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TO THE TORRANCE TESTS OF CREATIVE THINKING:
PICTURE COMPLETION TASK

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THE RELATIONSHIP OF SORTING ACTIVITIES TO THE TORRANCE TESTS OF CREATIVE THINKING: PICTURE COMPLETION TASK

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ABSTRACT

THE RELATIONSHIP OF SORTING ACTIVITIES
TO THE TORRANCE TESTS OF CREATIVE THINKING:
PICTURE COMPLETION TASK

By

John Bruce Shattuck

The majority of creativity research has attempted to investigate broad relationships between such areas as creativity and personality traits, intelligence, socio-economic levels, and school learning environments. The classroom teacher, while frequently the subject of role associated functions as they relate to creativity, is in need of empirically sound approaches that can be integrated into daily classroom activities and curricular models.

The need for this investigation, then, was promulgated by (1) the apparent minimal attention to the selection of researchable curriculum materials and activities, and (2) the dearth of classroom oriented experimental investigations that utilize the classroom as a frame of reference to buttress theoretical constructs.

The sample for this study included ninety-two randomly selected fifth grade students in a suburban public school. A Solomon four-group was employed as the research design.

The intervention consisted of two exposures to sorting activities. The sorting activity was basically defined as the ability to classify or group a collection of objects based upon either a specified rule or pre-established criteria selected by the student. The Torrance Test of Creative Thinking, Picture Completion Task Forms A and B were utilized as the independent and dependent variables, respectively.

Major findings included: (1) subjects who were administered the pretest received higher posttest means regardless of treatment, and (2) subjects who received the intervention received higher posttest means than those not exposed to the intervention.

This study demonstrated the need to identify appropriate classroom activities that appear to facilitate creative thinking. Sorting activities do appear to have this potential, however, the data only partially supported this notion.

DEDICATION

To Kathy

Without whom this document would

still be an unfinished thought.

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CHAPTER I

THE PROBLEM

Statement of the Problem

This research proposes to investigate if a relationship exists between sorting activities and the Torrance Tests of Creative Thinking: Picture Completion Task.

The Hypotheses

The first hypothesis is that subjects exposed to the sorting activity will exhibit higher overall posttest scores than subjects not exposed to the sorting activity as measured by the Torrance Tests of Creative Thinking: Picture Completion Task, Form B.

The second hypothesis is that subjects exposed to the sorting activity will score highest on measurements of originality on the posttest measure of the Torrance Tests of Creative Thinking: Picture Completion Task, Form B.

The third hypothesis is that following originality, subjects exposed to the sorting activity will then exhibit highest posttest scores for measures of flexibility followed by fluency and elaboration as measured by the Torrance Tests of Creative Thinking: Picture Completion Task, Form B.

The Delimitations

The study will be limited to the fifth grade population attending the Beecher School North, Woodbridge Public Schools, Woodbridge, Connecticut.

The study will not attempt to identify creativity per se in elementary school children or to compare subjects in the study with other school populations.

The study will not attempt to examine the merits of the school learning environment of this investigation as it relates to the identification, extension, or facilitation of creativity.

The study will not investigate possible relationships between intelligence and creative thinking.

The Definition of Terms

Creativity. The ability to generate new responses to problems presented by the available information or body of knowledge.

Sorting. The process of classifying or grouping objects, materials or elements according to a predetermined criteria or rule.

Torrance Test of Creative Thinking: Picture Completion Task. Part of a battery of tests designed to measure creative thinking. The Picture Completion Task figuratively measures frequency of response (originality), imagination

and exposition of detail (elaboration), quantity of figures completed within apportioned time (fluency), and the number of different categories into which the responses fall (flexibility).

Assumptions

The first assumption. The first assumption is that creative thinking abilities can be defined and measured among elementary school populations.

The second assumption. The second assumption is that activities can be developed to provide a facilitative learning environment for creative growth among elementary school populations.

The third assumption. The third assumption is that the inclusion of empirically evaluated activities will be an educational asset to the elementary school program.

Importance of the Study

The majority of creativity research seeks to establish broad relationships between creativity and personality, intelligence, socio-economic levels, environmental factors, and personality traits. Much less has been accomplished to illuminate approaches to the kinds of activities that appear to be productive to creative thinking. The classroom

teacher, while frequently the subject of role function as it relates to creativity, is in need of empirically sound approaches that can be integrated into daily classroom activities and curricular models.

Need for the Study

The process of education predates research in education by a considerable margin. Historically, inquiry into professional areas that included direct observation or experimental manipulation of variables constituted intellectual heresy. As Traxler[1] noted:

> "...if the application of research to the understanding and control of the physical world is of comparatively recent origin...the use of research in the study of man and his development is indeed a modern process. There is very little which can properly be called research in any of the social sciences that can be traced back as far as the middle of the nineteenth century."

While educational research, particularly of an experimental nature is a comparatively recent endeavor, creativity research is in the initial stages of development. Research devoted to virtually any dimension of creativity prior to 1950 is considered non-existent. The chronology is brief and

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[1]Traxler, Arthur E., "Some Comments on Educational Research at Midcentury," Journal of Educational Research, XLVII, (1954), p. 359-66.

this fact must temper judgements relative to tendencies, trends, and missing elements.

Contemporarily, creativity research has nonetheless provided us with what can generally be referred to as empirically defensible notions. These notions are largely contained in broad descriptions of children's creative characteristics and environmental factors related to those characteristics. For example, creative children tend to be more confident about themselves and their abilities to conceptualize problems.[2] They also seek to develop independence and to rely on their own judgements. Creative children appear to possess a spirit of inquiry--an investigative prowess that seeks to differentiate relevant from irrelevant information as a component of the problem solving process.[3]

Environmental parameters generally agreed upon include: (1) various social motivational and situational dimensions as profoundly effecting creative expression[4], (2) a considerable part of creative behaviors are learned and the behaviors that underlie the creative process can be

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[2]DeVito, Alfred, "Survival Through Creative Education," Journal of Creative Behavior, 10, No. 1, (1976), p. 45-61.

[3]E. Paul Torrance, Guiding Creative Talent, (Englewood Cliffs: Prentice Hall, Inc., 1963), p. 16-42.

[4]Gowan, J.C. and Olson, M., "The Soceity Which Maximizes Creativity," Journal of Creative Behavior, 13, No. 2, (1979), p. 194-210.

facilitated by appropriate instruction[5], (3) educational theory appears to recognize the need for attention to be rooted in a dependence upon the transmission of information[6], and the creative process is both a basic part of learning and a primary component by which the problem solving process is accomplished[7].

Once again it should be cautioned that inasmuch as the chronology of creativity research is brief but rapidly expanding, judgments relative to trends, tendencies and missing elements should be tempered and placed in its proper longitudinal perspective. The necessity for improvements in educational practices per se are seldom dissimilar to those addressing the proliferation of creative opportunity. Both are largely dependent upon the nature of curriculum materials and activities that ultimately surface in the teaching classroom.

The need for this investigation is promulgated by: (1) The minimal attention given to the selection of curriculum

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[5]Crutchfield, R.S., "Nurturing the Cognitive Skills of Productive Thinking," in Rubin, L.J., Life Skills in School and Society, (Washington, D.C.: Association for Supervision and Curriculum Development, N.E.A., 1969).

[6]Cole, H.P., and Bernstein, S., "Summary of Process-Promoting Units Resulting from Curricular Analysis Activities," (Paper delivered at the Eastern Regional Insitute for Education, Syracuse, New York, 1969).

[7]J. P. Guilford, The Nature of Intelligence, (New York: McGraw-Hill, 1967), p. 67.

materials and activities as indicated by the literature, and (2) The dearth of classroom oriented investigations that utilize the classroom as a frame of reference to buttress theoretical constructs.

Appropriate materials and activities--the objects of instruction rather than the information of instruction--help shift the focus of interaction from the teacher as a source of information to the teacher as a facilitator of a problem solving process. Teachers in this role are apt to be less judgmental and more accepting of divergent thinking critical to the creative process. Instruction utilizing objects are less relevant upon "correctness" and instead promote a spirit of inquiry to approach solutions to problems.

The literature indicates certain interpersonal/psychological dimensions as having a relationship to basic components of the creative process. Brainstorming was described by Osborn as a "creative conference for the purpose of producing ideas that lead to the solution of a problem."[8] During brainstorming, judgment is deferred, ideational quantity is encouraged, and combinations and improvements are sought. Since brainstorming offers an atmosphere with limited evaluation in which free expression is encouraged, it may be helpful in developing creative fluencies in children.

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[8]A. F. Osborn, Applied Imagination, (New York: Scribner's and Sons, 1963), p. 39.

Studies by Parnes and Meadow[9] using brainstorming have beenconducted at various grade levels and with students of different levels of ability and appears to substantiate its value as a method of increasing subjects' creative fluencies. Sharp[10] applied brainstorming techniques to educationally handicapped children with similar results. As a corollary to focusing attention on brainstorming per se, sorting activities appear to be suitable for using this technique as a vehicle for instruction during the activity. Empirical data is needed to lend credence to this notion.

Sorting activities also require involvement and active participation by the learner. Educational research has indicated the apparent positive relationship between higher levels of involvement and motivation during periods of instruction. These components encourage intrinsically oriented reward patterns that are a part of creative discovery and exploration.[11] Minimal investigations conducted during

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[9]Parnes, S.J., and Meadow, A., Effects of Brainstorming Instructions on Creative Problem Solving by Trained and Untrained Subjects," Journal of Educational Pyschology, 50, 1963.

[10]Sharp, Lawrence Wesley, "The Effects of a Creative Thinking Skills Program on Intermediate Grade Educationally Handicapped Children," Journal of Creative Behavior, 7, No. 5, (1973) p. 37.

[11]Mihaly Csikszentmihaly, Beyond Boredom and Anxiety, (San Francisco: Jossey-Bass, Inc., 1975), p. 32.

high learner involvement are recorded and more are needed to expose the function of involvement with the creative process. Similarly, will higher levels of involvement characteristic of sorting activities capitalize on pupil interest and thereby reduce boredom? Intuitively, it would appear that levels of boredom would be inversely proportional to creative performance. The relationship of boredom as a dysfunctional variable to creative performance has been suggested by Schubert[12].

Scattered in the literature are reports indicative of the importance for selection of activities that are facilitative of creative learning atmospheres[13]. However, most of these are completed prior to elaboration on the specific kinds of activities and materials that can be assimilated into the classroom[14].

The second area of need for this investigation relates to the nature of the setting for creativity research itself. The teaching environment in which learning strategies unfold

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[12]Schubert, Daniel S.P., "Boredom As An Antagonist of Creativity," The Journal of Creative Behavior, 11, No. 4, 1974.

[13]Yawkey, Thomas, D., "Facilitating Creative Thought Through Object Play in Young Children," The Journal of Creative Behavior, 17, No. 3, 1982.

[14]Penick, John E., "What Research Says: Encouraging Creativity," Science and Children, 20, No. 5, (1983), p. 32-33.

represent an appropriate milieu for impacting upon the conduct of education. The apparent hiatus between the research sophistication available and the lack of pragmatic applications tends to create a practice versus research dichotomy. The school classroom can provide the needed orienting frame of reference for investigations. Torrance's work with practitioners in the field poignantly addressed the impact of studies within the everyday classroom[15].

Investigations are also needed to obtain greater levels of generalizability to the data. It would appear helpful to pose questions to the frame of reference that initially prompted the hypothesis. This is a direct vehicle to extend the meaning of the study beyond the querry itself. Most of creativity research does make use of what is generally accepted or at least defensible, but makes minimal impact on the modification and extension of curriculum efforts due to the lack of generated hypotheses that focus upon classroom experiences as the frame of reference.

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[15]Torrance, E. Paul, "Predicting the Creativity of Elementary School Children--and the Teachers Who Made a Difference," The Gifted Child Quarterly, 25, No. 2, (1981), p. 55-61.

Sorting activities are unique in that they lend themselves to experimental manipulation. Given proper design considerations, it is less arduous to measure experimental interaction effects with sorting activities than broader, multi-dimensional approaches encompassing school attitudes, school environments, and educational learning styles. Knowledge of the dynamics of the aforementioned are necessary and provide important data, but are experimentally cumbersome.

The burden of responsibility relative to creative behavior ultimately rests with the classroom practitioner. The need to assist the classroom practitioner towards this objective is an important responsibility of the educational researcher. Conducted within the appropriate frame of reference, classroom research can leave behind a legacy of applicability.

CHAPTER II

THE REVIEW OF THE RELATED LITERATURE

Introduction

The Creative Education Foundation listed some 4,176 items pertaining to the nurture of creative behavior prior to 1967. Since that date, this number has nearly quadrupled and is expected to reach 20,000 items in 1988. Seven basic types of studies are found in the literature: (1) Differences between high and low creative individuals regarding personality structures, cognitive functioning, and biographical data; (2) Research comparing individual creativity with that of groups; (3) Analysis of relationships among creativity, intelligence, and some measurement index of achievement; (4) Studies of factors that inhibit creative thinking; (5) Studies evaluating programatic approaches to foster creative behavior; (6) Studies of environmental variables affecting creativity; and (7) Studies designed to identify the role of educators, psychologists, and others in a helping relationship to better understand the dynamics of creativity. Frequently discussions of the related literature fail to make the nexus between discussions of the literature others have produced and the researchable problem at hand. By establishing an appropriate criteria for inclusion, selectivity of entries can both display relevancy and a sense of overall connectedness.

In the discussions that follow, inclusion of bibliographical data will meet the following criteria: (1) Studies will directly relate to school populations or possess intrinsic transfer value when considering school populations; (2) Studies will focus upon specific variables that buttress an understanding for creativity experimentation in the schools; (3) Studies will expose a theoretical framework significant to the research problem of this investigation; and (4) Studies will be representative of other parallel studies and will be included for illustrative purposes.

Environmental Conditions

Investigations relative to modes of classroom instruction (i.e. open vs. traditional, process vs. content, inductive vs. deductive) occupy a large segment of the literature. Many educators believe that the open classroom facilitates creative growth through its emphasis on self direction, curriculum integration and decision making strategies. Assuming that open classrooms necessarily encompass these strategies, however, is researchably as unsound as assuming these elements are lacking in traditional classrooms.

Golub and Hahn[1] compared the effects of creative thinking programs on randomly assigned third-grade students at a suburban public elementary school. During four thirty-minute sessions per week for eight weeks subjects in the experimental groups were given a variety of creativity facilitating exercises and techniques. Both the pre and post measures consisted of Parallel Forms A and B of the Torrance Tests of Creative Thinking.[2] Responses were scored for fluency, flexibility, originality and elaboration.

No significant differences were found between the traditional and open classroom control groups. Significant differences between the control and experimental groups were revealed on all measures following exposure to training. In addition, gains in creativity were significantly greater for experimental subjects in the open classroom, supporting the view that with training the open classroom facilitates creative expression.[3]

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[1]Golub, Sharon and Hahn, Karen Sorci, "Training Creative Thinking in the Open and Traditional Classroom," Journal of Creative Behavior, 17, No. 3 (1976), 217.

[2]E. Paul Torrance, Torrance Tests of Creative Thinking, (Bensenville, Illinois: Scholastic Testing Service, 1974).

[3]Golub and Hahn, op. cit.

In an investigation into the relationship of high creative children and common characteristics of educational backgrounds, Hahn[4] examined student preferences for classroom environments, learning styles, teaching methods and teacher characteristics. Sixteen hypotheses were developed for the study. They stated that higher creatives would have, as example, attended nursery school; been early readers; preferred independent learning; preferred a democratic classroom structure and an open-style form of instruction.[5] Although high creatives in the study did have preferences for open classrooms and independent learning experiences, only these two of the sixteen hypotheses were statistically supported.[6]

Despite the apparent lack of verified support, the Wright study does have merit, however. The search for commonalities that appear among a target population could lend support and provide valuable data for longitudinally oriented investigations. The weakness of the Wright study was not one of poorly developed hypotheses that were empirically unsound,

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[4]Hahn, Beverly A., "Common Characteristics in the Educational Backgrounds of High Creative Children and Their Preferences Regarding Classroom Behavior," Journal of Creative Behavior, 15, No. 4 (1981), 283-285.

[5]Ibid, p. 284.

[6]Ibid, p. 285.

but was due to a basic design flaw that would have compromised the validity of any results. The population consisted of all 343 fifth grade students in the Auburn, Maine Public Schools. The forty-five students who attained the highest combined scores (figural and verbal) on the Torrance Tests of Creative Thinking were identified as high creatives. Thus, in excess of 13 percent of the total population were labeled "high creatives"--a statistical near impossibility. The : ndomized use of forty-five scores should have been deleted in favor of national norms for high creativity in the fifth grade, or less than five percent.

External validity of the investigation was further minimized by such factors as demographic mobility (some students may have attended several different schools); quality of educational opportunity (relative age at when reading abilities were professionally diagnosed if at all); preferences by students relative to learning atmospheres (presumes students have basis for comparison).

To reinterate, the intent of the Hahn study has merit. The methodological problem was contained in researchers only identifying what can be measured and measuring only what can be quantified. In the Hahn investigation, what was labeled as "high creative" was that which could be quantified to fit the study.

Much of the research findings appear inconsistent when examining the relationship of classroom environments and creative thinking. Haddon and Lytton[7] reported superior creativity scores for children in progressive schools than traditional ones. Research conducted by Wilson, Stuckey and Langevin[8] found open-class children were less creative than those in a traditional class. While results appeared to focus on either the positive or negative attributes of kinds of classroom environments, other alternative findings added to overall disparities. Bennett's[9] extensive work with elementary school children found little or no differences in creativity as compared to school environments. Wright's[10] findings provided collaboration to this theory.

It would appear more educationally sound to address the classroom environment question from other than traditional vs. progressive perspective. That is, perhaps certain kinds

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[7]Haddon, F.A. and Lytton, H., "Teaching Approach and the Development of Divergent Thinking Abilities in Primary Schools," British Journal of Educational Pyschology, 38, (1968), 171-180.

[8]Wilson, R.S.; Stuckey, T.; and Langevin, R., Are Pupils in the Open Plan School Different?", Journal of Educational Research, 66, (1972), 115-118.

[9]N. Bennett, Teaching Styles and Pupil Progress, (Cambridge, MA: Harvard University Press, 1976).

[10]Wright, R. J., "The Affective and Cognitive Consequences of an Open Education Elementary School," American Education Research Journal, 12, (1975), 449-468.

of measurable creativity would appear to be more appropriately compared to certain kinds of classroom environments. Consistent with this notion, Ramey and Piper[11] examined a broader range of classroom continuums and found a strong relationship of open-classroom figural creativity and traditional classroom superiority in verbal creativity.

Some consideration for the heterogeneity of results should be discussed. The basic problem may be contained within the labels attached to school types. One can assume a reasonably close chronological population within a given grade level, or a reasonably accurate description of content/skill development exposure contained within a school year. What is needed is a more behaviorally oriented definition of school types. The terms "open" or "free" are not precise and when applied to a research endeavor can represent confounding variables not accounted for. Terms employed by educators may frequently be more impressionistic than behaviorally reliable. While "open" and "free" may indicate what the school is not--precisely what the school is may represent undetected variables to the investigator.

A study by Thomas and Beck[12] explored the effects of

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[11]Ramey, C.T. and Piper, V., "Creativity in Open and Traditional Classrooms," Child Development, 45, (1974), 557-560.

varying school environments on the development of creativity over the course of a school year but improved upon prior research in the following ways: (a) By systematically measuring variations in schooling along a continuum. The study focused upon an intermediate level of school formality in which there existed "...a dual emphasis on both fact acquisition and leeway for self-expression that provided the optimal environment for growth in creative ability;"[13] (b) Since children's capacity for creativity had been predicted by other studies to be based upon school environments, Thomas and Beck investigated school learning interactions with teachers' views of student behaviors under those learning interactions; and (c) In order to appropriately evaluate the equivalence of school samples, parental characteristics related to creativity were added. These variables included mothers' and fathers' own creativity and their attitudes about child characteristics' associated with creativity.[14] This added design factor towards a greater assessment of subject equivalence had not been observed in other studies.

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[12]Thomas, Nancy G. and Berk, Laura E., "Effects of School Environments on the Development of Young Children's Creativity," Child Development, 52, (1981), 1153-1162.

[13]Ibid., p. 1154.

[14]Ibid., p. 1155.

All children, grades one and two in six schools participated. There were 126 boys and ninety-nine girls. The overall population was middle class. An interview system gathered data on the school descriptions; these descriptions were then rated along a continuum from extremely informal to extremely formal. The raters were specialists in elementary education and/or child development. Ratings were based upon ten dimensions. These included fact acquisition, subject matter areas, academic achievement, evaluation, verbal and artistic expression, self-awareness, peer relationships, authority, range of individual behavior exhibited, and group behavior exhibited. Parents were asked to respond to two tasks: (1) to assess their own creativity, the Torrance Thinking Creativity With Pictures, Form A was administered, and (2) to investigate parental values of personality characteristics associated with childrens' creativity, The Torrance Ideal Child Checklist was administered.[15]

The results of the study indicated the relationship between school environments and creativity development to be more complex than previously observed. It depended upon (a) type of school; (b) sex of the child; and (c) the particular component of creativity assessed.[16] The findings supported the hypothesis that children in the intermediate environment

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[15]Ibid.

[16]Ibid, p. 1160.

tended to perform better than children in the formal environment. Girls showed the greatest gain in originality in the informal schools, modest gains for intermediate schools, and a decrease in the formal schools. Boys gained in originality in all three school environments. On the flexibility measure, both boys and girls gained most in the informal schools. For the elaboration measure, girls showed greatest gains in the intermediate school and boys showed greatest gains in the formal environments and lower gains in the informal settings.[17]

In considering school environments the Thomas and Berk investigation recognized the multiplicity of interrelated elements and addressed the need to avoid oversimplification of formal vs. informal educational settings.

Ogilvie[18] added credence to the Thomas and Berk study with her statistically supported hypothesis that a curvilinear relationship exists between the degree of school formality and children's creativity. Ogilvie suggested that the concepts of formal and informal be thought of as extremes on a continuum. Her rationale was that highly formal environments allow little room for nonconformity and highly informal environments offer insufficient information

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[17]Ibid., p. 1161

[18]Ogilvie, E., "Creativity and Curriculum Structure", Educational Research, 16, (1974), 126-132.

reservoirs on which creative associations can be based.[19] Ogilvie states "The environment most favorable to creativity will be that which provides for both freedom of expression and good quality association reservoirs."[20]

Teaching Methodologies and Curricula

Investigations concerning school environments and their relationship to creativity development were usually conducted after the establishment of the individual school programs. That is, traditional, open and alternative settings were not established to reflect their relative impact upon the creative process, but later became the mileau in which hypothesis could be tested. What then of specific curricular approaches, teaching styles, training efforts, classroom activities and "climate" variables and their relationships to create behavior?

Possien,[21] using map studies as a vehicle, evaluated specific teaching methodologies in the development of problem solving skills among sixth grade children. Included were the inductive method, with a focus upon the processes of

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[19]Ibid, p. 127.

[20]Ibid, p. 129.

[21]Possien, Wilma Martens, "A Comparison of the Effects of Three Teaching Methodologies on the Development of the Problem Solving Skills of Sixth Grade Children," Journal of Creative Behavior, 1, No. 2, (1967).

searching and self discovery; the deductive method, comprised of information giving by the teacher and memorization by the students; and a third method deductive in nature but "detailed explanations of the causal relationships underlying the concepts were added to lesson plans."[22] Data for comparison of methodological effects were derived from pre and post scores on the map reading section of the Iowa Test of Basic Skills: Form I and on mental age by the California Test of Mental Maturity. Hypotheses for the investigation were twofold: (1) Differences in teaching method would not effect differences in achievement; and (2) Variations in methodology would not effect differences in problem solving behavior exhibited by the pupils.[23]

Results for the hypothesis that differences in teaching method would not effect differences in achievement were supported and this hypothesis was accepted. For the second hypothesis, that variations in methodology would not effect differences in problem solving were found to be significant and this hypothesis was rejected. Possien concluded that students trained in the use of inductive procedures exhibit some characteristics of problem solving more frequently than

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[22]Ibid, p. 87.

[23]Ibid, p. 89.

pupils taught by the deductive method.[24]

Intuitively it would appear that inductive approaches offer a more stimulating learning atmosphere and therefore a greater opportunity for individual growth. However the Possien investigation cannot be considered upon intuition but on the merits of its research methodology per se. Validity of the Possien study was reduced in two primary areas.

First, the treatment indicated each of the classes were instructed for thirty minutes each day over a three week period. All instruction involving each of three teaching approaches were taught by the investigator. Given the latitude of potential instructor/student interaction during the instructional periods, experimentor bias could be significant. Further, the experimentor could have preferred one method over the other two, had prior training in a particular teaching style, or unknowingly possessed greater communicative expertise in one mode of instruction. The procedures of the study suggest an alternative hypothesis: Students exposed to the Possien method of inductive teaching will exhibit higher gains in problem solving than other methods employed by the same instructor.

Second, pre and post instruments were identical. While the appropriateness of the instruments can be left to

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[24]Ibid, p. 90.

conjecture, the utilization of parallel forms would have reduced the possibility of pre and post interaction as a confounding variable. The consideration of test-retest effect was not addressed in the investigation.

It is nearly two decades since E. Paul Torrance reported the fourth-grade slumps in creative teaching.[25] Torrance's hypothesis was that certain periods of stress in children's lives contribute to behaviors that cause discontinuities in creative growth. More specifically, it is at about the fourth grade level that for the first time in pupils' lives they are expected to be regimented into certain academic molds imposed by teacher, peer, and parental pressures for school success.[26] The work of Torrance in this area pointed out the relationship between self worth and creative growth as a major variable in determining fourth grade losses in creative thinking.

An investigation by Williams[27] began as a primary prevention mental health project for schools, parents and the community at large. The project was an effort to reduce

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[25]E. Paul Torrance, Understanding the Fourth Grade Slump in Creative Thinking, (Washington, D.C.: U.S. Office of Education Final Report, December, 1967).

[26]F. E. Williams, Classroom Ideas for Encouraging Thinking and Feeling, (Buffalo, New York: D.O.K. Publishers, 1970), p. 93.

[27]Williams, F. E., "Rediscovering the Fourth Grade Slump in a Study of Children's Self-Concept," Journal of Creative Behavior, 10, No. 1 (1976), p. 15-28.

excessive stress by building coping mechanisms that would assist people to better handle daily situations prior to the development of mental problems requiring treatment.[28] Although not a new concept in the field of mental health, it was innovative to education. During this program, teachers and counselors were expected to use self-concept scales on a diagnostic basis by prescribing individual exercises in the classroom. These exercises were designed to develop children's feelings about themselves, others and school. The salient question of the project was whether the technique, when applied to children in a school setting, would eliminate or reduce the fourth grade slump in creative thinking.[29]

The program was undertaken in two inner-city schools having a population of fifty-five teachers and in excess of one thousand students in grades one through six. All staff participated in the training but pre and posttests were administered only to grades two, three and four. The instrument utilized for both pre and post measures was the Self Concept and Motivation Inventory (SCAMIN). Two scores are tabulated from this instrument: school self concept and motivation. Student self concept scores were derived from measured pupil role expectations and feelings of self

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[28]Ibid, p. 17.

[29]Ibid, p. 23.

adequacy. School motivation scores were derived from achievement investment--or the degree of desire to avoid school failure.[30] All pretests were conducted during the first full week of the school year.

Treatment for the experimental classrooms included weekly teacher inservice training sessions on strategies and procedures for improving school self concept. Classroom activities were intended to capitalize on student successes. Positive reinforcement throughout the year focused upon student trust, confidence and security in school. Activities were integrated into all aspects of the school curricula in an attempt to encourage learning while dealing with feelings. Class and small group discussions on attitudes and values clarification were further tied to content areas.[31]

Posttest scores revealed no fourth grade slump in school self-concept or motivation among experimental groups after treatment. T-tests indicated a significant (.05 significance) growth of fourth grade post over pretest scores. Treatment appeared to not only deter the fourth grade slump but improved pupils' feelings about school and themselves.[32]

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[30]Ibid.

[31]Ibid, p. 34.

[32]Ibid.

In discussion, work previously cited by Torrance appears to have been at least a partial catylist for the Williams' investigation into school self-concept and motivation. Indeed Williams had reinforced the need and relative value of providing the necessary training for educators in order to equip them with the mechanisms necessary to dually address emotional and academic appetities of the elementary school child. Eliminating or at least reducing the fourth grade slump in school self-concept and motivation was statistically supported. The relationship of school self-concept and motivation upon creative thinking was implied but not empirically tested. Follow-up investigations parallel to the Williams' study could contribute to these dynamics by the inclusion of: (1) Use of creativity instruments to identify specific relationships to figural and verbal forms of creative thinking; (2) Base line data that considers performances on cognitive parameters during programs specifically designed to address affective factors; and (3) Utilization of populations with broader generalizability to other school groups. While there is a humanitarian need for support data to improve the learning conditions of inner city children, their needs in the areas of self concept and school motivation may be different both in nature and degree.

Summary

The development of creative thinking in elementary school children is a complex issue. Research has been partially successful in finding some of the ingredients but much more is needed to improve the blend. Research to search for the optimal school environment, program and teacher characteristics have been met with a wide continuum of success.

Teacher workshops,[33] undergraduate courses and seminars,[34] specialized degree programs,[35] and research fellowships[36] all have made a contribution but appear to lack grass-roots endurance. Nonetheless, the evidence does suggest that creative abilities can be identified, measured, and developed.

The most complicated arena of all is the classroom. Investigations conducted in the classroom under day to day learning conditions may be the most beneficial to both

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[33]Feldhasen, John F. and Treffinger, Donald J., "Design and Evaluation of a Workshop on Creativity and Problem-Solving for Teachers," Journal of Creative Behavior, 10, No. 1, (1976), p. 12-14.

[34]Linder, Toni W., "Organizing a Course on Creativity: Theory and Practice," Journal for the Education of the Gifted, 4, No. 3, (1981), p. 211-224.

[35]Holman, E. Riley, "A Master of Education Degree in Elementary Education With An Emphasis on Creative Teaching-Learning," Creative Child and Adult Quarterly, 11, No. 2, (1977), p. 98-100.

[36]Harmin, Merrill, "N.E.X.T.E.P.: New Exploratory Teacher Education Program," Southern Illinois University, Edwardsville, Illinois, (1969).

learners--the teacher and the student. Simply stated, how can teacher-student-material interactions best be structured to allow the creative process to occur? Regardless of how we measure the final product, the final product is a reflection of the creative process.

CHAPTER III

METHODOLOGY AND PROCEDURES

The Setting

Woodbridge, Connecticut is a suburban community of New Haven with a population of 9,800. Essentially representative of a middle to upper middle class community, Woodbridge has a large proportion of professional citizenry associated with New Haven and its three Universities.

The school district has an elementary grade enrollment of 775. Secondary and junior high schools are provided on a regional basis. Woodbridge ranks in the top one-fourth of 169 school districts statewide in per pupil expenditures. There are two elementary schools, with students attending kindergarten through grade three in the primary unit and grade four through six in the intermediate unit. Regular classroom instruction is complemented in the areas of mathematics, art, music and physical education. French and literature instruction is also provided in the intermediate school. Psychological services and special education are both provided within the district.

The Population

There are ninety-one students enrolled in the fifth grades in the intermediate school. With certain exceptions,

all students are randomly assigned to each of the four fifth grades at the beginning of each academic year. Exceptions include siblings who are generally not placed in the same class group and students considered to be behavior problems who are not placed with other students of the same conduct. Methodology of randomization by the school district involved an overall ability ranking of each student prior to entering the next school year. Teachers assigned numerical weights of one through five to each student, with one as the highest. Students were then selected to each classroom with equal numbers of one, two, three, etc., assigned to each of the four fifth grade classes. For purposes of this investigation, the four fifth grade classes were then randomly selected to experimental and control groups. True randomization of subjects from the initial phases of this investigation would have been more favorable and enhanced the external validity of the study, however daily scheduling of the classes for specialized instruction presented problems and could not be performed. Results of the randomization process in terms of the homogeneity of the groups is presented in Chapter 4.

Organization for instruction is largely based upon content areas of the curriculum, with each of the four fifth grade teachers responsible for one or possibly two content areas. During a typical day, students move from class to

class and are exposed to the content and methodologies of each teacher. Support areas of physical education, French, literature, art and music are each taught by specialists to all students. All classes can be considered heterogeneously grouped and all students receive instruction from the same teaching staff.

The organization for instruction component was an important design consideration for the study. In most elementary schools classrooms are basically self contained with added specialists in music, art and physical education where budgetary restraints permit. Therefore, the bulk of instruction emanates from a single source. In this investigation no attempt has been made to consider the effectiveness of teaching styles relative to creative stimulation. In classrooms where a single teacher is responsible for instruction, measurements could be influenced by the manner of instruction and not the experimental treatment while interpretation of results would be based upon the treatment. Classroom studies seldom can be totally isolated from teacher induced influences. However, when subjects are exposed to the same groups of teachers the potential for any unidirectional influence is reduced. The assumption basic to this premise is that all of the teachers responsible for the subjects' instruction do not have the same approach to teaching.

The Instrument

The Journal of Creative Behavior describes in excess of one-hundred instruments for studying creative behavior.[1] This proliferation, together with the focus upon development, has created a spectrum of reactions among educational researchers.[2] Uses and abuses of existing creativity tests were also identified by Torrance.[3] Additionally, how researchers perceive creativity tests and how the creativity testing development movement has resulted in a significant decrease in educators seeking to find new ways to encourage creativity in a general sense appears to suggest a loss of perspective.[4]

The importance of the study addressed the need for classroom applied research involving classificatory oriented activities. Replication would offer greater generalizability

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[1]The reader is referred to the following previous issues of The Journal of Creative Behavior: "Instruments Useful in Studying Creative Behavior and Creative Talent, Part I, Commercially Available Instruments," 5, No. 2, 1971; "Instruments Useful in Studying Creative Behavior and Creative Talent, Part II, Noncommercially Available Instruments," 5, No. 3, 1971; "Additional Instruments Useful in Studying Creative Behavior and Creative Talent, Part III, Noncommercially Available Instruments," 6, No. 4, 1972.

[2]Crockenberg, Susan B., "Creativity Tests: A Boon or Boondoggle for Education?", Review of Educational Research, 2, No. 1, (1972), p. 27-45.

[3]Torrance, E. Paul, "Creativity Testing in Education," Creative Child and Adult Quarterly, 1, No. 3, (1976), p. 36.

[4]Crockenberg, op. cit., p. 30.

if results appeared consistently significant. Since replication suggests the involvement of classroom practitioners, choice of instrumentation presented a unique challenge if replication objectives were to be met. The instrument would have to possess acceptable levels of interscorer reliability using either trained or untrained scorers. To reduce possible effects of testing, parallel forms would be necessary. The instrument itself had to be accessible to classroom personnel. Accessibility to classroom teachers does not suggest the use of teachers to conduct their own investigations with their own classrooms, but the availability and subsequent familiarity with use of the instrument should encourage classroom personnel to be part of the research process with other populations.

The Torrance Tests of Creative Thinking[5] were ten years in development. The tests are available in parallel forms appropriately labeled "A" and "B". Test booklets, directions manual and scoring guide, and a norms-technical manual are available for purchase.[6]

Evidence concerning interscorer reliability among trained

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[5]E. Paul Torrance, Torrance Tests of Creative Thinking, (Bensenville, Illinois: Scholastic Testing Service, Inc.) 1974.

[6]Ibid.

scorers were consistently in the acceptable range.[7] Data obtained from untrained scorers who used only the scoring guides were of particular importance. Evidence from experiments in which untrained classroom scorers evaluated samples of test booklets completed by children at the grade level at which they were teaching yielded favorable results when compared with trained scorers who examined the same booklets. Mean reliability coefficients for the Incomplete Figures Activity ranged from .88 for originality to .96 for fluency. Measurements for flexibility and elaboration revealed reliability coefficients between these extremes.[8]

Statements relative to overall validity are at best permeated by disagreement. Torrance has stated that an overall validity coefficient for tests of creative thinking is inappropriate,[9] preferring to think in terms of kinds of criteria for creative behavior.

Reviews by Taylor[10] and Yamamoto[11] described the

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[7]E. Paul Torrance, Torrance Tests of Creative Thinking: Norms-Technical Manual, (Bensenville, Illinois: Scholastic Testing Service, Inc., 1974). p. 17

[8]Ibid., p. 18.

[9]Ibid., p. 21.

[10]C.W. Taylor, (Ed.), Creativity: Progress and Potential, (New York: McGraw-Hill Book Co., 1964), p. 81-92.

[11]Yamomoto, K., "Validation of Tests of Creative Thinking" A Review of Some Studies," Exceptional Children, 31, (1965), 281-290.

intricacies of validity assessment and lacked specific findings on overall measures of validity per se. Treffinger[12] cautioned that in the quest for developing creativity tests that are managable from a statistical perspective, the tasks contained within the tests may have minimal application to real life creative accomplishments in the future. Similar precautions relative to predictive validity were further buttressed by Yaird,[13] declaring that the Torrance Tests of Creative Thinking need to be more firmly linked to reality by showing predictive value in terms of socially valuable behavior.

Numerous studies in support of the overall validity of the Torrance battery were presented by Torrance in the Norms-Technical Manual previously cited. The eficacy of these findings should be left to the judgement of the reader. The Torrance Test of Creative Thinking, Incomplete Figures Activity, Form A was selected as the pretest for this investigation. Parallel Form B of the Incomplete Figures Activity was selected for administration as the posttest measurement.

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[12]Treffinger, D.J., J.S. Renzulli, and J. F. Feldhusen, "Problems in the Assessment of Creative Thinking," Journal of Creative Behavior, 5, (1971), 104-112.

[13]Yaird, Leonard L., "The Torrance Tests of Creative Thinking," in the Seventh Mental Measurements Yearbook, Oscar Krisen Buros, Ed., (Highland Park, New Jersey: 1972), 1, 837.

Procedures

The four fifth grade classroom teachers at the intermediate school were provided with a brief description of the study and were invited to participate. As stated earlier, fifth grade classes are randomly formed at the beginning of the school year and are heterogeneous in nature. Further randomization solely for the investigation represented a scheduling imposition for the school and did not occur. The four fifth grade classes, however, were randomly assigned as Groups I-IV.

Necessary test administration and activities were conducted by individual class basis over a three week period. The initial week was devoted to pretesting, the second for the sorting activity, and the third for collection of post-test data.

Groups I and III were administered the Torrance Incomplete Figures Activity, Form A. Prior to the start of each pretesting session, subjects were read the following instructions.

> "By adding lines to the incomplete figures on this and the next page, you can sketch some interesting objects or pictures. 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. All right, go ahead. You will have ten minutes."[14]

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[14]E. Paul Torrance, Torrance Tests of Creative Thinking: Directional Manual and Scoring Guide, (Bensenville, Illinois: Scholastic Testing Service, Inc., 1974), p. 8.

As per direction guidelines, the aforementioned represented the total verbal assistance to the subjects during test administration. Apparently, even slight variations in verbal instructions can alter performance on many of the tasks typically included on tests designed to measure divergent thinking.[15] Research also indicates most measures of creative thinking are susceptible to a myriad of variables related to testing conditions and procedures.[16] Significantly, exactly what the precise effects of time imposed constraints, low pressure psychological atmospheres and verbal variations during instruction are not known due to the presence of conflicting results in parallel studies.[17] Uses and abuses of testing conditions were also addressed by Torrance[18] as a potential confounding variable influencing the data.

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[15]McCormack, Alan J., "Nonverbal Administration Protocols for Figural Tasks of the Torrance Tests of Creative Thinking," The Journal of Creative Behavior, 9, No. 2, (1975), p. 89

[16]Manske, M.E. and Davis, G.A., "Effects of Simple Instructional Biases Upon Performance in the Unusual Uses Test", Journal of General Psychology, 79, (1968), p. 25.

[17]Van Mondfrans, A., et al., "The Effect of Instructions and Response Time on Divergent Thinking Test Scores," Psychology in the Schools, 8, (1971), p. 65-69.

[18]Torrance, E. Paul, "Creativity Testing in Education," Creative Child and Adult Quarterly, 1, No. 3, (1976), p. 136-148.

Sorting[19]

Sorting activities were not initially composed to investigate their possible relationship to creative thinking. The objective of sorting was to permit lower and middle elementary school children to practice classificatory skills using a collection of unrelated objects for which the student established classes or groups based upon whatever criterion he chose to select. As the activity was trial taught in the classroom, it became clear that while a majority of students would classify on the basis of more obvious attributes such as color and shape, some would create more original categories related to function (items one could build or construct with) or form (items that need to be processed to be used versus items available as they naturally occur).

Additionally, while some students encountered difficulty in classifying all of their items, others were able by creating new or additional criteria, to classify all of their materials. By amending their initial criterion, some students succeeded in expanding or changing the actual number of groups in a given array of materials. It was following several observations of students engaged in sorting that the question of possible relationships to some of the parameters

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[19]See Appendix A

of creativity measurement in the Torrance Battery were considered. Specifically, would sorting experiences facilitate performance in the areas of fluency (number of figures completed), flexibility (number of different categories), originality (unusual or infrequent categories), and elaboration (exposition and use of detail) as presented in the Torrance Incomplete Figures Activity?

Drawing relationships among people, or things and events, internalizing ideas and images, and forming patterns are all essential components of thinking. Such basic mental processes as observing, making inferences, problem solving, and classificatory skills are all necessary elements in need of coordination to facilitate thinking. Of these, a major vehicle for the development of thinking in young children involves concrete experiences with classification activities.[20]

With roots in the sensori-motor period of development, classification is a process that continues to be refined through the period of formal operations.[21] It is both sequential and hierarchial. As more sophisticated

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[20]Isenberg, Joan P. and Jacobs, Judith E., "Classification: Something to Think About," Childhood Education, May/June 1981, p. 284.

[21]Jean Piaget and B. Inhelder, The Psychology of the Child, (New York: Basic Books, 1969), p. 103.

classification tasks are presented to children, the more they become involved in higher level thinking.[22]

Sorting, then is basically the ability to classify or group a collection of chosen objects according to either a specified rule or pre-established criteria.[23] Discounting valuables and large unwieldly items, virtually any objects can be utilized for the sorting array. Metal, wood, and plastic materials; items chosen for attributes of texture; plain or multicolored materials; household objects and workshop scraps have all been used. For specific purposes, the assortment can be narrowed to suit desired learning objectives. For instance, primary children often confuse shapes and sizes. By providing an array of shapes, but with two or three sizes, the sorting experience can assist with skill development in this area. Sorting experiences designed to improve classificatory skills include a variety of materials as previously indicated.[24] Materials that are essentially similar (such as an assortment of leaves or shells) should be avoided as they tend to restrict imaginative responses.

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[22]Ibid.

[23]Shattuck, J. Bruce, "Sorting Activities," Science and Children, 6, No. 6, (1969), p. 14-16.

[24]Ibid, p. 14.

Important procedural elements needed to be observed during sorting activities. Initially the students were asked to empty the contents (See Appendix A) of their sorting boxes on their desks, tables, or on the floor. At this point students were given several minutes to freely explore the array and become thoroughly acquainted with the objects. After their initial exploration, guided instructions were administered to begin the process of sorting itself.[25]

The process began when students were verbally encouraged to arrange objects in combinations or groups. The students were encouraged to create any number or type of combinations provided each item in a group had something in common with every other object. In situations where objects had poorly defined or unknown attributes, students were asked to start a pile of "not sure" articles. Decisions relative to this group could be delayed until later in the sorting process, with all objects ultimately sorted. At designated times during the activity, students were asked to find ways to increase or decrease the number of groups, or establish new ones by altering the criterion for inclusion of an object into a group.[26]

Instructor assistance during the sorting activities were

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[25]Ibid, p. 15.

[26]Ibid.

designed to be clarifying[27] and to avoid judgmental or evaluative traits. The purpose of any dialogue between the teacher and student was to raise questions in the mind of the student relative to the rationale for the criterion employed for grouping objects. While the key ingredient of the experimental intervention was the sorting activity itself, care was taken to avoid placing adult values upon students' selections. The "correctness" of choice was a valid approximation of the student's perceptions of an object, therefore the relative importance of correct or incorrect grouping was displaced by the selection of a criterion to be employed. The use of clarifiers as a method of encouraging divergent thinking has not been statistically verified, however classificatory oriented activities appear well suited to its application.[28]

Groups I and III received the sorting activity during two thirty minute sessions. All sorting activities were administered during week two of the investigation.

During the third and final week of the investigation, all subjects were administered parallel Form B of the Torrance Test of Creative Thinking, Incomplete Figures Activity. Methodology of administration was identical to those employed during the pretest utilizing Form A of the same instrument.

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[27]Merrill Harmin, et. al., Values and Teaching, (Columbus, Ohio: Charles Merrill Pub. Co., 1966), p. 51-82.

[28]Shattuck, J. Bruce, "Values Clarification from Science Instruction," Science and Children, 8, No. 4, (1971), p. 16-18.

CHAPTER IV

PRESENTATION OF THE DATA

The Design

To investigate if a relationship existed between sorting activities and the Torrance Incomplete Figures Task, a Solomon four-group design was employed. In this four-group form, there are included two control (Groups II and IV) and two experimental (Groups I and III) groups. Only one of each of the two groups is pretested. All groups are posttested at the conclusion of the study. Inclusion of the groups that are not pretested enables one to determine both the main effects of pretesting and the interaction of pretesting with the experimental variable. The solomon four-group design makes a strong effort to disentangle the possible effects of experimental treatment, the pretest contemporaneous events, and interactions of pretest and treatment. The presentation of the groups for analysis is illustrated in Table 1.

Table 1. Analysis Groups

Group	I	II	III	IV
Pretest	X	X		
Treatment	X		X	
Postest	X	X	X	X

Homogeneity of Variance

Initial analysis of the data was to observe if randomization of subjects resulted in an observed homogeneity of variances at the pretest level for Groups I and II.

F max values were consistently low (fluency 1.05; flexibility 1.11; originality 1.12; elaboration 1.25), suggesting that homogeneity of variances existed. Probabilities were consistently greater than .05 for each of the four measurements. This allowed the variances to be pooled and utilize a pooled standard error of estimate in an independent t-test of significant difference. One can observe from Tables 2.1 - 2.4 that the revealed t values at the pretest for Groups I and II were not statistically significant. This analysis supported the assumption that the random assignment to Groups I and II resulted in no statistically significant differences. Accordingly, it was additionally assumed that Groups III and IV were equivalent although no pretest data existed.

Pre and Posttest Data

Referring to Tables 2.1 - 2.4, one can observe pre and posttest means for both Groups I and II. Related T scores indicated a statistically significant ($p<.05$) correlation for Group I on measures of fluency, flexibility and originality. For elaboration, related T-scores revealed no statistical significance. On pre and post mean scores for Group II, there was a statistically significant correlation ($p<.05$) on all four measures.

Table 2.1 Summary Statistics, Fluency

Fluency	Pretest			Posttest		
	n	x	SD.	x	S.D.	t-test
Group I	23	6.13	2.49	9.78	0.67	6.86 ($p<.05$)
Group II	23	6.87	2.44	9.22	1.17	3.63 ($p<.05$)
t-test*		1.32 ($p>.05$)		-2.01 ($p<0.5$)		

	n	x	S.D.	x	S.D.	t-test**
Group III	23			8.43	1.99	
Group IV	23			7.04	2.25	
t-test*				2.22	($p<.05$)	

* independent t-test

** related t-test

Table 2.2 Summary Statistics, Flexibility

Flexibility	Pretest			Posttest		
	n	x	SD.	x	S.D.	t-test
Group I	23	4.87	1.91	7.65	1.07	6.14 ($p<.05$)
Group II	23	5.26	1.81	8.35	1.26	7.09 ($p<.05$)
t-test*		0.71 ($p>.05$)		-2.01 ($p<.05$)		
	n	x	S.D.	x	S.D.	t-test**
Group III	23			7.34	1.72	
Group IV	23			5.96	2.03	
t-test*				2.50	($p<.05$)	

* independent t-test

** related t-test

Table 2.3 Summary Statistics, Originality

Originality	Pretest			Posttest		
	n	x	SD.	x	S.D.	t-test
Group I	23	5.43	2.42	7.96	2.65	3.47 ($p<.05$)
Group II	23	5.00	2.30	6.96	2.53	2.54 ($p<.05$)
t-test*		.62 ($p>.05$)		1.31 ($p>.05$)		

	n	x	S.D.	x	S.D.	t-test**
Group III	23			6.83	2.53	
Group IV	23			5.30	2.38	
t-test*				2.10	($p<.05$)	

* independent t-test

** related t-test

Table 2.4 Summary Statistics, Elaboration

Elaboration	Pretest			Posttest		
	n	x	SD.	x	S.D.	t-test
Group I	23	13.17	6.65	16.30	4.41	1.68 (p>.05)
Group II	23	16.56	5.94	21.30	7.29	2.71 (p<.05)
t-test*		-1.82 (p>.05)		-2.81 (p<.05)		

	n	x	S.D.	x	S.D.	t-test**
Group III				15.74	7.14	
Group IV				12.43	4.60	
t-test*				1.87	(p>.05)	

* independent t-test

** related t-test

One-Way Analysis of Variance

One-way analysis of variance was then employed to establish if a significant difference ($p<.05$) existed on the posttest means for Groups I-IV. Tables 3.1 - 3.4 reveal ANOVA calculations for each of the four posttest measurements.

Table 3.1 ANOVA

Fluency

Source	D.F.	Sum Sq.	X Sq.	F Ratio	F. Prob.
Between Gps.	3	97.2498	32.4166	11.964	0.0000
Within Gps.	88	238.4344	2.7095		
Total	91	335.6841			

Table 3.2 ANOVA

Flexibility

Source	D.F.	Sum Sq.	X Sq.	F Ratio	F. Prob.
Between Gps.	3	69.6090	23.2030	9.427	0.0000
Within Gps.	88	216.6083	2.4615		
Total	91	285.2173			

Table 3.3 ANOVA

Originality

Source	D.F.	Sum Sq.	X Sq.	F Ratio	F. Prob.
Between Gps.	3	82.6520	27.5507	4.313	0.0069
Within Gps.	88	562.0865	6.3873		
Total	91	644.7385			

Table 3.4 ANOVA

Elaboration

Source	D.F.	Sum Sq.	X Sq.	F Ratio	F. Prob.
Between Gps.	3	924.8981	308.2993	8.511	0.0001
Within Gps.	88	3187.8206	36.2252		
Total	91	4112.7148			

As indicated by Tables 3.1 - 3.4, F max probability values were consistently statistically significant ($p<.05$) at the posttest for each of the four measures. While the one-way analysis of variance revealed a significant difference between the means did exist, it did not reveal which means were significant and for what level of measurement. Matrices utilizing separate T values and their probabilities for each measurement and by groups were then profiled to determine which means were significant. See Tables 4.1 - 4.4.

Table 4.1

T-Test Values and Probabilities ($p<.05$) Matrix

Fluency

	I	II	III	IV	I,III/II,IV
I		2.01	3.07	5.60	
II	<.05		-1.62	4.12	
III	>.05	<.05		2.22	
IV	<.05	<.05	<.05		
I,III/II,IV					2.85
					<.05

As one may observe from Table 4.1, the following posttest means were statistically significant ($p<.05$) for fluency: Groups I and II; I and III; I and IV; II and IV; III and IV; I/III and II/IV. Contrasts between Groups II and III were not statistically significant.

Table 4.2

T-Test Values and Probabilities ($p<.05$) Matrix

Flexibility

	I	II	III	IV	I,III/II,IV
I		-2.01	.72	3.54	
II	<.05		-2.24	4.79	
III	>.05	<.05		2.50	
IV	<.05	<.05	<.05		
I,III/II,IV					1.06
					>.05

As one may observe from Table 4.2, the following posttest means were statistically significant ($p<.05$) for flexibility: Groups I and II; I and IV; II and III; II and IV; III and IV. Contrasts between Groups I and III and I/III and II/IV were not sitnificant.

Table 4.3

T-Test Values and Probabilities ($p<.05$) Matrix

Originality

	I	II	III	IV	I,III/II,IV
I		1.31	1.48	3.57	
II	>.05		-0.17	2.28	
III	>.05	>.05		2.10	
IV	<.05	<.05	<.05		
I,III/II,IV					2.40
					<.05

Observing Table 4.3, one finds the following posttest mears statistically significant ($p<.05$) for originality: Groups I and IV; II and IV; III and IV; and I/III and II/IV. Contrasts between Groups I and II, I and III and II and III were not statistically significant.

Table 4.4

T-Test Values and Probabilities ($p<.05$) Matrix

Elaboration

	I	II	III	IV	I,III/II,IV
I		-2.81	0.32	2.91	
II	<.05		-2.61	4.93	
III	>.05	<.05		1.86	
IV	<.05	<.05	>.05		
I,III/II,IV					-0.68
					>.05

Observing Table 4.4, one can observe the following post-test means as statistically significant ($p<.05$) for elaboration: Groups I and II; I and IV; II and III; II and IV. Contrasts with I and II; III and IV; I/III and II/IV were not statistically significant.

Analysis of Covariance

The one-way analysis of variance compared all four groups for significance at the posttest. Use of the T-test values and probabilities matrix presented which means were significant and for what groups. At this juncture the relative impact of group assignment will be investigated. Pretest influence has not been taken into consideration as a

covariate upon the posttest means. The analysis of covariance permits the factoring out of the covariate to observe if once the covariate is eliminated any significance remains between the posttest means for Groups I and II. Table 5.1 summarizes the results of an ANCOVA of fluency.

Table 5.1

ANCOVA - Fluency

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif. of F.
Preflu	2.970	1	2.970	3.385	0.073
Group	2.805	1	2.805	3.198	0.081
Explained	5.775	2	2.888	3.291	0.047
Residual	37.725	43	0.877		
Total	43.500	45	0.967		

One can observe from Table 5.1 that 13.2 percent of the total variance in the posttest scores is explained by the pre-test scores and the sorting activity.* The proportion of explained variance is statistically significant at the .05 level of significance. Slightly more than half of the explained variance (51.4%) is accounted for by the covariate.** The proportion of variance in the total variance

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* Explained - Total

**Preflu - Explained

explained by either the pretest or the sorting activity is not statistically significant at the .05 level of significance. Their respective F values were 3.39 and 3.20. Figure 1.1 shows the adjusted and unadjusted fluency means for Groups I and II.

Figure 1.1

Adjusted and Unadjusted

Fluency Means

Groups I and II

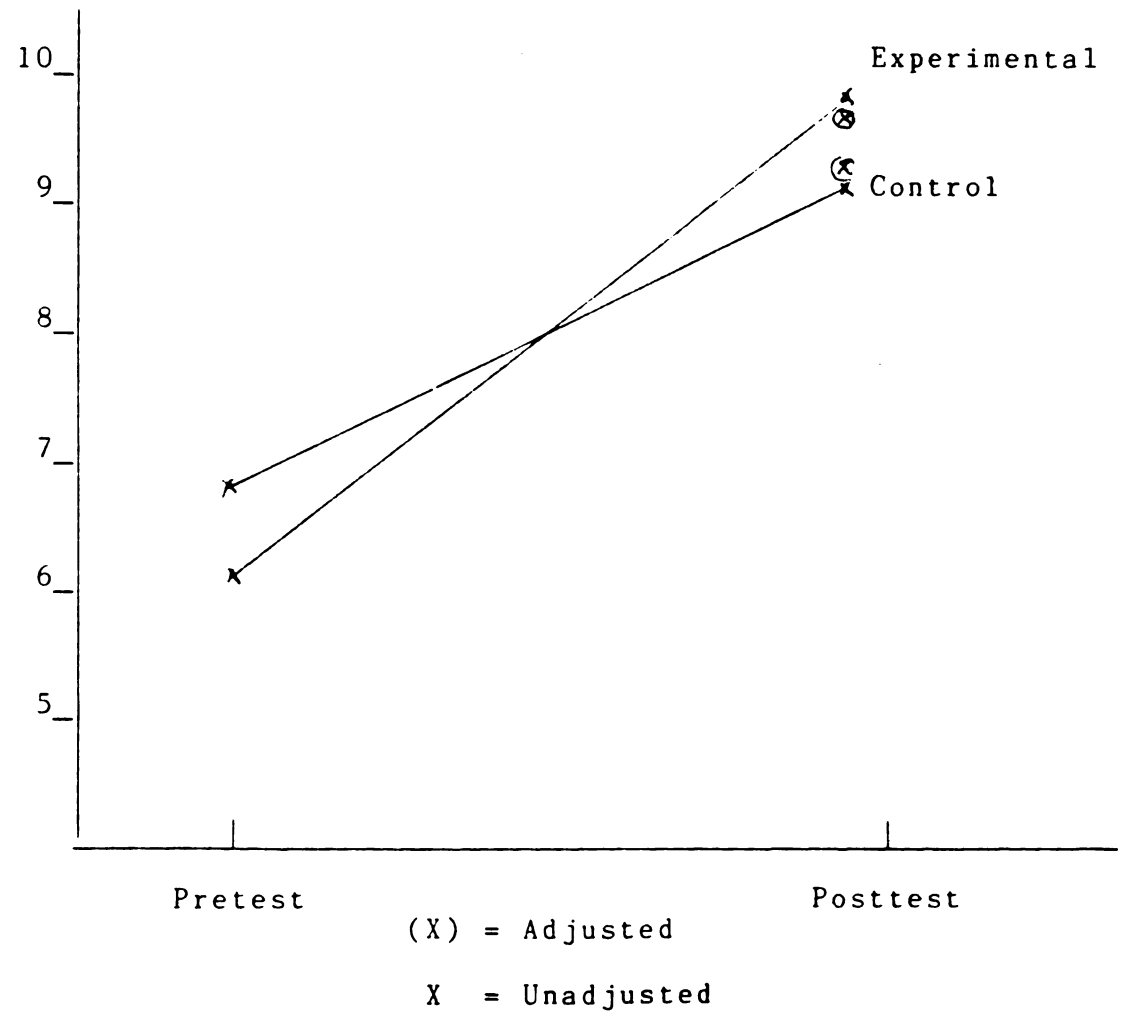


Table 5.2 summarizes the results of an ANCOVA of flexibility.

Table 5.2

ANCOVA - Flexibility

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif. of F.
Preflex	0.646	1	0.646	0.462	0.500
Group	5.228	1	5.228	3.739	0.060
Explained	5.874	2	2.937	2.100	0.135
Residual	60.126	43	1.398		
Total	66.000	45	1.467		

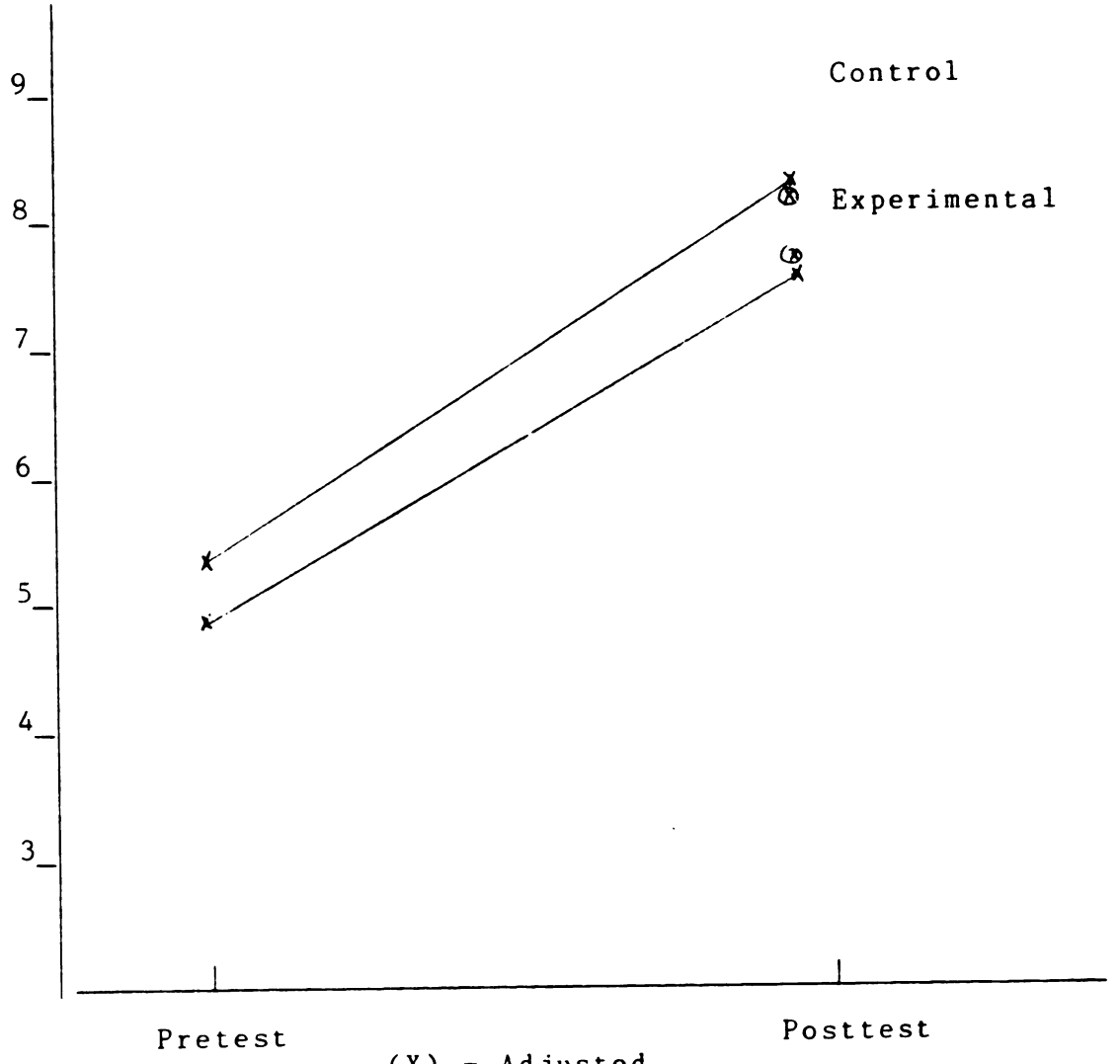
One can observe from the Table that 8.9 percent of the total variance in the posttest scores are explained by the pretest scores and the sorting activity. The proportion of explained variance is not statistically significant at the .05 level of significance. The covariate accounted for 10.9 percent of the explained variance. The proportion of variance in the total variance explained by either the pretest or the sorting activity is not statistically significant at the .05 level of significance. Their respective F values were 0.46 and 3.74. Figure 1.2 shows the adjusted and unadjusted flexibility means for Groups I and II.

Figure 1.2

Adjusted and Unadjusted

Flexibility Means

Groups I and II



(X) = Adjusted

X = Unadjusted

Table 5.3 summarizes the results of an ANCOVA of originality.

Table 5.3

ANCOVA - Originality

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif. of F.
Preorig.	0.048	1	0.048	0.007	0.934
Group	11.462	1	11.461	1.666	0.204
Explained	11.510	2	5.755	0.836	0.440
Residual	295.902	43	6.881		
Total	307.412	45	6.831		

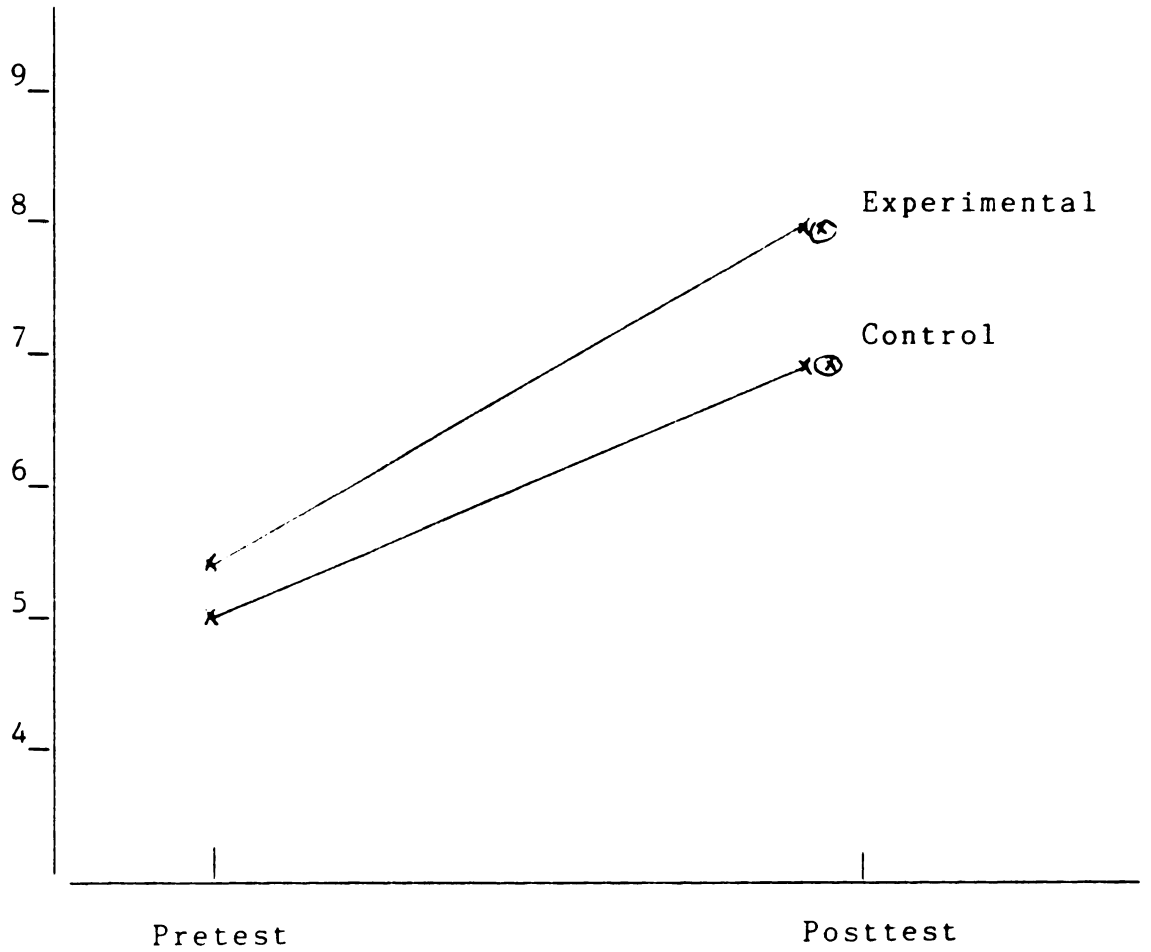
One can observe from the Table that 3.7 percent of the total variance in the posttest scores are explained by the pretest scores and the sorting activity. The proportion of explained variance is not statistically significant at the .05 level of significance. Less than one percent of the explained variance is accounted for by the covariate. The proportion of variance in the total variance explained by either the pretest or the sorting is not statistically significant at the .05 level of significance. Their respective F values were .01 and 1.67. Figure 1.3 shows the adjusted and unadjusted originality means for Groups I and II.

Figure 1.3

Adjusted and Unadjusted

Originality Means

Groups I and II



(X) = Adjusted

X = Unadjusted

Table 5.4 summarizes the results of an ANCOVA of elaboration.

Table 5.4

ANCOVA - Elaboration

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif. of F.
Preelab.	24.761	1	24.761	0.666	0.419
Group	262.987	1	262.987	7.070	0.011
Explained	287.748	2	143.874	3.868	0.029
Residual	1599.488	43	37.197		
Total	1887.236	45	41.939		

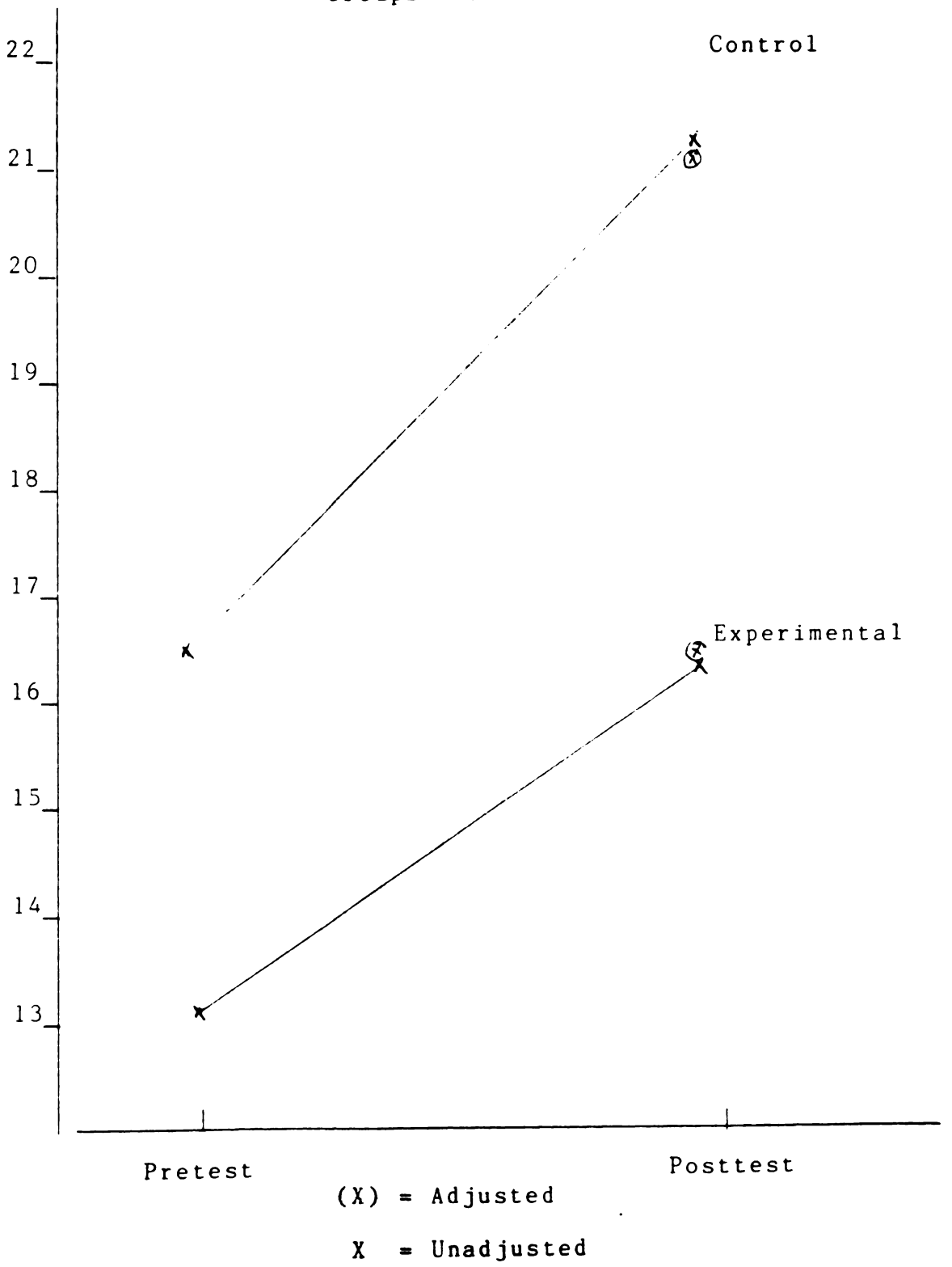
One can observe from the Table that 15.2 percent of the total variance in the posttest scores are explained by the pretest scores and the sorting activity. The proportion of explained variance is statistically significant at the .05 level of significance. Of the explained variance, 8.6 percent is accounted for by the covariate. The proportion of variance in the total variance explained by either the pretest or the sorting activity is statistically significant at the .05 level of significance. Their respective F values were .67 and 7.07. Figure 1.4 shows the adjusted and unadjusted elaboration means for Groups I and II.

Figure 1.4

Adjusted and Unadjusted

Elaboration Means

Groups I and II



Two-Way Analysis of Variance

To statistically evaluate the significance of group assignment and the covariate with the independent variable, a two-way analysis of variance was employed. As an extension of simple analysis of variances, the data was organized into a double entry table, with one of the independent variables placed into columns and the other into rows. Figure 2.1 illustrates the procedure.

Figure 2.1

Two-Way ANOVA

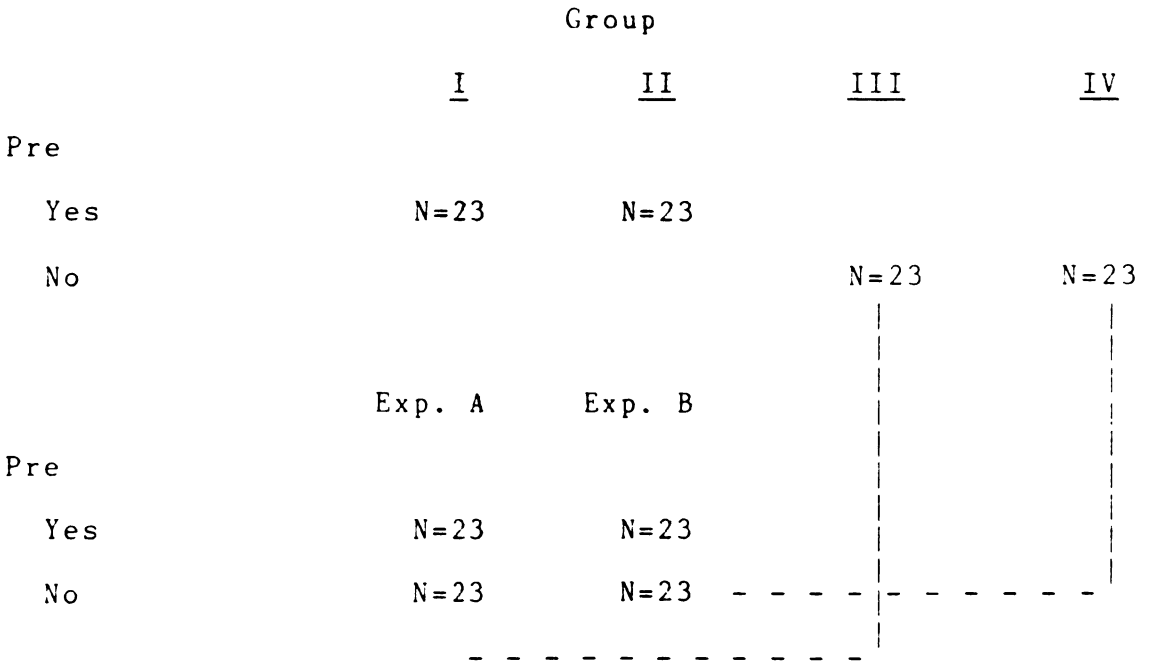


Table 6.1 summarizes the results of a two-way analysis of variance of fluency.

Table 6.1

Two-Way ANOVA

Fluency

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif. of F.
Main Effects	93.326	2	46.663	17.222	0.000
N Group	22.011	1	22.011	8.124	0.005
N Preflu	71.315	1	71.315	26.321	0.000
Two-Way Inter	3.924	1	3.924	1.448	0.232
Explained	97.250	3	32.417	11.964	0.000
Residual	238.433	88	2.709		
Total	335.683	91	3.689		

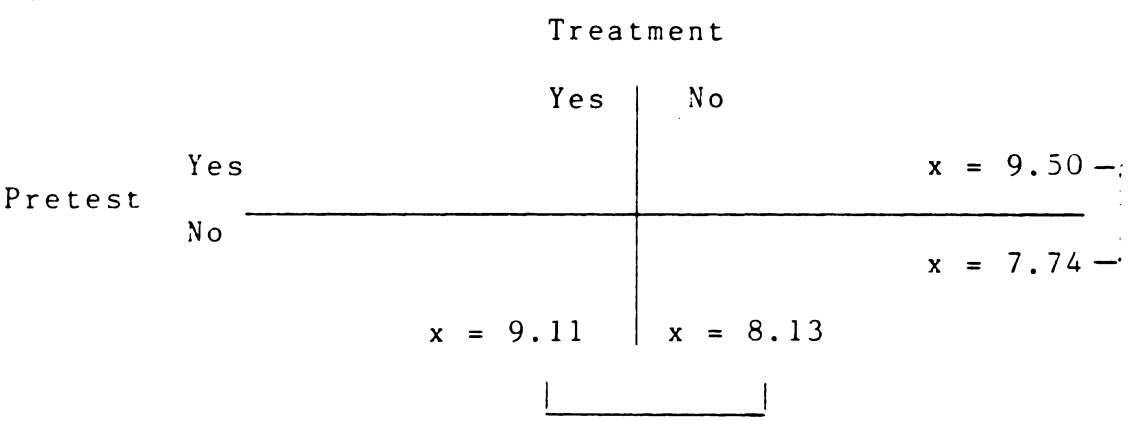
One can observe from the Table that 28.9 percent of the total explained variance was explained. Of the explained variance, 95.9 percent was accounted for by the main effect. Of the main effect, 14.4 percent was accounted for by the group assignment and 76.4 percent by the pretest. All of the aforementioned ratios were statistically significant at the

.05 level of significance. F values for the group and pretest were 8.12 and 26.32 respectively. Interaction, or the concomitant effect of the two independent variables was observed at 4.03 percent and was not statistically at the 0.5 level of significance. Adjusted fluency means are entered in the appropriate cells in Figure 2.2.

Figure 2.2

Two-Way ANOVA

Fluency Adjusted Means



Observations for fluency means revealed subjects who received the pretest scored higher on posttest means regardless of treatment (9.50 to 7.74). Subjects who were administered the treatment scored higher on posttest means than those not administered the treatment (9.11 to 8.13).

Table 6.2 summarizes the results of a two-way analysis of variance of flexibility.

Table 6.2

Two-Way ANOVA

Flexibility

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif. of F.
Main Effects	44.565	2	22.283	9.053	0.000
N Group	2.783	1	2.783	1.130	0.291
N Preflu	41.783	1	41.783	16.975	0.000
Two-Way Inter	25.043	1	25.043	10.174	0.002
Explained	69.609	3	23.203	9.427	0.000
Residual	216.607	88	2.461		
Total	286.216	91	3.145		

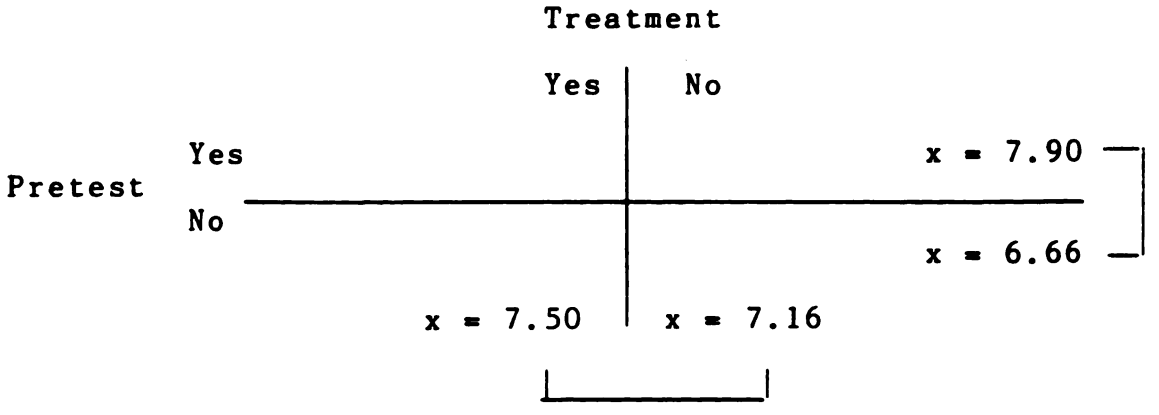
One can see from the Table that 24.0 percent of the total variance was explained. Of the explained variance, 64.3 percent was accounted for by the main effect. Both of the aforementioned ratios were statistically significant at the .05 level of significance. Of the main effect, 6.2 percent was accounted for by the group and was not statistically significant. The pretest, however, accounted for 93.5 percent of the main effect and was statistically significant at the .05 level of significance. F values for group and pretest

were 1.13 and 16.97 respectively. Interaction was observed as accounting for a statistically significant 35.9 percent of the explained variance. Adjusted flexibility means are entered in the appropriate cells in Figure 2.3.

Figure 2.3

Two-Way ANOVA

Flexibility Adjusted Means



Observations for flexibility means revealed subjects who were administered the pretest scored higher in posttest means regardless of treatment (7.90 to 6.66). Subjects administered the treatment scored higher on posttest measures than those not receiving the treatment (7.50 to 7.16).

Table 6.3 summarizes the results of a two-way analysis of variance of originality.

Table 6.3

Two-Way ANOVA

Originality

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif. of F.
Main Effects	81.087	2	40.543	6.348	0.003
N Group	36.565	1	36.565	5.725	0.019
N Preorig	44.522	1	44.522	6.970	0.010
Two-Way Inter	1.565	1	1.565	0.245	0.622
Explained	82.652	3	27.551	4.313	0.007
Residual	562.079	88	6.387		
Total	644.732	91	7.085		

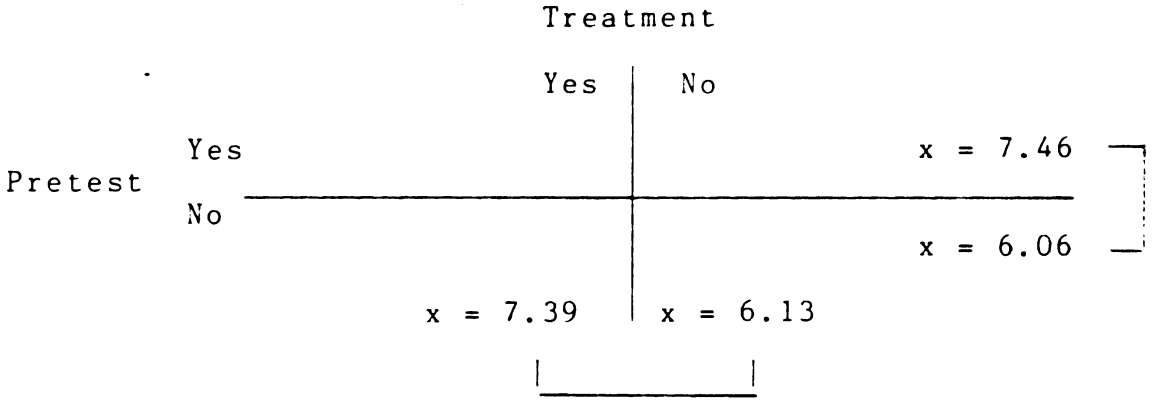
One can observe from the Table that 12.8 percent of the total variance was explained. This ratio was statistically significant at the .05 level of significance. Of the explained variance, 98.1 percent was accounted for by the main effect. Of the main effect, 45.1 and 54.9 percent were accounted for by the groups and the pretest, respectively. Both of these ratios were statistically significant at the .05 level of significance. F values were observed at 5.72 and 6.97 respectively for group and pretest. There was no

significant interaction observed. Adjusted means are entered in the appropriate cells in Figure 2.4

Figure 2.4

Two-Way ANOVA

Originality Adjusted Means



Observations for originality were similar to fluency and flexibility. Subjects administered the pretest scored higher on posttest means regardless of treatment (7.46 to 6.06). Subjects administered the treatment scored higher on posttest measures than those not receiving the treatment (7.39 to 6.13).

Table 6.4 summarizes the results of a two-way analysis of elaboration.

Table 6.4

Two-Way ANOVA

Elaboration

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif. of F.
Main Effects	528.369	2	264.185	7.293	0.001
N Group	16.533	1	16.533	0.456	0.501
N Preelab	511.837	1	511.837	14.129	0.000
Two-Way Inter	396.533	1	396.533	10.946	0.001
Explained	924.902	3	308.301	8.511	0.000
Residual	3187.817	88	36.225		
Total	4112.719	91	45.195		

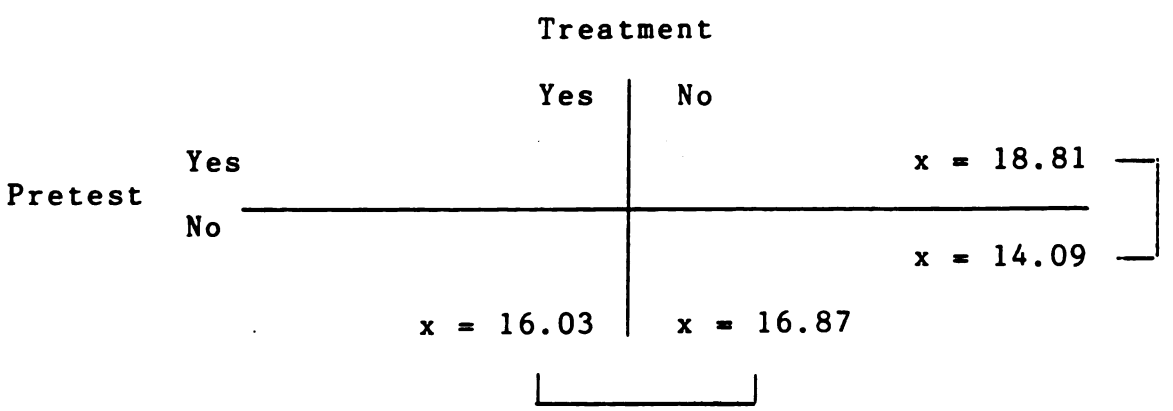
One can observe from the Table that 22.5 percent of the total variance was explained and was statistically significant at the .05 level of significance. The main effect accounted for 57.1 percent of the explained variance and was also statistically significant. Of the main effect, 1.7 percent was accounted for by the group and 55.3 percent by the pre-test. The former was not statistically significant; however the pretest was statistically significant at the .05 level of significance. F values were observed at 0.456 and 14.13,

respectively. There was a significant interaction of 42.8 percent. Adjusted means are entered in the appropriate cells in Figure 2.5.

Figure 2.5

Two-Way ANOVA

Elaboration Adjusted Means



Observations for elaboration means indicated subjects who received the pretest again scored higher in posttest means regardless of treatment (18.81 to 14.09). For elaboration, subjects who were not administered the treatment scored slightly higher (16.87 to 16.03) than subjects who were administered the treatment.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this chapter is to present a restatement of the problem and present a synopsis of the research procedures and findings. In addition, the conclusions regarding the hypotheses are summarily discussed.

Summary

The purpose of the study was to investigate if a relationship existed between sorting activities and creative thinking. Specifically, would participation in the sorting task impact upon the dependent variable, the Torrance Test of Creative Thinking: Incomplete Figures Activity Form B.

By 1988, the Creative Education Foundation projects some 20,000 items listed as creativity research. Six basic categories of investigation have been included:

1. Differences between high and low creative individuals regarding personality structures, cognitive functioning, and biographical data.

2. Research comparing individual creativity with that of selective groups.

3. Investigations designed to identify the role of educators, psychologists, and others in a helping relationship to better understand the dynamics of creativity.

4. Studies of factors that appear to inhibit creative thinking.

5. Analysis of relationships among creativity, intelligences, and some measurement index of achievement.

6. Studies of environmental variables affecting creativity, such as learning and home environmental factors, educational background, and sociological patterns.

This investigation directly involved a classroom teaching device and its relationship to creative thinking. The majority of the aforementioned categories, while of value to the field of creativity research in general, were not directly related to the researchable problem at hand. Appropriate criteria were established for inclusion of related investigations in order to gain greater relevancy and a sense of overall connectedness to the study. Inclusion of bibliographical data needed to meet the following criteria:

1. Studies that were directly related to school populations or possessed intrinsic transfer value when considering school populations.

2. Studies that focused upon specific variables that buttressed an understanding for creativity experimentation in the schools.

3. Investigations that expressed a theoretical framework significant to the research problem of this investigation.

4. Research representative of other parallel studies useful for illustrative purposes.

Examination of literature that met the above criteria revealed a dearth of appropriate investigations. While sufficient numbers of classroom oriented investigations were observed, these generally were not of an experimental nature or did not sufficiently isolate parameters that could facilitate empirical evaluation. Classificatory modes have long been considered a contributory attribute of science education, however their role as a vehicle for creative stimulus appears to rest in a neophytic milieu and were conspicuously absent.

The largest component of classroom investigations involved comparisons of classroom structure, such as "open" versus "traditional" approaches. Findings in this area appeared to be more related to structures of the classroom than structures of the activities designed to develop and extend creative thinking.

It would appear more educationally sound from a research perspective to address the classroom environment question from other than a "traditional" versus "progressive" perspective. Perhaps certain kinds of measurable creativity would appear to be more appropriate compared to certain kinds of classroom environments. This notion was buttressed by Ramez and Piper (1974) in observing a strong relationship of open-classroom figural activity and traditional classroom superiority in verbal creativity. The work of Thomas and Buck (1981)

indicated school environments to be an intensely complicated area of investigation. Dimensions such as type of school were the beginnings of other factors--these factors included sex of the child, age, and the component of creativity assessed.

The cumbersome approach to linking creative thinking with environmental factors may account for the range of findings encountered in the literature. Haddon and Lytton (1968) found a positive relationship of creativity sources for children in progressive schools. Research conducted by Wilson, Stuckey and Langivin (1972) found open-class children were less creative than those in a traditional class. Bennett (1976) and Wright (1975) found little or no correlation between creativity and school environments.

Conclusions

This study investigated if there is a relationship between sorting activities and the Torrance Test of Creative Thinking: Incomplete Figure Activity. This study was conducted in the classroom utilizing ninety-two randomly selected fifth grade students.

Since the limits of interpretation are established upon choice of design, it was imperative to select a strong and methodologically appropriate blueprint. The precision afforded by pretesting was desirable but the potential for interaction between pretest and treatment needed to be

addressed. An after-only design would be free of the interaction problem but interpretation of results would have been limited. If for example groups receiving the treatment received higher mean scores on the dependent variables all one could infer is just that. The literature is spotted with findings in which the investigators assume the reason for differences on posttest results has been caused by experimental manipulations.

The Solomon four-group design makes the strongest effort to disentangle the possible effects of experimental treatment, the pretest, contemporaneous events, and interactions of pretest and treatment. The Solomon four-group design was selected for this investigation after explicit consideration was given to its regard for factors relative to external validity.

Investigations that are classroom based should be conducted in order to consider policy making decisions within the school framework as regards curriculum. Use of the Solomon four-group design appears infrequently in the literature, however, its value in pinpointing the effects of the factors under consideration merit its widespread consideration and broader use. The methodological value of this investigation, prior to any statistical analysis or significance of findings, appear to be: (1) the study fulfills a need for more classroom oriented research in the area of instructional

strategies and (2) use of the Solomon four-square design with the population selected will help to facilitate generalizability of findings to other school populations.

Hypotheses for this investigation were established as follows:

HO_1: Subjects exposed to the sorting activity would exhibit higher posttest means than subjects not exposed to the sorting activity.

HO_2: Subjects exposed to the sorting activity would score highest on measurements of originality on the posttest instrument than subjects not exposed to the sorting activity.

HO_3: Following originality, subjects exposed to the sorting activity would then exhibit highest posttest scores for measures of flexibility followed by fluency and elaboration.

Initial analysis of the data revealed homogeneity of variance for Groups I and II existed at the pretest level. For each of the four measures, T-values were consistently greater than the .05 level of significance. In the Solomon four-group design, it is assumed that if the remaining experimental and control groups had received the pretest measurement, their scores would have been similar to the first experimental and control groups, since all four groups had been originally constituted by random assignment. Homogeneity

of variance was therefore assumed for all four groups.

Observations of summary statistics for Groups I and II yielded the following:

1. For Group I pre and posttest contrasts exhibited an increase in posttest means for each of the four measures. These changes were statistically significant for fluency, flexibility, and originality. No statistical significance was observed for elaboration.

2. For Group II pre and posttest contrasts also exhibited an increase in posttest means for each of the four measures. These changes were statistically significant for all four measures.

The increase in posttest mean for Group I was desirable. However, the accompanying increase in posttest mean for the control group minimized identification of possible causal relationships. Broadly, there was a change and this change was largely significant within and between the two groups.

Observations of summary statistics for Groups III and IV yielded the following:

1. Group III, as the second experimental group, attained higher posttest scores for each of the four measurements than did Group IV, the second control group.

2. Exclusive of the measurement for elaboration which was not statistically significant, the measurements for fluency, flexibility, and originality were statistically significant.

The first hypothesis, that subjects exposed to the sorting activity would attain higher posttest means than subjects not exposed to sorting was partially supported for Groups I and II. The data supported the first hypothesis with reference to Groups III and IV.

The second hypothesis, that subjects receiving the treatment would score highest on the measurement for originality, was not supported by the data for any of the four groups. It should be noted, however, that while attained scores did not reflect support for the second hypothesis, subjects receiving the sorting activity did score higher on the posttest measure of originality than subjects not receiving the intervention. For posttest results of Groups III and IV, this was statistically significant.

The third hypothesis, that following originality, subjects exposed to the sorting activity would then exhibit highest posttest means for measures of flexibility followed by fluency and elaboration, was not supported by the data. It should be noted that the third hypothesis was largely dependent upon relative support of the data for the second hypothesis. It therefore lacked any degree of interpretive integrity on its own merit. It should also be noted that the intended future replication of this investigation will not include attempts to hypothesize hierarchial results involving four levels of measurement at the posttest.

Analysis of covariance calculations investigated the relative impact of group assignment. Posttest means for Groups I and II had been previously observed as statistically significant both within and between groups. ANCOVA of fluency, flexibility, originality, and elaboration revealed no significance once the covariate was factored out. Fluency calculations revealed the strongest effort, however, with slightly more than half of the explained variance accounted for by the covariate. The reader is reminded that the measurement for fluency involves the total number of pictures that are completed by the subject at both the pre and post levels.

Perhaps the most revealing observations occurred as a result of the two-way analysis of variance. This function was performed in order to statistically evaluate the significance of group assignment and the covariate with the independent variable. As no pretest data was available for Groups III and IV as per the Solomon four-square design, the data was organized into a double entry table, with one of the independent variables placed into columns and the other into rows. In this fashion, Groups I and III actually became New Group I and Groups II and IV New Group II. Main effects of group assignment and pretest were statistically significant for fluency, with the pretest accounting for a large proportion of (76.4 percent) of the main effect. For flexibility, in excess of ninety percent of the main effect was accounted for by the

pretest. For originality, 98.1 percent of the variance was explained by the main effect, with over half of this ratio accounted for by the pretest. For elaboration, observations for main effect yielded in excess of 55.3 percent accounted for by the pretest.

Adjusted means for the two-way ANOVA fluency, flexibility and originality yielded two significant findings:

1. Subjects who received the pretest scored higher in posttest means regardless of the presence or absence of the treatment.

2. Subjects who were administered the treatment scored higher on posttest means than those subjects not administered the treatment.

Adjusted means for the two-way ANOVA of elaboration yielded the following findings:

1. As with fluency, flexibility and originality, subjects who received the pretest again scored higher on posttest means regardless of treatment.

2. Subjects who were not administered the treatment scored slightly higher than subjects who were administered the treatment.

The prevalent impact upon the dependent variable appears to have been the result of the synthesizing of subjects by the pretest. As interpreted by the finding, this impact was significant. Sorting activities appear to have had a

secondary influence although its impact was an identifiable one. Posttest scores from Groups III and IV lend credence to the role of sorting in creative thinking. This notion was further supported through observations of the two-way ANCOVA.

Sorting encourages active participation to problem solve and categorize with dependence upon the students criteria for grouping. This in itself is basic to original thinking and continuous appraisal of the available alternatives. Correct answers are not the students goal, but a continual refinement of thinking leading to intrinsically motivated rewards. During sorting, the students are encouraged to shift criteria in order to increase or decrease the number of groups that can be formed by their sorting array, which is related to the flexibility and fluency component of the instrument. Elaboration appears to be the least related to the sorting activity on the basis of the findings of this investigation. The cause for this may well be that elaboration scores reflect the quantity of detail added to the original idea. This process may be more dependent upon artistic fluency and not be as strongly related to original thinking.

Recommendations

The following represent suggested directions and design approaches that may serve as a coagulant to research approaches in creative thinking. They are most appropriate

when applied to experimental studies investigating the relationship of specific activities and creative testing. Recommendations include the following:

1. More focus should be given to future classroom studies in terms of what is done with the data once collected. Treatment of the data needs to do more than indicate change in the presence of what appear to be causal relationships. Possein (1967) concluded that students trained in the use of inductive procedures exhibited some characteristics of problem solving more frequently than pupils taught by the deductive method. However pre and post instruments were identical and the question of test-retest effects were not addressed.

2. Too many parameters are frequently investigated simultaneously and create an anatomically cumbersome investigation. Future contributions may be facilitated by the identification of the most appropriate activities that are found through statistical analysis to be intrinsically valuable relative to creative development. By using the activities in a systematic manner, their subsequent value can be networked into the myriad of labels that have been bestowed upon the classroom. Investigations most often appear to emanate from another direction, such as parental influences (Thomas and Berk, 1981), attendance at a pre-school program (Hahn, 1981), and preferences in teaching styles (Selkirk, 1979). While these approaches and choices of investigative

channels to contribute to a profile of information, their limitations in terms of classroom applications remain.

3. Subjects involved in this investigation were exposed to two thirty minute sessions with sorting. The possible combinations of the activity are endless. Students may well be hesitant to attempt original responses for fear of "incorrect" responses. Although the activity is non-judgmental in terms of evaluation, this is not made clear to the students during the instructions. This leaves a single thirty minute session in which the students become aware of the opportunity to freely explore grouping alternatives. A mini-unit could be developed in which students have the opportunity to practice their decision making skills during several sessions over a period of weeks. Randomly selected fifth grade students should be involved to broaden the data base. Selection of other age/grade populations would erode a desired focus of research. A second motivation for utilizing fifth grade populations involves the already statistically supported notion of creativity slumps that periodically occur (Torrance, 1967; Williams, 1976) but have not been reported with fifth grade students.

4. The results of this investigation suggest a significant impact of the pretest upon posttest scores. Each time subjects were administered the pretest they scored higher on posttest means than subjects not administered the pretest

regardless of treatment. The absence of a pretest eliminates test-retest effect but sharply reduces the validity of the study by disregarding homogeneity of the populations strength of the randomization, and removal of crucial comparative data. What may be present in creativity experimentation is the tendency of creativity instruments in general to disproportionately synthesize subjects via the pretest. If inferences are based upon analysis of the data collected by the instruments, then what may be needed is closer examination of the hypothesis that it is the testing and not the treatment that encompasses the main effect. Although appropriate statistical analysis should normally address the question, experimental designs need to be created that have as their primary function the effects of the instrument rather than the treatment. Certain types of research, particularly classroom research, have a distinct tendency to produce unequal variances. It could be possible that educators have used classroom research in the same manner the village inebriate utilizes the lamppost for support instead of illumination.

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