THE EFFECT OF HEAD START EXPERIENCES IN DEVELOPING COGNITIVE NUMERICAL CONCEPTS

A THESIS

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INTRODUCTION

An environment of meager stimulation can retard or distort a child's development, according to Child Development specialists in the Office of Child Development (18). The necessity of developing intervention programs designed to remedy identified educational deficits has for many years been neglected by the public schools. With the growing recognition that the elementary school years may be too late, current focus has moved to include also the preschool educational program. Head Start is the massive federally funded program designed to bring the nation's resources to bear on the vital preschool years, combining medical, nutritional, social service and educational resources.

Todd and Heffernan (17) stated, as the total child is nurtured, bringing him to the point of expected maturational level, cognitive development becomes an integral part of his total development. The child's mental processes expand, enhancing his ability to think reason, and speak clearly. The appropriate numerical concepts begin to form along with other necessary cognitive skills and is fundamental to the state of readiness for so-called "formal learning". An integral part of the assessment of the cognitive growth of preschool children is their concept of numbers--the foundation for future mathematical competence.

The investigator, in surveying literature pertinent to the development of numerical concepts of young children, recognized the fundamental influence of environmental and mental stimulation. A review of methods and techniques for consolidating and developing numerical concepts in the preschool years appeared appropriate to this study.

REVIEW OF LITERATURE

Historical Background

Smith (15) traced the origin of numbers before the time of Thales (c. 600 B.C.). According to records this philosopher taught certain of the elementary properties of numbers in the Ionic School, of which he was the founder. Smith further asserted that the first successful effort in the preparation of an expository treatise was made by Euclid (c. 300 B.C.), who showed great genius in systematizing mathematical knowledge. A parade of contributors shared their findings, to give man the fundamental processes of the number system. Figurate numbers projected by the Greeks gave birth to geometric shapes through the system of pyramidal and spherical numbers.

Todd and Heffernan (17) referred to mathematics as the science basic to all other sciences, because of the fundamental role mathematics plays in the function of other sciences. According to Gesell and Ilg (5):

> Time, space, numbers,form, texture, color and causality--these are the chief elements in the world of things in which the child must find himself. . .he acquires his command of eyes, hands, and feet. In this motor experience he lays the foundation for his later judgments and concepts.

One of the objectives of poignant interest reflected by the Head Start guidelines (18) is improving the child's mental processes and skills with particular attention to the growth of conceptual skills. Growth being both quantitative and qualitative, according to Breckenridge and Vincent (1), a child reaches a level of maturity through an orderly sequence of acquisitions. His growth will be orderly--the product of innate gifts of inheritance, enhanced or modified by his experiences.

Specialists from the Office of Child Development (18) concended that the Head Start Program fosters the idea of motivating within the children the process of creative thinking. Through this process comes the ability to change attitudes, skills and ideas.

Creative thinking enhances the procedures of: readiness to receive an idea, ability to enlarge, illumination of thought, verification of the facts and, finally, communicating with clarity the precise finding.

Jersild (8) maintained that each child has his own pattern of development. Readiness to learn changes from day to day as a result of biological maturation and daily experiences, enhancing understanding of the relationship between growth and learning. References made to physical growth were described as the normal changes within a healthy child such as increase in height, weight or structural change of the organic systems, while cognitive growth denotes a modification of behavior that has come about by virtue of experience, use, or exercise. The next term concerning development is maturation, and is expressed by Jersild as the process of ripening, of moving toward a fuller development of the potentials of the organism, thus making a distinction between changes affected by learning. Finally Jersild said:

> The child's education begins at birth, if not before. Much of this education takes place through countless contacts with his daily environment that are not definitely planned; but from the very beginning much of his environment and many experiences designed to promote his development are controlled by his elders. The huge budgets involved in the formal schooling of children represent only a small fraction of the total outlay of time and means devoted to the training of children from early infancy. To make this investment yield the best returns for all concerned, to prevent the discouraging effects of failure, and to make the best use of the stimulus of success, it is important to try to adapt the child's training to his growing abilities.

<u>Exploration of Methods</u>

In the present educational system, most emphasis has been placed upon the learning of factual information. The ability to question, to seek answers, to find new relationships, are qualities that are generally not taught. Through creative thinking the ability to discover and search for answers is encouraged, rather than wait for the teachers to give answers and directions. According to Erikson (4) eight aspects of creativity have emerged from the studies of the arts and sciences. Those eight aspects are:

1) <u>Sensitivity</u> is the awareness of problems, attitudes and feelings of other people, and to experiences of living. Using the eyes not only for seeing but observing; ears not only for hearing, but listening; hands not only for touching, but feeling--all are necessary for sensitivity.

2) <u>Fluency</u> is the ability to produce a large number of ideas in a short period of time, being able to think rapidly and freely. Both verbal and non-verbal are a part of fluency. The creative thinker will have the ability to produce numerous solutions or ideas on problems.

3) <u>Flexibility</u> is the ability to adjust quickly to new situations or to change rapidly in one's thinking.

4) <u>Originality</u> is the ability to think of new or novel responses and is the opposite of the usual or accepted.

5) <u>Re-organize</u> or <u>re-define</u> is the ability to arrange ideas and shift the uses and function of objects, or to see them in a new light, but for new or different purposes.

6) Abstract is the skill of analyzing the various parts of a problem or seeing specific relationships.

7) Synthesize is the ability to combine several elements into a new form or whole.

8) Organize is the ability to put parts together in a meaningful way.

Klausmier (9) listed four principles for encouraging creativity. These principles are: original expression, flexibility, allow time for creativity to unfold, and productivity.

Heffernan and Todd (6) stated that five-year-old children are ready for only a few experiences on spatial and quantitative relationships. The experiences are highly important and bear endless repetition in first one setting and then another. In helping children develop natural concepts, the teacher is careful to use terms correctly and to encourage the children to do likewise. The distinction that each child makes depends on his abilities. Each child is helped to understand more completely by hearing terms used correctly. Todd and Heffernan asserted that when the child is ready to cope with distinctions, the correct patterns help him set his mental patterns in order. For instance, the teacher constantly uses time concepts: "We have only 10 more minutes. Let's finish what we are doing and put away our things." The time concept shown in this directive gives children an idea of importance of the time interval.

Deal and Maness (3) reported a study concerning the teaching of mathematical concepts in the University of Georgia Laboratory School. Nursery and kindergarten teachers have been giving mathematical concepts to children but may not have been aware of doing this, nor able to communicate their goals to others. Upon analysis of the procedures used by these teachers, the findings indicated that the teachers had not thought primarily in terms of a content area such as mathematics, but taught numerical concepts in many activities not scheduled in a planned sequence. The teachers perceived the richness of the activities but gave very broad general concepts concerning what was being presented. That the teacher should be aware and able to communicate general concepts to others is fundamental. The teacher must be able to correlate the general concepts of broad experiences, for in these lay the foundation for the more specific, abstract concepts that will be prominent in later experiences.

Jersild (8) maintained that through learning, the growing child acquires competence in using his resources for doing, thinking, and feeling and establishing his unique selfhood. Learning is influenced, and in many ways limited, by provisions in the external environment.

Piaget (12) projected that much of the knowledge children absorb is best acquired by exploration in the real world where they may freely, actively, construct their vision of reality, rather than be passively instructed. A natural approach to child development is advocated.

<u>Methods of Teaching Concepts of Time</u>

Ovitt (11) stated that a knowledge of time comprises more than knowing how to read a watch, for this is a final step, symbolic of more concrete understanding by a child of himself. Time represents the past, present and future. The use of words or symbols denotes the placement of the person into a vast sequence of events. Preschool children are just beginning to discover that they have a past as well as a future. Waiting for a turn on the swing is incomprehensible for young children, which clearly points out the task yet ahead of them to completely understand the complicated symbol system of days, weeks, months, hours, minutes and seconds. Ovitt further related that the first understandable sequence of time that a preschool group retains is night and day, followed closely by nap time or mealtime.

Through the presentation of pictures from the prehistoric era, in contrast to those of present day environment, Todd and Heffernan (17) reported the procedure used by one teacher as a means for helping children understand a point of time. Another teacher used birthdays because of the importance a child usually attaches to this occasion.

At the first of each month the teacher asks: "Who has a birthday this month?" Thus, the stage is set for guiding the children in watching the calendar as the birthdays approach.

Two other experiences offered by Todd and Heffernan (17) indicated how the teacher shared numbers with a group by the use of an old alarm clock. Using the timer, an explanation was given that the clock would ring after a short number of minutes. Anticipating the ringing of the clock gave an opportunity to discriminate between a short period of time and a long one. The second experience involved a calendar with large numbers in which a sequence of prospective events to come were introduced. If the children chose to watch birds, a bird seal was placed on the date each day a child reported seeing a bird. Through daily usage the children saw the helpfulness of the calendar and they observed the days of the week as well as the sequence of the numbers.

Methods of Teaching Concepts of Space

Ovitt (11) projected the belief that preschool children begin the exploration of the world by learning of his image. Seeing the reflection of himself in a puddle of water, a mirror or a photograph motivates a comparison of form with other people and things. Feeling small, sometimes large, there comes faintly a revelation of graduated sizes and shapes.

Heffernan and Todd (6) contended that new learning opportunities prevail when young children learn to relate themselves to a new situation such as discovering the distance between nursery school and home. Fear of becoming lost because of enlarged life space, can greatly affect a child. The identification of landmarks during the trip between school and home is suggested in order that the child may become familiar with the route.

"How are balls and oranges alike? How are a ball and a building block different?" These are some of the questions asked by the teacher, according to Huck (7), to acquaint preschool children with shapes of familiar objects. A display of a mobile constructed of several geometric shapes offers a view of the contrast form and soon the children look around their environment to find replicas of them.

According to Todd and Heffernan (17), the choice of words used by preschool children reveal their cognitive advancement in relation to space. The use of words such as: small, tall, big, little, front, back, long, short, up, down, in and out gives a cue to the teacher that contrasting elements are being recognized by a child.

Robinson and Spodek (14) presented the theory that stresses recognition of fit and arrangement of objects as well as the fact that fit applies to function and containment. Children learn to recognize the symetry of matching pairs in objects and living things while developing cognitive directions through contrasting words such as: up, down, forward, backward, left, right. Finally the concept of distance and direction congeals.

Methods for Teaching Numbers

Ovitt (11) asserted that quantitative learning of mathematics for young children begins with the thinking of themselves and then another, an example of more than one. Experience with things in series is good preparation for learning to count. Strange (16) believed the first attempt at counting for children is primitive in nature, a naming process. "One" becomes the name of the first object in a row, with "two" representing the name of the second object, and continuing until the row of objects are completely named.

Deal and Maness (3) stated that after a child can make global comparisons in varied ways, the ability to match objects in sets becomes apparent. Comparing two sets reveals to the child that they do or do not contain the same number even though the number may be unknown. Deal and Maness pointed out that:

> The child may use the word five and we think he understands "five" in an abstract way, when he is thinking only of the five candles on his birthday cake. . . . He needs many specific opportunities to deal with a number such as five--five marbles, five fingers, five blocks, and to see how many parts or arrangements "five" can be broken into.

Todd and Heffernan (17) stated that a teacher should make a point of showing the children the method in which numbers are used such as: counting, the clock, calendar or telephone. On a walk through a residential area, she pointed out that each house is numbered. To relate this evidence to the actual experience of the child the question is asked, "Does your house at home have a number? You look and see when you go home today." Realizing the importance of these simple experiences, the teacher capitalizes on the quantitative aspect of everyday situations.

STATEMENT OF THE PROBLEM

The present study was undertaken to assess the effects of the Waco Head Start Program on five year old children in the area of numerical concepts. Numerous studies in the field of teaching numerical concepts to young children of middle class families exist, while listings of prescribed methods for teaching numerical concepts to children from disadvantaged families are limited.

Young children learn from their environment. The knowledge absorbed is acquired through exploration of the world about them. From such experiences comes the reality of cognitive development. The effectiveness of instructions received determines the ability of children to relate to their surroundings.

For many years barriers have existed that prevented children from disadvantaged homes from adjusting to school situations, hence impeding the natural maturational growth. The stereotype situations in environment, pupil-teacher attitudes and interest, motivation of lesson and objectives, values and skills learned, proved to be ineffective in producing the desired effect.

The lack of proper instruction in numerical concepts during preschool years becomes a handicap for future mathematical comprehension. The slow realization of abstract truths by young children necessitates more specific methods in teaching numerical concepts to disadvantaged preschool children. The specific purposes of the study were to:

1) Examine methods of teaching numerical concepts to five year old children.

2) Analyze the progress made by children when specific methods were employed in the Head Start Program in Waco, Texas.

3) Identify possible deficits in teaching numerical concepts to five year old children.

The investigator of the present study attempted to define and evaluate methods of teaching numerical concepts to children in the Waco Head Start Program.

CHAPTER II

P R O C E D U R E

Numerical concepts for school readiness are regarded as fundamental to the child's training at the preschool level. The child's introduction to numbers in a framework of known and familiar materials that appear to be games rather than tasks is a basic characteristic of number activities in the Head Start Child Development Program in Waco, Texas

DESCRIPTION OF THE NUMERICAL CONCEPT PROGRAM

For this study, many situations in which the children were being introduced to numbers were observed. Seeking to compensate for cultural deprivation, the teacher supplied extra enrichment in all activities.

Situations involving one to one correspondence were introduced first. By the use of the game "Musical Chair," the children were able to associate themselves with chairs. The children were directed to march by music, around a row of chairs with the backs placed alternately to the front and back of one another, using one less chair then children participating. As the music was stopped, the objective was to sit in the nearest chair. One player was always without a chair, hence the concept of one child to one chair was inescapable.

Using individual flannel boards, pictures of objects such as; an equal number of dogs and bones, bird houses and birds, rabbits and carrots, a realization of one to one correspondence was enhanced. When these pictures were properly matched, a chance for one to one number relationship was offered through visual inspection.

Some of the stages of counting were: rote, enumeration, identification, reproduction, comparison and grouping. From these stages methods for projecting ordinal and cardinal numbers were used.

The rote method of counting, through the use of finger plays, rhymes and games introduced number names in sequence. After a period of time, roll call gave an opportunity for counting. An example of a question asked was "How many girls are present?" Some other situations used for counting were, the number of children to dramatize a story, children who walked to school, stripes in the flag, long stripes, short stripes, persons in the family and many other objects familiar to the environment.

An experience in counting sounds and movement was initiated. Sounds or movement were made first by the teacher and later by a child. At first children looked, listened, and counted. Later the same procedure was done with closed eyes.

With typical activities as described above, children were learning to formulate numerical concepts in terms of how many, how far, how large or small. Reinforcement occurred as the child was able to identify similar materials and numbers in his home as were encountered in the learning environment of the Head Start classroom.

THE SAMPLE

Data for the study were collected from 100 five year old children enrolled in the Waco Head Start Program. The ages ranged from 5.5 to 5.11 years. Home environments of all children were impoverished and offered limited experiences and opportunities. Low income, sub-standard housing, inadequate nutrition, and neglected medical and dental needs classified the families of these children as disadvantaged. The sample included three ethnic groups. Composition of the group studied, according to racial groups, is shown below:

Race	Number	Per cent
Negro	62	62.0
Mexican American	24	24.0
Caucasian	14	14.0

INSTRUMENTATION

The *Preschool Inventory* was used, both as a pretest and post-test, to evaluate the amount of progress the children had made in numerical concepts during the six month period. The pretest was administered to the children in November, 1968, and post-test evaluation was accomplished in May, 1970. Caldwell (2) described the purpose of the *Preschool Inventory* as follows:

> The Preschool Inventory is a brief assessment procedure designed for individual use with children in the three-to-six age range. It was developed to give a measure of achievement in areas regarded as necessary for success in school. It is by no means culture free; in fact one aim of the instrument is to permit educators to highlight the degree of disadvantage which a child from a deprived background has at the time of entering school in order to help eliminate any observed deficits. Another goal in the development of the procedure was to make available an instrument that was sensitive to experience and could thus be used to demonstrate changes associated with educational intervention.

The *Preschool Inventory* included four separate factors to be tested. They are: Personal-Social Responsiveness, Associative Vocabulary, Concept Activation-Numerical, and Concept Activation-Sensory. For this study, only the Concept Activation-Numerical scores were used. The pretest and post-test were administered to the children by the same person.

During January, 1970 the *Test of Basic Experiences* (10) (TOBE) was administered. The *Test of Basic Experiences*

(TOBE) was developed specifically to measure disadvantaged Head Start children by Moss (10) at George Washington University under an Office of Economic Opportunity grant. As the name implies, the test places primary emphasis on experiences rather than upon imformation. The Test of Basic Experiences (TOBE) is composed of five test-bookets, "Mathematics," "Language," "Science," "Social Studies," and "General Concepts." Two levels are available. "Level K" is designed for children in the preschool or kindergarten age group, and "Level L" is designed for both kindergarten and first grade children. For this study, data from the "Mathematics Test, Level K," were used.

The "Mathematics Test, Level K" attempts to determine the child's mastery of fundamental mathematical concepts, the terms associated with them, and his ability to see relationships between objects and quantitative terms such as the biggest piece of cake, the oldest boy, the most marbles, and the number of eyes people have. This type of information is a prerequisite to much of the primary mathematics curriculum.

STATISTICAL DESIGN

Three separate methods of statistical analysis were employed in evaluating the data for this study. Mean and standard deviations were computed separately for the Test of *Basic Experiences* (TOBE) (10) and the *Preschool Inventory* (2) pretest, and the *Preschool Inventory* post-test. A correlation matrix was generated using raw scores from the *Test of Basic Experiences* (TOBE) and the *Preschool Inventory* to determine the correlation among the instruments used. A chi square test was utilized to analyze the significance of the amount of gain in scores of the Head Start children when compared to the gain in middle and lower class children during a similar period of time. Data for the middle and lower class comparison groups were obtained from the *Preschool Inventory Manual*. The .05 level of significance was used in all statistical analyses employed in this study.

A copy of the *Preschool Inventory* follows.

PRESCHOOL INVENTORY

Name ______________________________ Boy ☐ Girl ☐
Last First

	Year	Month	Day	
Date of test	______	______	______	Time finished ______
Birthdate	______	______	______	Time started ______
Age	______	______	______	Total time ______

School attended ______________________ How long? ______________

Name of teacher ______________________ Name of examiner ______________

Child's major language ______________________ Language in which given ______________

Item Nos.	Factor	Subtest	Raw Score	Percentile	
1-26	A	Personal-Social Responsiveness			
27-47	B	Associative Vocabulary			
48-66	C_1	Concept Activation—Numerical			
67-85	C_2	Concept Activation—Sensory			
1-85		Total			

PRESCHOOL INVENTORY
(Standardization edition)

Bettye M. Caldwell

INSTRUCTIONS

1. SPECIFIC DIRECTIONS FOR ADMINISTERING WILL BE FOUND IN THE PRESCHOOL INVENTORY MANUAL.

2. THIS ANSWER SHEET IS NOT MACHINE SCORABLE.

TEST I

1. WHAT IS YOUR FIRST NAME?	13. RAISE YOUR HAND
2. WHAT IS YOUR LAST NAME?	14. WIGGLE
3. HOW OLD ARE YOU?	15. HELLO VERY LOUDLY
4. WHEN IS YOUR BIRTHDAY?	16. HELLO VERY SOFTLY
5. SHOW ME YOUR EYE	17. FACE DOOR
6. SHOW ME YOUR NECK	18. JUMP
7. SHOW ME YOUR SHOULDER	19. RED CAR ON BLACK BOX
8. SHOW ME YOUR HEEL	20. BLUE CAR UNDER GREEN BOX
9. WHAT CALL (EAR)	21. YELLOW CAR ON LITTLE BOX
10. WHAT CALL (FINGER)	22. ONE CAR IN MIDDLE-SIZE BOX
11. WHAT CALL (KNEE)	23. ALL CARS ONE SIDE, ALL BOXES OTHER SIDE
12. WHAT CALL (ELBOW)	24. 3 CARS IN BIG BOX
	25. 2 CARS BEHIND BOX IN MIDDLE
	26. GIVE EVERYTHING TO ME

TEST II

27. (CHECKERS) CAR THAT PULLS TRAIN	35. TIME OF YEAR HOTTEST?
28. (CHECKERS) LAST CAR ON TRAIN	36. TIME OF YEAR COLDEST?
29. WHICH WAY DOES SAW GO?	37. TIME OF YEAR NOW?
30. WHICH WAY ELEVATOR?	38. WHERE FIND LION?
31. WHICH WAY FERRIS WHEEL?	39. WHERE BUY GAS?
32. WHICH WAY PHONOGRAPH RECORD?	40. WHO GO TO IF SICK?
33. WHICH WAY WATER FALL?	41. WHERE FIND BOAT?
34. WHEN BREAKFAST?	42. WHAT DO TO READ SOMETHING?

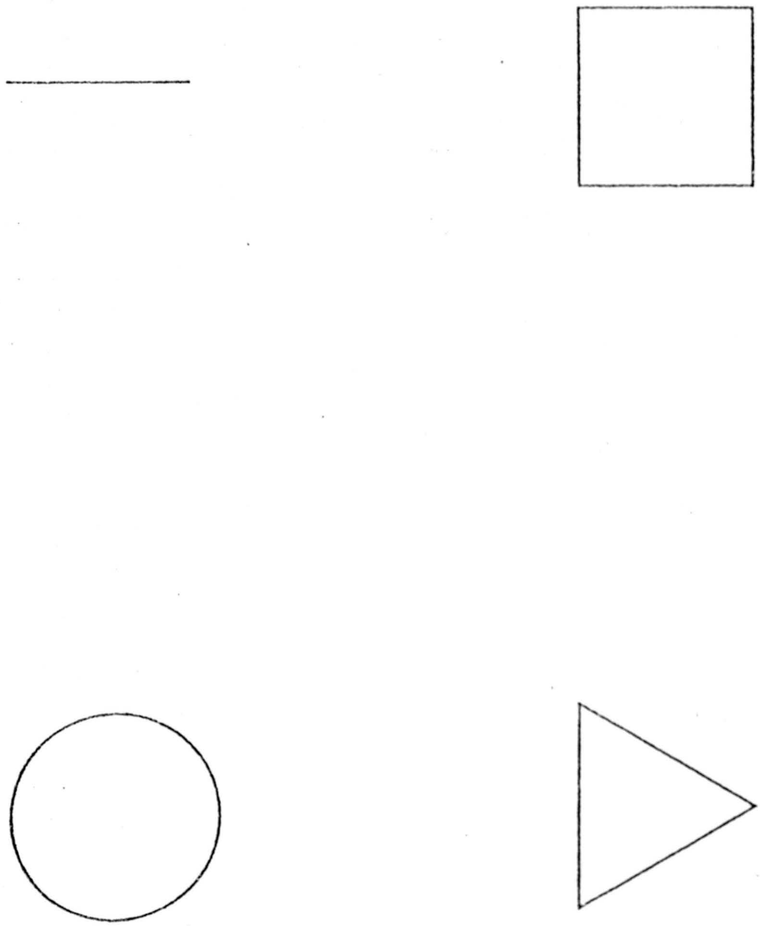
43. WHAT DOES DENTIST DO?	2	1	0	______
44. WHAT DOES POLICEMAN DO?	2	1	0	______
45. WHAT DOES TEACHER DO?	2	1	0	______
46. WHAT DOES FATHER DO?	2	1	0	______
47. WHAT DOES MOTHER DO?	2	1	0	______

TEST III

48. HOW MANY EYES?	57. COUNT (TO 5)
49. HOW MANY NOSES?	58. HOW MANY CORNERS, PAPER
50. HOW MANY HANDS?	59. 2 & 8 CHECKERS, WHICH MORE
51. HOW MANY TOES?	60. 6 & 6 CHECKERS, WHICH MORE
52. HOW MANY WHEELS-CAR?	61. 2 & 8 CHECKERS, WHICH FEWER
53. HOW MANY WHEELS-BICYCLE?	62. POINT TO MIDDLE ONE
54. HOW MANY WHEELS-TRICYCLE?	63. POINT TO FIRST ONE
55. HOW MANY WHEELS-WHEELBARROW?	64. POINT TO LAST ONE
56. HOW MANY WHEELS-ROW BOAT?	65. POINT TO SECOND ONE
	66. POINT TO NEXT-TO-LAST

TEST IV

67. DRAW A LINE	79. WHAT COLOR IS: (RED CRAYON)
68. DRAW A CIRCLE	80. WHAT COLOR IS: (BLACK CRAYON)
69. DRAW A SQUARE	81. SAME COLOR AS THE SKY
70. DRAW A TRIANGLE	82. SAME COLOR AS THE NIGHT
71. WHICH MOST LIKE WHEEL	83. COLOR CIRCLE YELLOW
72. WHICH MOST LIKE TENT	84. COLOR SQUARE PURPLE
73. WHICH MOST LIKE STICK	85. COLOR TRIANGLE ORANGE
74. BIGGER, BALL OR BICYCLE	
75. BIGGER, TREE OR FLOWER	
76. SLOWER, CAR OR BICYCLE	
77. HEAVIER, BRICK OR SHOE	
78. HEAVIER, FEATHER OR FORK	



CHAPTER III

PRESENTATION OF DATA ANALYSIS WITH DISCUSSION OF FINDINGS

That children achieve at their own individual rate and are either accelerated or handicapped by the circumstances of opportunity or environment is the hypothesis underlying the concern for providing special programs for the disadvantaged child. The methods used for teaching numerical concepts to five year old children in the Waco Head Start Program were designed to allow each child to progress at his own individual rate. At the same time newly formed concepts were absorbed and united with previously established realizations.

The Preschool Inventory (2) (pretest) was administered in October, 1969 to the children enrolled in the Head Start Child Development Program to identify the deficits of the children in the area of numerical concepts. A post-test was administered in April, 1970 to assess the amount of gain the children had achieved during a six month period.

During the mid-point of the testing period the numerical area of the Test of Basic Experiences (10) was applied to measure receptiveness of methods that were being used to solidify numerical concepts. The initial purpose of the _Test of Basic Experiences_ was to determine the strengths and weaknesses of individual children as well as class deficiencies, based upon the fact that the experiences and associated learning opportunities were quite varied.

Data employed in this study are presented in Tables I and II. In Table I, the age, raw score and percentile rank of each child in the present study are listed for the purpose of comparison with the norms for middle class children as presented in the _Preschool Inventory Manual_. Table II records similar data using the norms for lower class children as presented in the _Preschool Inventory Manual_.

The findings of percentile ranks for pretest and post-tests were classified as; improved, no change, or regressed. All percentile ranks within five points above or below the original score were classified as no change. Children who improved or regressed by five or more percentile points were classified as either improved or regressed on the basis of scores.

Table III presents the comparison of the range for all tests used in the present study. The _Preschool Inventory_ pretest revealed a range of 14, while the post-test showed a range of 13. The range of the _Test of Basic Experiences_

TABLE I

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S MIDDLE CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Middle Class Percentile	Age	Raw Score	Percentile	Middle Class Percentile
1	5.4	12	80	40	5.10	12	65	20
2	5.3	6	15	5	5.9	9	40	5
3	6.2	14	85	35	6.8	16	85	80
4	6.2	11	45	20	6.8	12	55	20
5	5.4	10	35	15	5.10	12	55	20
6	5.3	14	90	60	5.9	17	90	80
7	5.7	14	95	55	6.1	19	95	95
8	5.6	11	70	30	6.0	16	90	85
9	5.9	8	30	5	6.3	17	90	95
10	6.2	13	75	25	6.8	16	85	85
11	6.0	16	95	35	6.6	14	85	35

TABLE I (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S MIDDLE CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Middle Class Percentile	Age	Raw Score	Percentile	Middle Class Percentile
12	5.10	15	85	95	6.4	18	95	95
13	5.3	10	60	15	5.9	12	65	20
14	6.1	10	50	15	6.7	11	45	20
15	5.7	15	95	60	6.1	16	90	85
16	5.10	11	60	15	6.4	13	65	25
17	5.4	10	60	15	5.10	15	85	60
18	6.2	16	85	85	6.8	19	95	95
19	6.1	8	30	10	6.7	12	55	20
20	5.5	9	50	10	5.11	11	60	15
21	5.6	8	35	5	6.0	12	65	20
22	5.9	18	95	95	6.3	18	95	95

TABLE I (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S MIDDLE CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Middle Class Percentile	Age	Raw Score	Percentile	Middle Class Percentile
23	5.4	10	60	15	5.10	16	90	65
24	5.8	13	90	45	6.2	10	50	15
25	5.10	16	90	65	6.4	17	95	65
26	5.9	12	65	20	6.3	17	90	95
27	5.3	9	50	10	5.9	14	85	55
28	5.3	11	70	30	5.9	16	90	65
29	5.10	6	15	5	6.4	9	30	15
30	5.10	8	30	5	6.4	11	45	20
31	5.9	11	60	15	6.3	15	80	55
32	6.0	18	95	95	6.6	18	95	95
33	5.4	14	75	60	5.10	16	85	65

TABLE I (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S MIDDLE CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Middle Class Percentile	Age	Raw Score	Percentile	Middle Class Percentile
34	5.5	10	60	15	5.11	14	85	55
35	5.4	11	70	30	5.10	11	90	15
36	5.11	9	40	5	6.5	13	65	25
37	5.5	8	50	10	5.11	11	60	15
38	6.0	13	75	50	6.6	16	85	85
39	5.7	11	45	35	6.1	12	65	20
40	5.3	8	35	5	5.9	12	65	40
41	5.3	7	25	5	5.9	9	40	5
42	5.1	16	90	40	6.5	18	95	95
43	5.1	14	85	35	6.5	15	80	55
44	5.4	11	70	30	5.1	15	90	60

TABLE I (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S MIDDLE CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Middle Class Percentile	Age	Raw Score	Percentile	Middle Class Percentile
45	5.9	12	65	20	6.3	15	80	55
46	5.8	16	90	85	6.2	18	95	95
47	5.3	5	10	5	5.9	7	25	5
48	5.7	8	35	5	6.1	12	55	20
49	5.7	9	55	5	6.1	10	35	20
50	5.11	9	60	5	6.5	17	95	95
51	5.11	10	50	10	6.1	16	85	85
52	5.5	13	65	50	5.11	16	90	65
53	5.4	5	10	5	5.10	6	15	5
54	5.6	9	50	10	5.11	9	30	5
55	5.11	14	75	55	6.5	17	90	95

TABLE I (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S MIDDLE CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Middle Class Percentile	Age	Raw Score	Percentile	Middle Class Percentile
56	5.7	11	70	15	6.1	13	65	25
57	6.3	14	90	35	6.9	17	95	95
58	5.5	9	50	10	5.11	16	90	80
59	6.0	16	90	85	6.6	12	55	20
60	5.7	11	70	15	6.1	15	80	55
61	5.3	12	80	40	5.9	17	95	80
62	5.6	13	90	50	6.0	15	85	60
63	5.6	12	65	40	6.0	16	90	65
64	6.2	16	85	85	6.8	13	65	25
65	6.1	15	85	80	6.7	16	85	85
66	5.4	6	15	5	5.10	9	40	5

TABLE I (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S MIDDLE CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Middle Class Percentile	Age	Raw Score	Percentile	Middle Class Percentile
67	6.1	18	85	85	6.7	19	95	95
68	5.4	13	90	50	5.10	17	95	80
69	5.11	12	65	20	6.5	19	30	95
70	5.11	17	90	80	6.5	9	95	15
71	5.6	13	90	50	6.0	13	95	45
72	5.3	16	95	80	5.9	16	95	65
73	6.0	14	85	35	6.6	16	85	85
74	6.2	16	85	85	6.8	17	90	95
75	5.3	14	90	60	5.9	17	95	80
76	6.2	16	90	85	6.8	19	95	95
77	5.7	13	75	45	6.1	13	85	25

TABLE I (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S MIDDLE CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Middle Class Percentile	Age	Raw Score	Percentile	Middle Class Percentile
78	5.7	11	60	15	6.1	13	75	25
79	6.1	13	65	25	6.7	17	90	95
80	6.1	15	80	55	6.7	15	80	55
81	5.5	16	95	80	5.11	19	95	95
82	6.0	14	85	55	6.6	16	85	85
83	5.9	16	90	65	6.3	16	90	85
84	5.7	12	95	20	6.1	16	90	85
85	5.9	11	35	15	6.3	10	35	20
86	5.4	16	85	80	5.10	14	85	55
87	6.2	9	90	15	6.8	16	90	85
88	6.2	8	45	10	6.8	11	45	15
89	5.8	9	35	5	6.2	10	35	15

TABLE I (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S MIDDLE CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Middle Class Percentile	Age	Raw Score	Percentile	Middle Class Percentile
90	6.2	7	20	5	6.8	8	20	10
91	5.10	7	35	5	6.4	10	35	10
92	5.11	14	90	55	6.5	17	90	90
93	5.11	16	85	65	6.5	16	85	85
94	6.1	13	95	25	6.7	17	95	95
95	6.1	11	75	20	6.7	14	75	35
96	5.5	11	85	30	5.11	14	85	55
97	6.2	9	85	15	6.8	16	85	85
98	6.2	13	90	25	6.8	17	90	95
99	5.8	12	85	20	6.2	16	85	85
100	5.7	6	75	5	6.1	13	75	25

TABLE II

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S LOWER CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Per-centile	Lower Class Percentile	Age	Raw Score	Per-centile	Lower Class Percentile
1	5.4	12	80	80	5.10	12	65	65
2	5.3	6	15	15	5.9	9	40	40
3	6.2	14	85	75	6.8	16	85	85
4	6.2	11	45	45	6.8	12	55	65
5	5.4	10	35	60	5.10	12	55	65
6	5.3	14	90	90	5.9	17	90	95
7	5.7	14	95	85	6.1	19	95	95
8	5.6	11	70	70	6.0	16	90	85
9	5.9	8	30	30	6.3	17	90	90
10	6.2	13	75	65	6.8	16	85	85
11	6.0	16	95	90	6.6	14	85	75

TABLE II (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S LOWER CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Lower Class Percentile	Age	Raw Score	Percentile	Lower Class Percentile
12	5.10	15	85	85	6.4	18	95	95
13	5.3	10	60	60	5.9	12	65	60
14	6.1	10	50	35	6.7	11	45	45
15	5.7	15	95	90	6.1	16	90	85
16	5.10	11	60	60	6.4	13	65	65
17	5.4	10	60	50	5.10	15	85	90
18	6.2	16	85	85	6.8	19	95	85
19	6.1	8	30	20	6.7	12	55	80
20	5.5	9	50	50	5.11	11	60	60
21	5.6	8	35	35	6.0	12	65	65
22	5.9	18	95	95	6.3	18	95	95

TABLE II (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S LOWER CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Lower Class Percentile	Age	Raw Score	Percentile	Lower Class Percentile
23	5.4	10	60	60	5.10	16	90	90
24	5.8	13	90	75	6.2	10	50	35
25	5.10	16	90	90	6.4	17	95	90
26	5.9	12	65	65	6.3	17	90	90
27	5.3	9	50	50	5.9	14	85	85
28	5.3	11	70	55	5.9	16	90	90
29	5.10	6	15	15	6.4	9	30	30
30	5.10	8	30	30	6.4	11	45	45
31	5.9	11	60	60	6.3	15	80	80
32	6.0	18	95	95	6.6	18	95	95
33	5.4	14	75	85	5.10	16	85	90

TABLE II (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S LOWER CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Lower Class Percentile	Age	Raw Score	Percentile	Lower Class Percentile
34	5.5	10	60	75	5.11	14	85	85
35	5.4	11	70	75	5.10	11	90	80
36	5.11	9	40	45	6.5	13	65	80
37	5.5	8	50	35	5.11	11	60	70
38	6.0	13	75	75	6.6	16	85	85
39	5.7	11	45	60	6.1	12	65	60
40	5.3	8	35	45	5.9	12	65	65
41	5.3	7	25	25	5.9	9	40	45
42	5.11	16	90	90	6.5	18	95	95
43	5.11	14	85	85	6.5	15	80	80
44	5.4	11	70	70	5.10	15	90	90

TABLE II (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S LOWER CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Lower Class Percentile	Age	Raw Score	Percentile	Lower Class Percentile
45	5.9	12	65	70	6.3	15	80	80
46	5.8	16	90	90	6.2	18	95	95
47	5.3	5	10	10	5.9	7	25	25
48	5.7	8	35	30	6.1	12	55	55
49	5.7	9	55	40	6.1	10	35	35
50	5.11	9	60	40	6.5	17	95	90
51	5.11	10	50	50	6.1	16	85	85
52	5.5	13	65	90	5.11	16	90	90
53	5.4	5	10	10	5.10	6	15	15
54	5.6	9	50	50	5.11	9	30	40
55	5.11	14	75	85	5.5	17	90	45

TABLE II (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S LOWER CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Lower Class Percentile	Age	Raw Score	Percentile	Lower Class Percentile
56	5.7	11	70	60	6.1	13	65	65
57	6.3	14	90	75	6.9	17	95	90
58	5.5	9	50	50	5.11	16	90	90
59	6.0	16	90	85	6.6	12	55	55
60	5.7	11	70	60	6.1	15	80	80
61	5.3	12	80	80	5.9	17	95	95
62	5.6	13	90	90	6.0	15	85	80
63	5.6	12	65	80	6.0	16	90	90
64	6.2	16	85	85	6.8	13	65	65
65	6.1	15	85	80	6.7	16	85	85
66	5.4	6	15	15	5.10	9	40	40

TABLE II (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S LOWER CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Lower Class Percentile	Age	Raw Score	Percentile	Lower Class Percentile
67	6.1	18	65	95	6.7	19	95	95
68	5.4	13	90	90	5.10	17	95	95
69	5.11	12	65	65	6.5	19	30	95
70	5.11	17	90	95	6.5	9	95	30
71	5.6	13	90	90	6.0	13	95	65
72	5.3	16	95	95	5.9	16	95	90
73	6.0	14	85	75	6.6	16	85	85
74	6.2	16	85	85	6.8	17	90	90
75	5.3	14	90	90	5.9	17	95	95
76	6.2	16	90	85	6.8	19	95	95
77	5.7	13	75	75	6.1	13	85	65

TABLE II (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S LOWER CLASS NORMS

Case Number	Pretest				Post-test			
	Age	Raw Score	Percentile	Lower Class Percentile	Age	Raw Score	Percentile	Lower Class Percentile
78	5.7	11	60	60	6.1	13	75	65
79	6.1	13	65	65	6.7	17	90	90
80	6.1	15	80	80	6.7	15	80	80
81	5.5	16	95	95	5.11	19	95	95
82	6.0	14	85	75	6.6	16	85	85
83	5.9	16	90	90	6.3	16	90	85
84	5.7	12	95	65	6.1	16	90	85
85	5.9	11	35	60	6.3	10	35	35
86	5.4	16	85	95	5.10	14	85	85
87	6.2	9	90	30	6.8	16	90	85
88	6.2	8	45	20	6.8	11	45	45
89	5.8	9	35	40	6.2	10	35	35

TABLE II (Continued)

COMPARISON OF PRESCHOOL INVENTORY PERCENTILE SCORES OF 100 HEAD START CHILDREN WITH CALDWELL'S LOWER CLASS NORMS

Case Num-ber	Pretest				Post-test			
	Age	Raw Score	Per-centile	Lower Class Percentile	Age	Raw Score	Per-centile	Lower Class Percentile
90	6.2	7	20	10	6.8	8	20	20
91	5.10	7	35	25	6.4	10	35	35
92	5.11	14	90	85	6.5	17	90	90
93	5.11	16	85	90	6.5	16	85	90
94	6.1	13	95	65	6.7	17	95	90
95	6.1	11	75	45	6.7	14	75	75
96	5.5	11	85	70	5.11	14	85	85
97	6.2	9	85	30	6.8	16	85	85
98	6.2	13	90	65	6.8	17	90	90
99	5.8	12	85	65	6.2	16	85	85
100	5.7	6	75	15	6.1	13	75	65

TABLE III

COMPARISON OF RANGE FOR 100 HEAD START CHILDREN FOR THE TEST OF BASIC EXPERIENCES AND THE PRESCHOOL INVENTORY PRETEST AND POST-TEST

Test	Low	High	Range
Test of Basic Experiences	6	27	22
Pretest (Preschool Inventory)	5	18	14
Post-test (Preschool Inventory)	7	19	13

was 22. The range score indicated the ability of the children to master the fundamental mathematical concepts along with the terms associated with them. Another finding was the ability of the children to comprehend the relationship between objects and quantitative terms, which are prerequisite to much of the primary mathematical curriculum. Table IV gives an overview of the mean and standard deviation for all data.

The chi square analysis was computed separately for the data obtained from comparison of the middle and lower class norms with the pretest and post-test of the Preschool Inventory. A hypothetical expected frequency of 33.33 was used for these tests using the following assumption: If there are no systematic trends in the data, the frequencies will be equally distributed among the three categories.

Table V presents the chi square analysis of the comparison of gains of Head Start children over a six month period to standards of middle class gains. Examination of the findings revealed that the gain of the Head Start children was significant at the .001 level (X^2=25.66). Examination of the cell frequencies indicated that more of the students were classified as improved in numerical ability that would be expected by chance. Thus the children's gain in numerical concepts was according to the expectation of the investigator because of the programs presented.

TABLE IV

STATISTICAL SUMMARY FOR 100 PRESCHOOL CHILDREN CONCERNING THE TEST OF BASIC EXPERIENCES AND PRESCHOOL INVENTORY

Test	Mean	Standard Deviation
Test of Basic Experiences	16.99	5.49
Pretest (Preschool Inventory)	11.81	3.20
Post-test (Preschool Inventory)	14.30	3.05

TABLE V

A CHI SQUARE ANALYSIS COMPARISON FOR GAINS OF 100 HEAD START CHILDREN TO STANDARDS OF MIDDLE CLASS GAINS

Group	Observed Frequency	Expected Frequency
Improved	66***	33.33
No change	21	33.33
Regressed	13	33.33

***Significant at $P < .001$ $(X^2_2 = 48.98)$

Table VI presents the chi square analysis of the comparison of the gains in a six month period of Head Start children to standards of lower class gains. The findings revealed the achievement of the Head Start children was significant at the .001 level ($X^2_{(2)}$=25.66). Examination of the cell frequencies again indicated that more of the children were classified as improved in numerical ability than would be expected by chance.

Table VII presents the intercorrelation matrix for all data used in the present study. All of the correlations were significant, indicating that the measures employed were measuring to some extent the same thing.

TABLE VI

A CHI SQUARE ANALYSIS COMPARISON FOR GAINS OF 100 HEAD START CHILDREN TO STANDARDS OF LOWER CLASS GAINS

Group	Observed Frequency	Expected Frequency
Improved	54***	33.33
No change	34***	33.33
Regressed	12	33.33

***Significant at P<.001

TABLE VII

AN INTER-CORRELATION MATRIX OF SCORES OF 100 HEAD START CHILDREN GIVEN THE TEST OF BASIC EXPERIENCES AND PRESCHOOL INVENTORY PRETEST AND POST-TEST

Test	Test of Basic Experiences	Preschool Inventory Pretest	Preschool Inventory Post-test
Test of Basic Experiences	1.00	.23*	.26**
Preschool Inventory Pretest		1.00	.67***
Preschool Inventory Post-test			1.00

*Significant at .05 level

**Significant at .01 level

***Significant at 1.00 level

CHAPTER IV

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Most educators accept the basic value of Head Start programs. Evaluation of specific programs such as the one presently being studied tend to establish the value of goal-oriented programming in the education of young children.

The specific purposes of the study were to:

1) Examine methods of teaching numerical concepts to five year old children.
2) Analyze the progress made by children when specific methods were employed in the Head Start Program in Waco, Texas.
3) Identify possible deficits in teaching numerical concepts to five year old children.

Results of the present study revealed positive gains in numerical abilities for five year old children enrolled in the Waco Head Start Child Development Program as a result of specific programming.

The children of the present study responded favorably to the stimulation received during the testing period. Approximately two-thirds of the subjects indicated a higher level of performance as compared with middle class and lower class norms of the <u>Preschool Inventory</u>. Some indications of the study suggested that the children showed greater variability in numerical concept development. The pattern of dramatic gain indicated a stronger orientation for growth in the area of numerical concepts.

The investigator asserts that the creativity and the awareness of the child's teacher is a primary factor to be considered in success techniques and methods used to develop numerical concepts. The ability to expand upon the materials at hand and to use incidental experiential learning situations to introduce mathematics characterizes the good teacher.

The investigator recommends that special preliminary studies be made to identify problems, that special programming be implemented which will be designed to relieve the diagnosed deficiency, and that appropriate instruments should be developed to measure changes and educational progress in preschool children. A further recommendation is that the children in such studies be followed through school with continuing tests and measurements to assess changes as these children mature.

In summary, and upon findings of this study, the following recommendations are offered:

1) That special preliminary studies be made to diagnose deficiencies.

2) That goal-oriented curriculum be designed to overcome the identified deficiencies in learning.

3) That teachers continue the methods used for the present study, and untiringly seek to expand and reorganize the techniques for the purpose of enhancing the desired results.

4) Develop appropriate instruments to measure changes in preschool children.

5) That children in such studies be followed through school in a longitudinal study of tests and measurements to assess changes over a period of developmental years.

There is sufficient evidence available relative to the importance of specific methods and techniques in working with disadvantaged children to eliminate problem areas in solidifying numerical concepts for these children. This study affirmed the findings of other researchers that an enriched evnironment for general learning will also enhance the concept formation in the area of mathematics. Continued exploration of more refined methods and techniques must be encouraged, especially in the use of familiar objects relative to the disadvantaged environment in order that the child may more comfortably and realistically internalize learning.

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