual uses as you can think of. Do not limit yourself to any one size of box. You may use as many boxes as you like. Do not limit yourself to the uses you have seen or heard about; think about as many possible new uses as you can.

1.	
	-
	_
24.	

25.		
26		
50.		





TASK 5

ASKING -- On this page, write all the questions you can think of about the drawing of Cream Puff. Ask all the questions you would need to ask to know for sure what is happening. Do not ask questions which can be answered just by looking at the drawing. You may look at the drawing of Cream Puff as much as you wish.

1.	
5.	
6.	
7.	
8.	
16.	

Seeing Problems -- Suppose that it rains when Cream Puff's rope is pulled, and suppose that all the water in this whole state comes from Cream Puff. List on the lines below, all the problems you can, that you think might possibly take place when Cream Puff's rope is pulled.

1.	
6.	
7.	
8.	
9.	
10.	
11.	

TASK 7

SOLVING PROBLEMS -- Suppose that people in cities decide not to use Cream Puff, and people on farms decide to use Cream Puff for their crops. As a result, it now rains in the country, but never rains in the cities. People in the cities need water for drinking, washing clothes, watering trees and grass, to fight fires and for many other reasons. List, on the lines below, as many suggestions as you can for solving some of the problems of living in a city in which it never rains. Be sure your suggestions are fair and practical.

1.	
2.	
3.	
8.	
9.	
10.	
11.	
12.	
13.	
15.	
16.	

APPENDIC C

REFERENCED DATA

 $\label{eq:table A-1} \mbox{RESULTS OF INTERSCORER RELIABILITY CHECK FORM A}$ (N=25)

					SECOND TRIAL Aver. Score	RELIABILITY COEFFICIENT, (r
Task	1	Fluency Non-verbal	8.	0	8.2	.93
Task	1	Flexibility Non-verbal	6.	8	6.7	.93
Task	1	Originality Non-verbal	9.	1	9.2	.91
ľask	1	Elaboration Non-verbal	15.	7	18.5	.93
ľask	2	Fluency Non-verbal	12.		12.3	.99
ľask			7.		7.8	.94
ask	2	Originality Non-verbal	9.	6	9.0	.94
ask	2	Elaboration Non-verbal	28.	3	29.5	.94
ask	3	Fluency Verbal	14.	7	14.4	.99
ask	3		6.	1	6.3	.93
ask	3	Originality Verbal	13.	Э	13.0	.99
'ask	3	Elaboration Verbal	1.	3	1.6	.93
ask	4	Fluency Verbal	21.		21.6	.99
ask	4	Flexibility Verbal	7.	6	7.7	.89
ask	4	Originality Verbal	14.	3	14.4	.97
ask	4	Elaboration Verbal	0.	5	1.2	.66
ask	5	Fluency Problem Solving	9.	5	10.1	.97
ask	5	Flexibility Problem Solving	4.	5	4.8	.72
ask	5	Adequacy Problem Solving	6.	4	6.3	.96
ask	6	Fluency Problem Solving	8.	5	8.9	.98
ask	6	Flexibility Problem Solving			3.2	.90
ask	6	Adequacy Problem Solving	4.	4	4,3	.93
ask	7	Fluency Problem Solving	5.	7	5.6	.98
ask	7	Flexibility Problem Solving	4.	1	4.1	.95
ask	7	Adequacy Problem Solving	4.	1	4.4	.95

			Form A Aver. Score	FORM B Aver. Score	RELIABILITY COEFFICIENT, (r
Task	1 1	luency Non-verbal	8.5	9.2	0.40
Task	1 1	Plexibility Non-verbal	7.1	7.5	0.26
Task	1 (Originality Non-verbal	9.3	9.1	0.31
Task	1 1	Elaboration Non-verbal	19.5	14.9	0.57
Task	2 1	Fluency Non-verbal	13.0	11.8	0.39
Task	2 1	Plexibility Non-verbal	8.1	9.0	0.44
Task	2 (Originality Non-verbal	9.5	8.4	0.37
rask	2 1	Elaboration Non-verbal	29.2	16.2	0.45
Task	3 1	luency Verbal	13.9	16.9	0.56
ľask	3 1	lexibility Verbal	6.0	5.6	0.40
Task	3 (riginality Verbal	11.9	7.4	0.42
Task	3 1	Elaboration Verbal	1.3	0.5	0.21
Task	4 1	luency Verbal	19.3	16.3	0.50
Task	-	Plexibility Verbal	6.9	6.7	0.41
rask		Originality Verbal	12.3	14.0	0.39
ľask		Claboration Verbal	1.3	0.5	0.17
Task	5 1	luency Problem Solving	7.8	8.6	0.49
ľask		Plexibility Problem Solving	4.0	3.8	0.32
Task		Adequacy Problem Solving	5.2	6.2	0.39
rask.	6 1	Pluency Problem Solving	7.0	5.9	0.40
Task		Plexibility Problem Solving	2.7	3.9	0.21
Task		dequacy Problem Solving	3.5	4.4	0.38
Task		Pluency Problem Solving	4.4	3.5	0.46
rask	7 1	Plexibility Problem Solving	3.0	2.6	0.36
Task		Adequacy Problem Solving	3.1	2.3	0.37
Task			36.7	37.6	0.47
		2 Originality Non-verbal	18.8	17.5	0.44
rask			55.5	55.2	0.49
rask			48.7	31.0	0.63
		4 Flux Verbal	46.3	45.7	0.61
			22.5	19.8	0.48
ľask ľask			68.8	65.5	0.57
Task	-		29.2	28.9	0.57
				13.3	0.52
rask rask				42.2	0.57
LUSK	510	, IIODICM COLVING CO.	219.9	198.0	0.68

TABLE A-3

PRINCIPAL FACTOR LOADINGS FROM A VERIMAX ROTATION OF 50 PRIMARY VARIABLES OF FORMS A AND B

TEST YOUR IMAGINATION
(2 FACTORS)

TASK	FACTOR 1 LOADINGS*	TASK	FACTOR 2
Flue 1A	30	Flue 1B	39
Flex 1A		Flex 1B	35
Orig 1A	28	Orig 1B	41
Elab 1A	34	Elab 1B	41
Flue 2A	61	Flue 2B	63
Flex 2A	59	Flex 2B	60
Orig 2A	61	Orig 2B	66
Elab 2A	42	Elab 2B	42
Flue 3A	64	Flue 3B	71
Flex 3A	52	Flex 3B	56
Orig 3A	45	Orig 3B	58
Elab 3A		Elab 3B	
Flue 4A	68	Flue 4B	68
Flex 4A	64	Flex 4B	61
Orig 4A	52	Orig 4B	53
Elab 4A		Elab 4B	
Flue 5A	77	Flue 5B	72
Flex 5A	56	Flex 5B	51
Orig 5A	69	Orig 5B	62
Flue 6A	77	Flue 6B	69
Flex 6A	68	Flex 6B	47
Orig 6A	72	Orig 6B	58
Flue 7A	72	Flue 7B	65
Flue /A Flex 7A	66	Flex 7B	60
Flex /A Orig 7A	65	Orig 7B	58

^{*}Decimal omitted.

FACTOR LOADINGS FROM A VERIMAX ROTATION OF 50 PRIMARY VARIABLES OF FORMS A AND B TEST YOUR IMAGINATION (6 FACTORS) * TABLE A-4

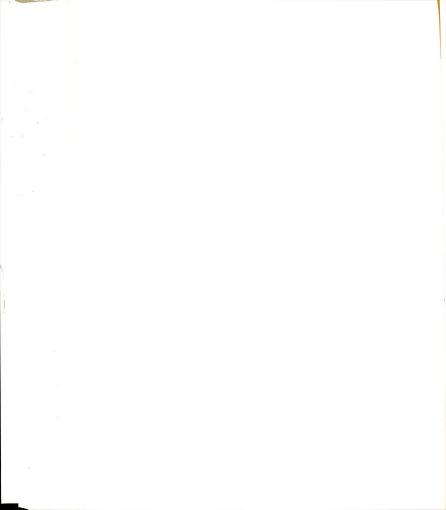
Pactor Loadings Pactor Loadings Piex A Pi	ngs	Factor 2	Factor 3	1000		
		Loadings	Loadings	Loadings	Factor 5 Loadings	Factor 6
		(FORM B)	(NV FORM B)	(ELAB A)	(NV FORM A)	(Fragings
						(g gung)
					71	
					28	
					52	
				26		
					29	
					58	
					54	
				69		
	_					
Elab 3A						
				46		
Flex 4A 62						
Elab 4A				;		
Flue 5A				44		
Orig 5A 69						
Flue 6A 79						
Flex 6A 74						
Orig 6A 77						
Flue 7A 74						
Flex 7A 69				32		
Orig 7A 66				31		

*Decimal omitted.

continued

TABLE A-4--continued

	Factor 1 Loadings (FORM A)	Factor 2 Loadings (FORM B)	Factor 3 Loadings	Factor 4 Loadings	Factor 5 Loadings	Factor 6 Loadings
Flue 1B Flex 1B Orig 1B Elab 1B			77 74 66	(ELAB A)	(TASK 1 A)	(ELAB B)
Flue 2B Flex 2B Orig 2B Elab 2B		36 40 39	61 52 51			58 34 46
Flue 3B Flex 3B Orig 3B Elab 3B		72 58 57				70
Flue 4B Flex 4B Orig 4B Elab 4B		64 57 50				43
Flue 5B Flex 5B Orig 5B Flue 6B		72 51 62 71				41
Flex 6B Orig 6B Flue 7B Flex 7B		54 63 72				
Orig /B		69				



SUMMARY STATISTICS AND DISTRIBUTIONS FOR TRANSFORMED MEASURES OF CREATIVE PERFORMANCE TABLE A-5

continued

TABLE A-5--continued

NON-VERBAL ORIGINALITY

NV ORIG A	A Median: 18.3	18.3	Range:	2-48	NV ORIG B	Median: 1/02	7,07	kange: 0-24
	Mean: 18.78	18.78	S.D.:	7.2		Mean:	17.5	S.D.: 7.0
z	Interval	f,	% f	e & f	Interval	f	% H 'd	ε % f.
-2	0.4.5	7	6.0	6.0	0-3.5	4	0.5	0.5
-1	5-11.5	110	14.3	15.2	3.5-10.5	121	15.7	16.2
0	12-18.5	277	36.0	51.2	10.5-17.5	271	35.3	51.5
+	19-26.5	273	35.6	86.8	17.5-24.5	267	34.7	86.2
+2	27-33.5	81	10.6	97.4	24.5-31.5	82	10.7	6°96
۳ +	34-40.5	18	2.3	7.96	31.5-38.5	20	2.6	99.5
+4	41-48.5	м	4.0	100.0	38.5-45.5	ю	0.4	6°66
+5					45.5+	ч	0.1	100.0
Total		769	100.0			492	100.0	
								continued

TABLE A-5--continued

VERBAL FLUX

VB FLUX A	Median: 43.1	43.1	Range: 0-109	0-109	VB FLUX B	Median:	41.0	Range: 0-122
	Mean: 45.4	15.4	S,D,: 19,4	19.4		Mean:	44.75	S.D.: 21.3
23	Interval	f,	% H		Interval	f.	.⊢ ₩	e % L
-2	0-6.5	4	0.5	0.5	0-2.5	Ф	1.0	1.0
ī	7-26.5	115	15.0	15.5	02-22.5	94	12.5	13.5
0	27-45.5	316	41.0	56.5	23.4-44.75	327	42.5	56.0
+1	46-65.5	211	27.4	83.9	45-65,5	204	26.6	82.6
+2	66-84.5	91	11.8	95.7	66-86.5	101	13,2	95.8
۳ +	85-104.5	29	3.8	5.66	87-107.5	29	3,8	9*66
+4	104+	ю	0.4	6*66	107+	4	0.5	100.1
Total		692	6.66			767	100.1	
								continued

TABLE A-5--continued

VERBAL ORIGINALITY

VB ORIG A		Median: 18.1	Range:	Range: 0-94	VB ORIG B	Median	Median: 14.7	Range: 0-123	0-123
	Mean: 22.0	22.0	S.D.: 15.8	15.8		Mean: 19.3	19,3	S.D.: 18.0	0.8
2	Interval	f,	æ £	.5 % ± 1.	Interval	.t	% H '-1	€ % f.	
7	0-6.5	96	12.5	12.5	0-1.5	23	3.0	3.0	
0	7-22.0	380	49.5	61.9	2-19.5	474	61.6	64.6	
+	23-38.0	187	24.3	86.2	20-37.5	177	23.0	87.6	
+	39-54,5	89	80	95.0	38-55,5	54	7.0	94.6	
+3	55-70.5	27	3,5	98.5	56-73.5	26	3.4	98°0	
+4	71-85.5	σ	1.2	7°66	74-91.5	80	1.0	0°66	

continued

694

100.0

692

Total

9.66

0.6

S

92-109.5

100,0

0.3

2

85-94.5

+5

TABLE A-5--continued

				PROBLEM SOLVING FLUX	VING FLUX			
OB SOL	PROB SOLV FLUX A Medi	Median: 27.4	Range:	: 0-68	PROB SOLV FLUX B		Median: 26.3	Range: 0-75
	Mean:	n: 27.8	S.D.	S.D.: 10,75		Me	Mean: 27.5	S.D.: 12
23	Interval	, rt	% f ₁	e » f ₁	Interval	f	% £1.	э ж Н
-2	0-6.25	7	6.0	6.0	0-3,5	12	1.6	1.6
7	6.25-16.0	106	13.8	14.7	4-15.5	96	12.5	14.1
0	17.0-28.5	312	40.7	55.4	16-27.5	312	40.6	54.7
7	29-39,5	233	30.4	85.8	28-41.5	257	33.4	88.1
+2	40-49.5	85	11.1	6.96	42-53.5	71	9.2	97.3
+3	49.5-60.5	22	2.9	8°66	54-65.5	18	2.3	9°66
+4	61-71.5	4	0.5	100,3	66-77.5	e	0.4	100.0
Total		169	100.3			492	100.0	
								continued

continued

TABLE A-5--continued

PROBLEM SOLVING ADEQUACY

ADEQ A	Median: 11.9	11.9	Range: 0-28	0-28	ADEQ B	Median: 11.8	11.8	Range: 0-40
	Mean: 11.3	.3	S.D.: 5.16	5.16		Mean: 1.	12.5	S.D.: 6.646
Z	Interval	£	% F.	с % f.	Interval	f,	% H	8 F.
-2	0-1.5	е	0.4	0.4				
-1	1.5-6.5	134	17.4	17.8	0-5.5	102	13,3	13.3
0	7-11.5	287	37.4	55.2	5.5-12.5	317	41.2	54.5
+1	12-16.5	234	30.5	85.7	13-19.5	236	30.7	85,2
+2	17-21.5	80	10.4	96.1	20-26.5	87	11.3	96.5
+	22-27.5	59	3.8	6.66	27-32.5	23	3.0	5.66
+4	28+	2	0.3	100.2	33-39.5	е	0.4	6.66
+2					40+	1	0.1	100.0
Total		769	100.02			769	100.0	

TABLE A-5--continued

EXPECTED FREQUENCIES BASED ON NORMAL DISTRIBUTION PROBABILITIES

CUMULATIVE FREQUENCIES (n x p)	61	17	122	384	646	751	768	769
EXPECTED FREQUENCIES n x p	61	1.7	105	262	262	105	17	-
NORMAL DISTRIBUTION P	.001	.022	.136	.341	.341	.136	.022	
STANDARD SCORE interval	-4 to -3	-3 to -2	-2 to -1	-1 to 0	0 to 1	1 to 2	2 to 3	

TABLE A-6
PEARSON CORRELATIONS OF SCORES OF CREATIVITY*
FORM A AND B
(N = 700-769)**

	FLUX	ORIG	SUB TOTAL	ELABORATION
	NV A	NV A	NV A	NV A
FLUX NA A	1.00			
ORIG NV A	.70	1.00		
SUB TOTAL NV A	.94	.89	1.00	
ELAB NV A	.34	.48	.43	1.00
FLUX VB A	.48	.47	.51	.30
ORIG VB A	.35	.42	.41	.28
SUB TOTAL VB A	.45	.48	.50	.32
FLUX PS A	.38	.41	.42	.32
ADEQ PS A	.34	.36	.37	.33
SUB TOTAL PS A	.38	.41	.42	.34
TOTAL I A	.66	.67	.71	.41
PS 5 A	.38	.40	.42	.28
PS 6 A	.33	.34	.36	.26
PS 7 A	.22	.27	.26	.26
MAT A	.11	.22	.17	.25
FLUX NV B	.46	.36	.46	.28
ORIG NV B	.41	.44	.46	.29
SUB TOTAL NV B	.48	.43	.49	.31
ELAB NV B	.19	.30	.26	.63
FLUX VB A	.33	.33	.35	.23
ORIG VB B	.20	.27	.25	.20
SUB TOTAL VB B	.29	.32	.33	.24
FLUX PS B	.24	.27	.27	.30
ADEO PS B	.17	.23	.21	.30
SUB TOTAL B	.22	.27	.26	.30
PS 5 B	.23	.26	.26	.28
PS 6 B	.16	.22	.20	.26
S 7 B	.12	.16	.15	.20
TOTAL B	.38	.40	.42	.32
MAT B	.09	.20	.15	.24

*A Correlation 0.07 has a .05 probability of chance occurrence.
A Correlation of 0.09 has a .01 probability of occurring by chance.

**Missing data routine.

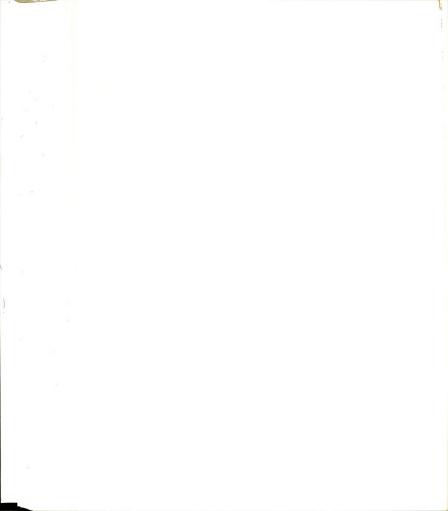


TABLE A-6--continued

	FLUX	ORIG	SUB TOTAL	FLUX	ADEQ	SUB TOTAL
	VB A	VB A	VB A	PS A	PS A	Α
FLUX VB A	1.00					
ORIG VB A	.76	1.00				
SUB TOTAL VB A	.51	.92	1.00			
FLUX PS A	.67	.52	.64	1.00		
ADEQ PS A	. 56	.46	. 55	,84	1.00	
SUB TOTAL A	.66	.52	.64	.98	.92	1.00
TOTAL I A	.91	.83	.93	.79	.71	.79
PS 5 A	.59	.44	.56	.80	.74	.81
PS 6 A	.56	.43	. 54	.82	.73	.82
PS 7 A	.47	.41	.47	.76	.76	.79
MAT A	.28	.27	.30	.41	.46	.44
FLUX NV B	.41	.31	. 39	.39	.39	.41
ORIG NV B	.37	.34	. 38	.39	,39	.40
SUB TOTAL NV B	.42	.35	.42	.42	,42	.44
ELAB NV B	.25	.23	. 26	.31	.36	.34
FLUX VB B	.62	.51	.61	.52	.47	.52
ORIG VB B	.41	.48	.47	.34	.30	.34
SUB TOTAL VB B	.56	.53	,58	.47	.43	.48
FLUX PS B	.48	.41	.48	.59	.59	.61
ADEO PS B	.40	.35	.40	.50	.55	.53
SUB TOTAL PS B	.47	.40	.47	.57	.59	.60
TOTAL I B	.62	. 55	.63	.60	.57	.61
5 B	.41	.33	.40	.51	.52	.53
6 B	.41	.37	.42	.48	.50	.50
7 B	.30	.28	.31	.43	.45	.45
MAT B	.27	. 28	.40	.40	.45	.42

TABLE-A-6--continued

	TOTAL 1 A	PS 5 A	PS 6 A	PS 7 A	MAT A	FLUX NV E
TOTAL 1 A	1.00					
PS 5 A	.69	1.00				
PS 6 A	,66	.53	1.00			
PS 7 A	.59	.42	.52	1.00		
MAT A	.36	.34	.31	.36	1.00	
FLUX NV B	.49	.38	.33	.29	.22	1.00
ORIG NV B	.48	.35	.33	.30	.32	.70
SUB TOTAL NV B	.53	.40	. 36	.32	.28	.95
ELAB NV B	.33	.28	.27	.27	.34	.37
FLUX VB B	.62	.43	.44	.44	.26	.47
ORIG VB B	.46	.28	.28	.32	.21	.28
SUB TOTAL VB B	.59	.39	.40	.42	.26	.41
FLUX PS B	.55	.49	.49	.50	.43	.46
ADEQ PS B	.46	.42	.41	.43	.47	.39
SUB TOTAL PS B	.53	.48	.46	.49	.46	.44
TOTAL I B	.68	.51	,50	.51	.39	.66
PS 5 B	.47	.49	.39	.40	.39	.43
PS 6 B	.46	.37	.42	.42	.38	.35
PS 7 B	.36	.30	.34	.44	.35	.31
MAT B	.35	.33	.29	.32	.93	.24

TABLE A-6--continued

	ORIG NV B	SUB TOTAL NV B	ELAB NV B	FLUX VB B	ORIG VB B	SUB TOTAL
ORIG NV B	1.00					
SUB TOTAL NV B	.89	1.00				
ELAB NV B	.36	.40	1.00			
FLUX VB B	.42	.49	.27	1.00		
ORIG VB B	.31	.32	.20	.76	1.00	
SUB TOTAL VB B	.39	.44	.25	.95	.93	1.00
FLUX PS B	.40	.47	.36	.62	.42	.56
ADEQ PS B	.37	.41	.37	.50	.32	.45
SUB TOTAL PS B	.40	.46	.37	.59	.39	.53
TOTAL I B	.62	.70	.39	.91	.79	.91
PS 5 B	.35	.43	.32	.54	.33	.47
PS 6 B	.34	.37	.32	.51	.35	.46
PS 7 B	.29	.33	.26	.42	.30	.39
MAT B	.32	.29	.34	.27	.22	.27



TABLE A-6--continued

	FLUX PS B	ADEQ PS B	SUB TOTAL PS B	TOTAL I B	PS 5B	PS 6B	PS 7B	MAT B
FLUX PS B	1.00							
ADEQ PS B	.90	1.00						
SUB TOTAL PS B	.99	.96	1.00					
TOTAL I B	.79	.69	.77	1.00				
PS 5 B	.86	.85	.88	.69	1.00			
PS 6 B	.87	.84	.88	.67	.63	1.00		
PS 7 B	.77	.73	.77	.58	.51	.60	1.00	
MAT B	.45	.48	.48	.41	.39	.39	.38	1.00

TABLE A-7

CORRELATIONAL VALUES BETWEEN SUB-TOTAL SCORES OF NON-VERBAL, VERBAL AND PROBLEM SOLVING MEASURES FROM THE BATTERY TEST YOUR IMAGINATION

FORM A

	Non-Verbal (NV)	Verbal (VA)	Problem Solving (PS)
Non-Verbal (NV)	1.0	. 50	.42
Verbal (VB)	.50	1.0	.64
Problem Solving	(PS) .42	. 64	1.0

FORM B

1.0	.44	.46
.44	1,0	.53
.46	.53	1.0

TABLE A-8

ANALYSIS OF VARIANCE BY CLASSROOM GROUPS
A SUMMARY OF SCORES FROM THE TEST BATTERY, TEST YOUR IMAGINATION

TASK	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F STATISTIC	SIGNIFI- CANCE
FLUX NVA		FOR	4 A		
BETWEEN	11967.73	29	412.68	4.57	0.00
WITHIN	66742.10	739	90.31	4.37	0.00
TOTAL	78709.83	768	50.31		
TOTAL	78709.83	766			
ORIG NVA					
BETWEEN	5500.08	29	189,66	4.13	0.00
WITHIN	33951.22	739	45.94		
TOTAL	39451.30	768			
SUB-TOTAL N	IVA				
BETWEEN	30421.38	29	1049.01	4,67	0.00
WITHIN	166106.85	739	224.77		
TOTAL	196528.24	768			
ELAB NVA					
BETWEEN	27118.20	29	935.11	2.36	0.00
WITHIN	292845.17	739	396.27		
TOTAL	319963.38	768			
FLUX VBA					
BETWEEN	88580.21	29	3054.49	11.16	0.00
WITHIN	202241,12	739	273.67		
TOTAL	290821.33	768			
ORIG VBA					
BETWEEN	36996.74	29	1275.75	6.10	0.00
WITHIN	154553.24	739	209.14		
TOTAL	191550.00	768			
SUB-TOTAL V	'BA				0.00
BETWEEN	223131.53	29	7694.19	9.19	0.00
WITHIN	618810.12	739	837.36		
TOTAL	841941.65	768			
FLUX PSA				100.42	0.00
BETWEEN	25610.69	29	883.13	10.34	0.00
WITHIN	63134.83	739	85.43		
TOTAL	88745.52	768			

TABLE A-8--continued

TASK	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F STATISTIC	SIGNIFI- CANCE
ADEQ PSA					
BETWEEN	4873.78	29	168.06	7.99	0.00
WITHIN	15540.11	739	21.03		
TOTAL	20413.88	768			
SUB-TOTAL 1	PSA				
BETWEEN	51240.40	29	1766.91	10.08	0.00
WITHIN	129565.52	739	175.33		
TOTAL	180805.92	768			
TOTAL I A					
BETWEEN	652812.23	29	22510.77	10.17	0.00
WITHIN	1635031.03	739	2212.49		
TOTAL	2287843.26				
		FOR	м в		
FLUX NVB					
BETWEEN	11565.35	29	398.81	4.53	0.00
WITHIN	65062.88	739	88.04		
TOTAL	76628.24	768			
ORIG NVB				202120	
BETWEEN	4854.97	29	167.41	3.81	0.00
WITHIN	32481.28	739	43.95		
TOTAL	37336.25	768			
SUB-TOTAL I	NVB		- 100 m Ma		0.00
BETWEEN	28530.16	29	983.80	4.54	0.00
WITHIN	160284.73	739	216.89		
TOTAL	188814.88	768			
ELAB NVB			00	3.68	0.00
BETWEEN	21283.76	29	733.92	3.08	0.00
WITHIN	147301.23	739	199.33		
TOTAL	168584.99	768			
FLUX VBB			0070 50	8.38	0.00
BETWEEN	86379.00	29	2978.59	0.30	0.00
WITHIN	262568.05	739	355.30		
TOTAL	348947.06	768			
ORIG VBB			3507.34	5.86	0.00
BETWEEN	46322.94	29	1597.34	5.00	0.00
WITHIN	201463.05	739	272.62		
TOTAL	247785.99	768			continued

TABLE A-8--continued

TASK	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F STATISTIC	SIGNIFI- CANCE
SUB-TOTAL '	VBB				
BETWEEN	244581.69	29	8433.85	7.78	0.00
WITHIN	800739.89	739	1083.55		
TOTAL	1045321.58	768			
FLUX PSB					
BETWEEN	32888.76	29	1134.10	10.86	0.00
WITHIN	77170.94	739	104.43		
TOTAL	110059.70	768			
ADEO PSB					
BETWEEN	8929.76	29	307.92	9.10	0.00
WITHIN	24994.21	739	33.82		
TOTAL	33923.98	768			
SUB-TOTAL 1	PSB				
BETWEEN	75049.80	29	2587.92	10.65	0.00
WITHIN	179640.16	739	243.09		
TOTAL	254689.95	768			
TOTAL I B					
BETWEEN	759339.73	29	26184,13	10.12	0.00
WITHIN	1911653.66	739	2586.81		
TOTAL	2670993.39	768			

TABLE A-9

DISTRIBUTIONS* OF THE TOTAL SCORE OF CREATIVITY AND PROBLEM SOLVING OF SIXTH GRADE PUPILS BY CLASSROOM GROUPS

CLASSROOM	TOTAL CLASS	FRE	QUEN	CIES	PERC	ENTAGES BY	
NUMBER	FREQUENCY, N	BY	ROW		1	2	3
1	29	3	22	4	10.3	75.9	13.8
2	26	2	16	8	7.7	61.5	30.8
3	23	4	12	7	17.4	52.2	30.4
4	24	6	16	2	25.0	66.7	8.3
5	24	4	11	9	16.7	45.8	37.5
6	29	6	14	9	20.7	48.3	31.0
7	25	5	15	5	20.0	60.0	20.0
8	27	1	10	16	3.7	37.0	59.3
9	26	4	16	6	15.4	61.5	23.1
10	31	4	16	11	12.9	51.6	35.5
11	26	5	15	6	19.2	57.7	23.1
12	23	3	14	6	13.0	60.9	26.1
13	31	11	18	2	35.5	58.1	6.5
14	29	2	14	13	6.9	48.3	44.8
15	33	3	13	17	9.1	39.4	51.5
16	28	15	13	0	53.6	46.4	0.0
17	27	5	18	4	18.5	66.7	14.8
18	23	10	11	2	43.5	47.8	8.7
19	21	6	9	6	28.6	42.9	28.6
20	18	3	10	5	16.7	55.6	27.8
21	28	8	14	6	28.6	50.0	21.4
22	19	0	6	13	0.0	31.6	68.4
23	18	0	5	13	0.0	27.8	72.2
24	22	10	11	1	45.5	50.0	4.5
25	27	1	19	7	3.7	70.4	25.9
26	27	1	18	8	3.7	66.7	29.6
27	30	3	17	10	10.0	56.7	33.3
28	22	10	12	0	45.5	54.5	0.0
29	24	4	14	6	16.7	58.3	25.0
30	29	11	17	1	37.9	58.6	3.4
TOTAL	769	150	416	203			

*Column 1 is about 2/3 of a standard deviation above the median; Column 3 is about 2/3 of a deviation below the median.

CORRELATIONS FORM A WITH CLASSROOM INTERACTION VARIABLES AND CORRELATIONS CLASSROOM INTERACTION VARIABLES WITH FORM B* TABLE A-10

Contraction of the Person Street and Street or other Designation of the Person of the	Carried Street, or other Designation of the last of th	-	-	MACHINE MICHELLAND CHICAGO	Management and department	Manager and Publishment	-		-							
INTERACTION	FLUX NVA	NVA p.	ORIG NVA	NVA P.	TOTAL NVA	NVA P.	ELAB r.	1A P.	FLUX VBA	VBA P.	ORIG VBA	VBA P·	TOTAL VBA	. VBA	FLUX PSA	PSA P.
4 5 6	1	003	1	004	12	.002		-							90	0
<	4 1	0 0		L			- 07	90	20	.000512 .00217 .0005	12	002 -	.17 .0		18 .0005	9000
5 X S	14	,0005	100-	.05	12	TOO.	0.									
9 X 9			90	9			07	• 05								
; ;			90	0			07	- 90°	12	.001	-,12	000	-,12 ,002 -,13 ,001	100		
					;	100									-,07 .04	04
TI	-,14	0000.			11.	* 000°					0.0		000		90	œ
TD							- 07	. 00.	01	. /00.	000)	,
damwao	71 -	.0005	09	.01	15	.0005	07	90*	20	. 0000	11	.004	17 .	.0005	20 .0005	0002
CENTER															.08	.03
TENS														000	4	2000
α > α	.15	.0005	+.10	.008	.14	0000	.07	o	.18	.0005	.08 .04	0.4	.14 .0003	9000	· CT ·	2000
															. 07	.05
8,9,10 x 9															- 07	Ф
SMALL I	60°-	600°			07	90*	+.07	e e							2	,
2									90	0	08	.032	08 .03207 .04	04		
SMALL D							-	000			07	0.5				
TI RATIO	09	.01					07.	.000				3				
10 RATIO	13	.001	07	.04	11	.002					.08 .04	.04				
PD RATIO	12	.001	07	0	11	.004			90	ø					11 .002	002
DT RATTO			.10	.008	+.07	90°	,10	600.	.28	.0005	.23	.0005	.23 .0005 .28 .0005	9000	.16	.16 .0005
DE LA CA	15	50005	.10	.007	.14	.0005	.08	.04	.19	.0005	10. 60.	.01	.16 .0005	9000	.16	.16.0005
PD MESH									.10	,005	.11	.003	.11	.002	.11	.002
PI MESH																
SMALL ID	08	3 .03					80.	.03								
*The symbol @ indicates calculated probabilities .06 $\leq p \leq$.10.	@ indic	cates ca	lculate	ed prob	abiliti	90. səl	∨I □ ∨I	.10.						8	continued	ø

continued

TABLE A-10--continued

	ADEQ PSA		SUB-TO	SUB-TOTAL PSA	TOTAL 1A	114	MATA		FLUX NVB	NVB	ORIG NVB	NVB	TOTAL NVB	NVB	ELAB	NB VB
VARIABLE	r.	ъ.	r.	ď.	r.	ь.	H	d		·d		i.	;	·	1	
4 X 4	60	.01	07	.001	07	.03										
5 X 5	12	.001	16	.0005	17	.0005			14 .	14 .000509		.02	.0213 .001	100		
9 x 9							09	.01							08 .02	2
7 x 7					60	.02	23	.0005			08	.02				
TI							.19	.0005							.13 .001	01
TD	09	.01	07	.04	60	.02	23	.0005								
CENTER	15	.0005	.000519	.0005	19	.0005			14 .0005	.0005						
TENS	.08	.01	.08	.02					.15	.15 .0005						
8 X 8	.13	.0005	.15	.0005	.16	.0005										23
8,9,10 X 9	.08	.02	.08	.03			.22	.0005								,
SMALL I	05		07	9			.14	.0005								
SMALL D	06	0					25	.0005								
TI RATIO							.26	.0005								
10 RATIO							.19	.0005								
PD RATIO			10	.007	60	.01	.20	.0005								
PI RATIO	.19	.0005	5 .18	.0005	.20	.0005	.27	.0005								
PD MESH	.14	.0005	5 .16	.0005	.17	.0005										
PI MESH	.14	.0005	5 .13	.001	.11	.004	.31	.0005								
SMALL ID							.25	.0005								

TABLE A-10--continued

INTERACTION	FLUX r.	VBB P·	ORIG r.	VBB P.	rotal VBB	VBB P.	r. P.		ADEÇ PSB r. P.	PSB P.	r. p.	PSB P.	r.	L 1B	r.	م م
4 X 4																
5 X 5	16	.0005			-,11	.003	-,10 .007		07 .06		. 60	.01	600. 60	600°		
9 X 9																
7 X 7	07	.04	-,08 ,03	.03	-,08 ,02	0.02	12 .	- 100.	11	.002	12	.001	60°-	800°	-,26	-,26 ,0005
TI			10. 60.	.01					.07	0.05		9	60'	.02	.25	.25 .0005
TD	10	000°	11	.003	-,11	11 .002	15	- 5000°	16 .0005		-,16	00000	13	13 ,0005	-,24	-,24 ,0005
CENTER	.17	.0005			-,12	12 .001	-,11	.002	- 08	.03	-,10	*0000	11	,004		
TENS	+,10	.003	0.08	,04	.10	900*	.13	.001	.11	.004	.12	.001	13	.0005		
80 80	13	.0005			0.08	.02	80.	.03			.07	.04				
9 × 01.9.8	11	000	.14	.14 .0005	.13	.13 ,0005	.11	.003	,12	.001	.12	.002	.15	.0005	,24	.24 .0005
															.19	.0005
SMALL I	20	G	0	007	- 09	.02	-,13	13 .000514 .000514	-,14	.0005	-,14	.0005	11	.003	-, 28	-,28 ,0005
SMALL D	î	ט	2 6	.00	000		=	.003	13	.001	.12	.002	.13	.005	,31	.0005
TI			. T.	TOO . 71.						5000		2000	4	0005	24	.0005
10 RATIO	.10	.01	.14	.0005	.13	.00T	· T3	TOO.			. H				1 1	0 0
PD RATIO			.07	0			90.	e e	90.	ø	90.	0			. 26	.0005
PI RATIO	.18	.0005	14	,0005	.17	.17 .0005	.22	.0005	.19	.0005	.22	.0005	.17	.0005	.31	.0005
PD MESH	.15	.0005	10		.10	.10 .007	.10	° 005	.08	.03	.10	600°	90°	9		
PI MESH	.14	0000°	. 18	.0005	.17	,0005	.17	,0005	.17	,0005	.17	.0005		.19 .0005	.36	36 .0005
SMALT. ID			90°	0			.07	90° 20°	.09	.02	.07	.04	.08	.08 .02	.30	.30 .0005

TABLE A-11

COMPARISONS OF SCORES BY SEX OF MEAN SCORES OF CREATIVE PERFORMANCE (691 = N)

.56 (N.S.) SIGNIFICANCE .0005 .0005 .0005 .0005 .02 .02 Sub-total Averages 57.35 33,18 67.07 20,19 GIRL Task Mean Scores 18,96 6.77 18.11 Sub-total Averages 16.22 52,84 28.82 61.01 BOY Task Mean Scores 19.73 5,36 16.92 SUB-TOTAL VB SUB-TOTAL NV ADEQ ASKING ORIG VB ORIG NV ELAB

SNOTHILL COLUMN	19.44	73.3T	
			.0005
and be	11.01		
ADEX : 5	20 10	44.10	.0005
SUB-TOTAL PS	33.00		1000
OHUE S DIEG IEMON	47.66	51.04	5000.
TOTAL CALC & MICK		201.70	.0005
TOTAL SCORE	1/8.33	1	
The state of the s			

.0005

23.91

7.20

19.44

5.65

SUB-TOTAL ASKING ADEQ SOLUTIONS

.0005

TABLE A-12

DEFINITIONS OF INTERACTION VARIABLES AND SAMPLE CALCULATIONS TAKEN FROM THE 10 X 10 MATRIX OF TEACHER ONE

MATRIX COLUMN SUB-TOTALS 3 30 54 428 2220 251 85 908 843 680 5994 TOTAL TALLIES 5994

1. TI - 1,2,3 X 1,2,3 = 111 = 0.0185 2. 1 X 4 = 0 = 0.0

3. 2,3 X 4 = 71 = 0.0118

4. $4 \times 2,3 = 9 = 0.0015$

5. 4 X 4 = 70 = 0.01167

6. 1.2.3 X 5 = 198 = 0.0330

7. 5 \times 1,2,3 = 17 = 0.0028

7. 5 K 1/2/5 1/ 010020

8. $4 \times 5 = 201 = 0.0335$

 $9.5 \times 5 = 1559 = 0.26$

10. 1,2,3 \times 6 = 29 = 0.0048

11. $4,5 \times 6 = 150 = 0.025$

12. 6 \times 6 = 79 = 0.013

13. 1,2,3 X 7 = 4 = 0.00066

 $14.4,5,6 \times 7 = 42 = 0.007$

15. $7 \times 7 = 24 = 0.004$

16. 1,2,3 X 8 = 186 = 0.031

 $17. \ 4,5 \ X \ 8 = 399 = 0.0665$

 $18.6 \times 8 = 26 = 0.0043$

19. 7 X 8 = 4 = 0.000667

 $20.8 \times 8 = 580 = 0.0967$

21. 1,2,3 X 9 = 390 = 0.065

22, 4 X 9 = 81 = 0,0135

23. 5 X 9 = 369 = 0.0615

24. 6 X 9 = 37 = 0.00617

25. 7 X 9 = 31 = 0.00517

26. 8,9 X 9 = 358 = 0.06

27. 1,2,3 X 10 = 32 = 0.0053

28. 4,5 x 10 = 308 = 0.0513

29. 6 X 10 = 93 = 0.0155

30. $7 \times 10 = 41 = 0.0068$

 $31.8 \times 10 = 32 = 0.0053$

32. 9 \times 10 = 71 = 0.0118

33. 10 \times 10 = 392 = 0.065

34. I = 579 = 0.0965

35. D = 336 = 0.056

36. I/D = I/I+D = 0.63

TABLE A-13

100 CELLS OF A 10 X 10 INTERACTION ANALYSIS MATRIX AND VARIABLES
BY AREA AND REFERENCE NUMBER*

	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4 (2)	5	6	7	8	9	10
2	11 (1)	12	13	14 (3)	15 (6)	16 (10)	17 (13)	18 (16)	19 (21)	20 (27)
3	21	22	23	24	25	26	27	28	29	30
4	31 (2)	32 (4)	33	34 (5)	35 (8)	36 (11)	37	38 (17)	39 (22)	40 (28)
5	41 (7)		43	44 (8)	45 (9)	46	47 (14)	48	49 (23)	50
6	51	52 I (10)	53	54 (1	55 1)	56 (12)	57	58 (18)	59 (24)	60 (29)
7	61	62 (13)	63	64 (1	65	66	67 (15)	68 (19)	69 (25)	70 (30)
8	71	72 (16)		74	75 7)	76 (18)	77 (19)	78 (20)	79 	80 (31)
9	81	82 (21)	83	84 (22)	85 (23)	86 (24)	87 (25)	88		90 (32)
10	91		93	94	95 (28)	96 (29)	97 (30)	98 (31)	99 (32)	100 (33)

^{*}The number in parenthesis is the interaction variable number used in Table A-12.

TABLE A-14

COMPARISON OF CLASSROOM INTERACTION VARIABLES BY PARTIAL CORRELATION COEFFICIENTS AND SIGNIFICANCE LEVEL*
DEPENDENT VARIABLE: MAT

CLASSROOM INTERACTION VARIABLE	р	Partial r
PDM N.S.	.920	0.0
PIM	0.0005	0.16
10-R	0.0005	0.17
IDEAS (DBQI)	0.064	0.067
TIPI	0.0005	0.18
I	0.0005	0.14
D	-0.001	-0.12
I/D	0.0005	0.16

^{*}Covariates: Mat A, Age, Sex, Intercepts: High, Middle, Low academic ability.

APPENDIX D

BASIC NON-REFERENCED DATA

TABLE A-15

SUMMARY STATISTICS OF MEASURES OF CREATIVE PERFORMANCE AND CLASSROOM INTERACTION VARIABLES

FLUX NVA 36.6 1064356. 10.2 76112. 26 ORIG NVA 18.7 295843. 7.14 37532. 43 ORIG NVA 18.7 295843. 7.14 37532. 43 ELAB NVA 48.5 2044376. 16.0 188734. .33 ELAB NVA 48.5 204325. 20.4 30.56. .43 FLUX PSA 21.9 537492. 15.8 18373. .43 ORIG VBA 21.9 537492. 15.8 183373. .14 ADEQ PSA 11.3 112861 5.12 19312. .43 ADEQ PSA 11.3 112861 5.12 19312. .44 ADEQ PSA 11.3 112861 5.12 19312. .44 ADEQ PSA 11.3 112861 5.12 19312. .44 ADEQ PSA 11.3 112861 5.12 17068. .43 ADEQ PSA 11.2 12.2 17068. .43 <t< th=""><th>NAME</th><th>MEAN</th><th>SUM OF SQUARES</th><th>STANDARD DEVIATION</th><th>SUM OF SQUARED DEVIATIONS FROM THE MEAN</th><th>SKEWNESS</th><th>KURTOSIS</th></t<>	NAME	MEAN	SUM OF SQUARES	STANDARD DEVIATION	SUM OF SQUARED DEVIATIONS FROM THE MEAN	SKEWNESS	KURTOSIS
NVA 18.7 295843. 7.14 37532. L NV 55.3 2445761. 16.0 188734. NVA 48.5 2445761. 16.0 188734. NVA 48.5 2445761. 16.0 188734. NVB 45.4 1801229 20.4 37656. VBA 21.9 537492. 15.8 18373. L VB 67.3 4149597. 33.0 804442. L VB 67.3 112861 5.12 19312. L PS 39.1 12961 5.12 19312. L PS 39.1 12982. 10.0 83556. L PS 39.1 10.0 73899.	FLUX NVA	9	4356	•	611		3,1
L NV 55.3 2445761. 16.0 188734. NVA 48.5 2049925 20.4 307576. NVBA 48.5 2049925 20.4 307576. VBA 45.4 1801229 19.4 278658. VBA 21.9 537492. 15.8 183373. L NB 67.3 4149597. 33.0 804342. PSA 27.8 655169. 10.6 83556. PSA 11.3 112861 5.12 19312. L PS 39.1 12297820 10.6 83556. L PS 39.1 12297820 10.0 73889. L A 40.9 1912812. 10.0 75744. A 500348. 30.1 66408. 1. A .0180 .303 .00931 .05744. A .000345 .00048 .00349 .0399 A .0164 .236 .00048 .00349 A	ORIG NVA	œ	584	r-I	53		•
NVA 48.5 2043925 20.4 307576. VBA 45.4 1801229 19.4 278658. VBA 21.9 53492. 15.8 183373. 1 L VB 67.3 4149597. 33.0 804342. 1 E SA 27.8 655169. 10.6 83556. 1 PSA 11.3 112861 5.12 19312. 1 L PS 39.1 1297820 15.2 170168. 1 L PSA 132 1257820 10.0 73989. L PS 39.1 10.0 73989. L A 50.3 1932920. 9.64 68509. 3 170.1 22567642. 30.1 705744. 4 .0180 .00031 .00031 .0034 .0039 23 .0164 .00048 .00048 .00039 .00039 A .0164 .0206	TOTAL NV	5.	576	9	188734.		3.5
VBA 45.4 1801229 19.4 278658. VBA 21.9 537492. 15.8 183373. 1 VBA 21.9 537492. 15.8 183373. 1 PSA 21.9 4149597. 33.0 804342. 1 PSA 11.3 112861 5.12 19312. 1 PSA 11.3 12861 5.2 10.6 83556. 1 PSA 11.3 12861 5.2 10.6 83556. 1 PSA 11.3 12861 10.6 83556. 1 L PS 39.1 10.0 73899. - A 50.3 1932920. 9.64 68509. - A 50.3 1932920. 9.64 68509. - 3 170.5 22126048. 30.1 666408. - 4 .0180 .00231 .00344 .00349 .00349 3 .0164 .02	ELAB NVA	œ	392	0	307576.		•
VBA 21.9 537492. 15.8 183373. 1 L VB 67.3 4149597. 33.0 804342. 1 PSA 27.8 655169. 10.6 83556. . PSA 11.3 112861 5.12 19312. . L PS 39.1 1297820 16.2 170168. . L PS 49.9 1912812. 10.0 73989. . L PS 192 10.0 73989. . L PS 1922. 10.0 705744. . A 50.3 1932920. 964 668509. . A 50.1 22567642. 30.1 666408. . A .0180 .00031 .00044 .00044 .00044 .00044 .00044 A .0148 .00170 .00072 .00039 . . X .0164 .326 .0074 .00039 . . <th< td=""><td></td><td>٥</td><td>122</td><td>о О</td><td>278658.</td><td></td><td>٥</td></th<>		٥	122	о О	278658.		٥
L VB 67.3 4149597. 33.0 804342. PSA 27.8 655169. 10.6 83556. PSA 11.3 112861 5.12 19312. L PS 39.1 12861 15.2 170168. L A 49.9 1912812. 10.0 73899. L A 50.3 1932920. 9.64 68509. 2 172.1 22567642. 30.9 705744. 3 170.5 22126048. 30.1 6664080639 4 .0180 .00033 .00044 .00014 1. 4 .0148 .192 .00044 .00039 23 .00134 .00170 .00072 .00039 24 .0164 .236 .00072 .00039 25 .0036 .339 .00598 .00638 26 .034 .925 .0117 .101 1. 2 .0025 .00387 .00387 2 .0025 .00387 .00387 2 .0025 .00387 .00387 2 .0025 .00387 .00387 2 .0025 .00387 .00387 2 .0025 .00387 .00387 2 .0025 .00387 .00387 2 .0025 .00387 .00387 2 .0025 .00387 .00387 2 .0025 .00387 .00387 2 .0025 .00387 .00387 2 .0025 .00387 .00387 2 .0025 .00387 .00387 2 .00220 .00387 .00387 2 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00387 .00387 .00387 2 .00220 .00220 .00387 .00387 2 .00220 .00220 .00220 .00220 .00220 .00220 .00220 .00220 .00220 .00220 .00220 .00220 .0022	ORIG VBA	٠	3749	Ŋ,	183373.	٥	5.1
PSA 27.8 655169. 10.6 83556. PSA 11.3 112861 5.12 19312. L PS 39.1 1297820 15.2 170168. L A 49.9 1912812. 10.0 73989. L A 49.9 1912812. 10.0 73989. A 50.3 1932920. 9.64 68509. A 50.3 1932920. 30.9 705744. 3 170.5 22126048. 30.9 705744. 4 .0180 .00023 .0094 .0039 . 4 .0148 .192 .00648 .00014 .00014 .00014 .00014 .00039 . X 4 .0164 .236 .00701 .00648 .0060 1. X 5 .0206 .335 .00046 .0060 .0060 1. X 5 .0206 .339 .00598 .0060 .0060 . X 6 .0045		•	1495	ë.	04	∞	٠
PSA 11.3 112861 5.12 19312. L PS 39.1 1297820 15.2 170168. L A 49.9 1912812. 10.0 73989. L A 50.3 1932920. 9.64 68509. 2 172.1 22567642. 30.9 705744. 3 170.5 22126048. 30.1 666408. 4 .0180 .303 .00931 .0639 . 4 .0148 .192 .00648 .0309 . 4 .0148 .192 .00648 .0309 . 5 .0164 .236 .00701 .0363 . A .0191 .335 .00946 .0660 1. A .0206 .339 .00229 .00387 . 5 .034 .0767 4.34 . 6 .0223 .00912 .0614 . 1 .0223 .0622 .0614<	FLUX PSA	7,	5516	o	\sim		v
L PS 39.1 1297820 15.2 170168. L A 49.9 1912812. 10.0 73989. L A 50.3 1932920. 9.64 68509. 2 172.1 22567642. 30.9 705744. 3 170.5 22126048. 30.1 666408. 123 .0180 .303 .00031 .0639 4 .0148 .192 .00044 .00014 .192 2 .00134 .00170 .00072 .00039 2 .00134 .0164 .236 .00701 .0363 2 .0206 .339 .00598 .0263 2 .0334 .925 .0117 .101 2 .00455 .0189 .00220 .00357 2 .0223 .428 .00912 .00357 3 .00357 .00387 .10357 .101 3 .00358 .00359 .00359 3 .00358 .00359 .00359 .00359 3 .00358 .00359 .00598 .00598 .00563	ADEQ PSA	۲.	1286		19312.	. 46	3.1
L A 49.9 1912812. 10.0 73989. A 50.3 1932920. 9.64 68509. 2 172.1 22567642. 30.9 705744. 3 170.5 22126048. 30.1 666408. 4 .0180 .00023 .00044 .0039 .1 4 .0148 .192 .00648 .0309 23 .00134 .00170 .00072 .00039 4 .0164 .236 .00701 .0363 4 .0164 .335 .00946 .0660 1. 4 .0164 .335 .00598 .0263 5 .0206 .339 .00598 .0263 5 .0334 .925 .0117 4.34 5 .0253 .00220 .00387 6 .0223 .00220 4.34 <	_	9	29782	5.	170168.	.40	٠
A 50.3 1932920. 9.64 68509.		٥	91281	0	\sim	,25	2.8
2 172.1 22567642. 30.9 705744. 3 170.5 22126048. 30.1 666408. 123 .0180 .303 .0033 .0639 4 .00148 .00023 .00044 .00309 4 .0148 .00170 .00072 .00039 23 .00170 .00072 .0363 3 .0164 .236 .00701 .0363 4 .0191 .335 .00598 .0263 1. 5 .0206 .339 .00598 .0263 1. 5 .0334 .925 .0117 .101 1. 5 .00455 .0189 .00220 1.00357 . 6 .0223 .428 .00912 1.00357 .	MAT A	0	93292		.68509.	۰	•
3 170.5 22126048. 30.1 666408.		72.	56764	٠	705744.	26	2.5
123 .0180 .303 .00931 .0639 . 4 .000345 .00023 .00044 .00014 1. 4 .0148 .192 .00648 .0309 . 23 .00134 .00170 .00072 .00039 . 23 .0154 .236 .00701 .0363 . 4 .0191 .335 .00946 .0660 . 5 .0206 .339 .00598 .0263 . 123 .00376 .0143 .00229 .00387 . 5 .179 .27.94 .0767 4.34 . 6 .0223 .0189 .00220 1.00357 . 6 .0223 .00912 .0614 1.		70.	212604	30.1	666408.	•	•
x 4 .000345 .00023 .00044 .00014 1. x 4 .0148 .192 .00648 .0309 . x 23 .00134 .00170 .00072 .00039 . 3 x 4 .0164 .236 .00701 .0363 . x 4 .0191 .335 .00946 .0660 1. 3 x 5 .0206 .339 .00598 .0263 . x 123 .00376 .0143 .0029 .00387 . x 5 .0334 .925 .0117 4.34 . x 5 .00455 .0189 .00220 1.00357 . x 6 .0223 .0223 .0614 .	\sim	018	.303	.00931	.0639	99.	3.6
x 4 .0148 .192 .00648 .0309 x 23 .00134 .00170 .00072 .00039 3 x 4 .0164 .236 .00701 .0363 . x 4 .0191 .335 .00946 .0660 1. 3 x 5 .0206 .339 .00598 .0263 . x 123 .00376 .0143 .00229 .00387 . x 5 .0334 .925 .0117 4.34 . x 5 .00455 .0189 .00220 1.00357 . x 6 .0223 .428 .00912 .0614 1.	×	34	.00023	.00044	.00014	1.2	•
x 23 .00134 .00170 .00072 .00039 3 x 4 .0164 .236 .00701 .0363 . x 4 .0191 .335 .00946 .0660 1. 3 x 5 .0206 .339 .00598 .0263 . x 123 .00376 .0143 .00229 .00387 . x 5 .0334 .925 .0117 .101 1. x 5 .179 .27.94 .0767 4.34 . x 6 .00223 .008220 .00357 . x 6 .0223 .428 .00912 .0614 .	×	.0148	.192	.00648	6080.	.54	2.9
23 X 4 .0164 .236 .00701 .0363 . X 4 .0191 .335 .00946 .0660 1. 23 X 5 .0206 .339 .00598 .0263 . X 123 .00376 .0143 .00229 .00387 . X 5 .0334 .925 .0117 .101 1. X 5 .179 .27.94 .0767 4.34 . 23 X 6 .00455 .0189 .00220 1.00357 . 5 X 6 .0223 .428 .00912 .0614 1.	×	13	7	.00072	68000.	.82	4.3
x 4 .0191 .335 .00946 .0660 1.0660 23 x 5 .0206 .339 .00598 .0263 . x 123 .00376 .0143 .00229 .00387 . x 5 .0334 .925 .0117 .101 1. x 5 .179 .27.94 .0767 4.34 . 23 x 6 .00455 .0189 .00220 1.00357 . 5 x 6 .0223 .428 .00912 .0614 1.	23 X	.0164	.236	.00701	.0363	.51	•
23 x 5 .0206 .339 .00598 .0263 . x 123 .00376 .0143 .00229 .00387 . x 5 .0334 .925 .0117 .101 1. x 5 .179 27.94 .0767 4.34 . 23 x 6 .00455 .0189 .00220 1.00357 . 5 x 6 .0223 .428 .00912 .0614 1.		.0191	\sim	.00946	0990.	•	4.0
x 123 .00376 .0143 .00229 .00387 . x 5 .0334 .925 .0117 .101 1. x 5 .179 27.94 .0767 4.34 . 23 x 6 .00455 .0189 .00220 1.00357 . 5 x 6 .0223 .428 .00912 .0614 1.	23 X	.0206	33	.00598	.0263	.14	2.3
x 5 .0334 .925 .0117 .101 1. x 5 .179 27.94 .0767 4.34 . 23 x 6 .00455 .0189 .00220 1.00357 . 5 x 6 .0223 .428 .00912 .0614 1.	X 12	.00376	014	.00229		.10	1.7
x 5 .179 27.94 .0767 4.34 . 23 X 6 .0189 .00220 1.00357 . 5 X 6 .0223 .428 .00912 .0614 1.	×	.0334	92	.0117	.101	•	3.9
23 x 6 .00455 .0189 .00220 1.00357 . 5 x 6 .0223 .428 .00912 .0614 1.	×	.179	7.9	.0767	•	.49	2.9
5 X 6 .0223 .428 .00912 .0614 l.	23 X	45	018	.00220	.003	86.	3.4
	2 ×	22	0	.00912	.0614	1.5	0.9

continued

6 x 6 .0211 .414 .0109 .0870 1.4 123 x 7 .00161 .0287 .0014 .00096 1.2 456 x 7 .0015 .132 .00096 1.2 7 x 7 .00939 .137 .00968 1.04 45 x 8 .00397 .137 .00968 1.08 45 x 8 .00394 .118 .00799 .0471 1.8 45 x 8 .00394 .116 .00799 .0471 1.8 8 x 8 .116 .00799 .0471 1.8 .05 8 x 8 .0039 .116 .00799 .0471 1.8 8 x 8 .0039 .0471 .078 .15 .05 8 x 8 .0130 .146 .0079 .0471 .16 .05 8 x 9 .0239 .0246 .0253 .0257 .05 .05 8 x 9 .0239 .0246 .0657 .015 .14 7 x 9 .0054	NAME	MEAN	SUM OF SQUARES	STANDARD DEVIATION	SUM OF SQUARED DEVLATIONS FROM THE MEAN	SKEWNESS	KURTOSIS
. 0.00161 . 0.00287 . 0.00114 . 0.0096 . 0.0039 . 1.37 . 0.0036 . 0.0718 . 0.0397 . 1.37 . 0.0036 . 0.0718 . 0.0394 . 1.18 . 0.0039 . 0.0471 . 0.0394 . 1.18 . 0.0039 . 0.0471 . 0.0394 . 1.18 . 0.0039 . 0.0471 . 0.039 . 1.01 . 0.0353 . 0.0258 . 0.037 . 1.01 . 0.0553 . 0.0258 . 0.0538 . 0.0345 . 0.0155 . 0.0538 . 0.0346 . 0.0155 . 0.054 . 0.046 . 0.0349 . 0.0168 . 0.057 . 2.65 . 0.0349 . 0.048 . 0.077 . 2.65 . 0.0349 . 0.048 . 0.078 . 0.0840 . 0.0478 . 0.048 . 0.078 . 0.0840 . 0.00478 . 0.048 . 0.046 . 0.0478 . 0.0418 . 0.046 . 0.049 . 0.0418 . 0.0438 . 0.046 . 0.049 . 0.0418 . 0.0438 . 0.046 . 0.048 . 0.0438 . 0.0589 . 0.059 . 0.0991 . 0.0539 . 0.070 . 0.0891 . 0.0539 . 0.070 . 0.0592 . 2.41	9 X 9	.0211	.414	.0109	.0870	1.4	6.7
	123 X 7	.00161	.00287	.00114	96000.	1.2	4.5
	456 X 7	.0112	.132	.00725	.0388	1.4	4.5
. 1.11 10.09 1.137 . 0.168 . 2.08 . 2.09 . 2.0094 . 1.18 . 0.0395 . 0.0474 . 0.0379 . 0.0379 . 0.0471 . 0.0379 . 0.0379 . 0.0471 . 0.0379 . 0.0379 . 0.0375 . 0.0363 . 0.0375 . 0.0375 . 0.0352 . 0.0352 . 0.0352 . 0.0353 . 0.0252 . 0.0353 . 0.0253 . 0.0253 . 0.0253 . 0.0353 . 0.0353 . 0.0354 . 0.045 . 0.045 . 0.0374 . 0.037 . 0.0381 . 0.0381 . 0.0581 . 0.057 . 0.056 . 0.0478 . 0.0478 . 0.0478 . 0.0478 . 0.0478 . 0.0478 . 0.0478 . 0.0478 . 0.0478 . 0.0478 . 0.0478 . 0.0478 . 0.0478 . 0.0459 . 0.0559 . 0.0559 . 0.0559 . 0.0570 . 0.0591 . 0.0559 . 0.0571 . 0.0570 . 0.0	7 X 7	.00939	.137	98600.	.0716	1.8	6.2
111 10.08 .0354 .925 .00394 .0174 .00399 .0471 .00379 .0174 .00305 .0471 .0130 .0174 .00305 .0471 .0130 .147 .00553 .172 .0139 .147 .00553 .0225 .00546 .0346 .0156 .0156 .00546 .0416 .00516 .0115 .0645 .0671 .0061 .0163 .0168 .0087 .0671 .00631 .0168 .0168 .0087 .0671 .00631 .0168 .0168 .0163 .214 .00649 .0403 .0168 .0164 .0060 .00616 .0269 .0169 .0145 .124 .00649 .0369 .0569 .0145 .124 .00878 .178 .0569 .0145 .124 .00878 .178 .178 .0180 .1303 .00931	123 X 8	.0397	1.37	.0168	.208	.51	2.5
.00394 .118 .00799 .0471 .00379 .10174 .00305 .04683 .116 .14.667 .08305 .4.78 .103 .1.01 .00553 .1.72 .0130 .1.01 .00553 .0.225 .00538 .0.329 .0.0345 .0.015 .00546 .4.06 .0.0345 .0.015 .0057 .0.046 .0.051 .0.051 .0077 .2.05 .0.0381 .0.108 .0077 .2.05 .0.0478 .0.168 .0078 .0.060 .0.0740 .0.048 .0.078 .182 .0.0740 .0.048 .0.046 .1.182 .0.0678 .0.0580 .0.046 .1.182 .0.0678 .0.0580 .0.046 .1.04 .0.0478 .0.0458 .0.055 .1.11 .0.155 .1.78 .0.355 .1.11 .0.155 .1.78 .0.350 .0.001 .0.059 .0.001 .0.180 .0.200 .0.001 .0.180 .0.200 .0.001 .0.180 .0.200 .0.0031 .0.0031 .0.180 .0.200 .0.0031 .0.0031 .0.180 .0.200 .0.0032 .0.0031 .0.180 .0.200 .0.0032 .0.0031	45 X 8	.111	10.08	.0354	.925	.15	2.5
. 116 14.667 .00365 .00683 .00683 .00683 .00379 .0174 .00365 .00379 .0178 .00375 .0025 .00375 .0025 .00375 .0025 .0025 .0025 .00239 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0026 .0026 .0026 .0026 .0026 .0026 .0026 .0026 .0026 .0026 .0026 .0027 .0027 .0027 .0027 .0027 .0027 .0026 .0027	8 X 9	.00984	.118	66/00.	.0471	1.8	5.6
116 14.667 .0805 4.78	7 X 8	.00379	.0174	.00305	.00683	1.4	3.8
. 0.1337 1.01 .0.05.3 .1.72	8 X 8	.116	14.667	.0805	4.78	1.6	5.8
. 0.0330 . 1.47 . 0.0553 . 0.0255 . 0.0255 . 0.0239 . 0.0339 . 0.0346 . 0.016 . 0.00546 . 0.016 . 0.00546 . 0.016 . 0.00546 . 0.016 . 0.00546 . 0.016 . 0.00516 . 0.0197 . 0.00546 . 0.0410 . 0.0077 . 2.65 . 0.0163 . 0.0168 . 0.0087 . 0.0087 . 0.0087 . 0.0067 . 0.0087 . 0.0061 . 0.0087 . 0.00616 . 0.0280 . 0.0145 . 0.0047 . 0.0087 . 0.0051 . 0.0087 . 0.0051 . 0.0051 . 0.0051 . 0.0559 . 0.0180 . 0.0051 . 0.0052 . 0.0051 . 0.0052 . 0.0	123 X 9	.0337	1.01	.0153	.172	.05	2.3
	4 X 9	.0130	.147	.00553	.0225	99*	3.4
	5 X 9	.0239	.577	.0146	.156	1.4	4.9
	6 X 9	.00538	.0329	.00395	.0115	1.4	4.1
. 0645 4.06 .0367 .995 .00874 .00874 .0071 .00881 .0098 .0077 .00874 .0071 .0098 .0079 .0079 .0079 .0079 .0079 .0079 .0079 .0079 .0079 .0079 .0079 .0079 .0077 .00	6 X L	,00546	.0416	.00516	.0197	1.9	9.9
. 000874 . 0.671 . 0.0381 . 0.108 . 0.108 . 0.0087 2.65 . 0.163 . 0.108 . 0.108 . 0.0163 . 0.108 . 0.0163 . 0.108 . 0.0163 . 0.0163 . 0.0164 . 0.0047 0. 0.0403 . 0.0047 0. 0.0403 . 0.0047 0. 0.0047 0. 0.0040 . 0.0040 . 0.0040 . 0.0087 0. 0.0087 0. 0.0087 0. 0.0087 0. 0.0087 0. 0.0087 0. 0.0099 0	6 X 68	.0645	4.06	.0367	366.	1.1	5.1
	123 X 10	.00874	.0671	.00381	.0108	.40	2.2
. 0.0163	45 X 10	.0577	2.65	.0163	.1955	.41	2.7
	6 X 10	.0163	.214	.00478	.0168	17	2.3
. 0145 . 1.82 . 00616 . 0.280 . 0348 . 034 . 00878 . 0569 . 0355 . 1.11 . 0.155 . 1.78 . 0.280 . 303 . 00931 . 0.639 . 0701 . 4.18 . 0.072 . 547 . 160 . 21.36 . 06772 . 2.44	7 X 10	.00787	.0860	.00740	.0403	2.5	10.1
. 0.0346 . 0.0878 . 0.0569 . 0.0358 . 0.03 . 0.0457 . 1.54 . 0.337 . 47.04 . 0.0881 5.72 . 0.180303 . 0.0931 . 0.639 . 0.701 4.18 . 0.0772 . 547 . 160 21.36 . 0.0572 2.41	8 X 10	.0145	.182	.00616	.0280	.72	3.3
. 0938 8.03 . 0457 1.54 . 0355 1.11 . 0155178 . 237 4.04 .0881 5.72 . 0180009310639 . 0701 4.18072547 . 272 60.460589 5.82 . 160 21.360572 2.41	9 X 10	.0146	.214	.00878	.0569	.29	2.0
5 .0355 1.11 .0155 .178 5 .0280 .303 .00931 .0639 .0701 4.18 .0272 .547 .160 21.36 .0572 2.44	10 X 10	.0938	8.03	.0457	1.54	99.	2.7
5 .237 47.04 .0881 5.72 .0180 4.18 .00931 .0639 .0701 4.18 .0272 5.47 .160 21.36 .0572 2.41	123 X 4	.0355	1.11	.0155	.178	1.15	4.0
.0180 .303 .00931 .0639 .7071 4.18 .0272 .347 .272 60.48 .0889 5.82 .160 21.36 .0572 2.41	12345 X 5	.237	47.04	.0881	5.72	.42	2.9
. 0701 4.18 . 0272 . 547 . 272 60.48 . 0889 5.82 . 160 21.36 . 0572 2.41	TI	.0180	.303	.00931	.0639	99.	3.4
. 272 60.48 .0889 5.82 .160 21.36 .0572 2.41	TD	.0701	4.18	.0272	.547	.92	3.6
.160 21.36 .0572	CENTER	.272	60.48	.0889	5.82	.28	2.6
	TENS	.160	21.36	.0572	2.41	.46	2.5

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TABLE A-15--continued

NAME	MEAN	SUM OF SQUARES	STANDARD	DEVIATIONS FROM	SKEWNESS	KURTOSĮS
12345 X 8	.151	18.30	.0447	1.47	22	2.2
76 X 8	.0136	.204	.00954	.0671	1.7	5.7
8 X 8	.116	14.67	.0805	4.78	1.6	5.8
123 X 9	.0467	1.86	.0184	.249	10	2.3
4567 X 9	.0347	1.21	.210	.326	1.3	4.5
8910 X 9	.0791	5.88	.0415	1.27	.80	4.3
SMALL I	.0825	5.41	,0228	.384	04	2.1
SMALL D	.0760	4.89	.0291	.625	.92	3.1
TI RATIO	.218	44.39	.113	9.46	.27	2.1
10 RATIO	.865	554.	.0417	1.28	76	3.4
PD RATIO	.918	623.	.0472	1.64	-1.29	4.1
PI RATIO	.589	266.	.115	9.68	69*-	3.2
PD MESH	.229	53.05	.139	14.27	1.5	5.3
PI MESH	.0461	2.05	.0254	.474	.85	4.1
TOTAL I	.635	309.	.123	11.23	74	3.0
TOTAL 2	2.23	3698.	.198	28.85	17	2.6
SMALL ID	.526	216.	.129	12.35	17	2.6
FLUX NVB	37.6	1116449.	66.6	73530.	.26	3.0
ORIG NVB	17.5	261868.	6.92	35260.	.61	4.0
TOTAL NV	55.1	2421187.	15.6	179377.	.43	3.5
ELAB NVB	31.0	869970.	14.8	161372.	.93	4.7
FLUX VBB	44.8	1818880.	21.3	334493.	.70	3.3
ORIG VBB	19.3	513063,	18.0	239106.	2.1	8.6
TOTAL VB	64.1	4037225.	36.9	1003487.	1.3	5.2
FLUX PSB	27.45	659659.	11.8	103415.	.50	3.4
ADEQ PSB	12.55	148638.	6.63	32399.	99.	3.5
TOTAL PS	40.0	1421793.	18.1	240753.	.54	3.5
TOTAL : B	50.0	1914221.	9.88	71885.	.34	3.1
MAT B	54.5	2275329.	10.4	80035.	29	2.4

