1971

Piaget's Theory As The Basis For The Assessment Of Reading Disability Andsuggested Remediation Through An Adapted Science Curriculum

Vivian Helen Mcprouty
University of the Pacific

PIAGET'S THEORY AS THE BASIS FOR THE ASSESSMENT OF READING DISABILITY AND SUGGESTED REMEDIATION THROUGH AN ADAPTED SCIENCE CURRICULUM

A Dissertation

Presented to

the Faculty of the Graduate School

University of the Pacific

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

by

Vivian Helen McProuty

April, 1971

PIAGET'S THEORY AS THE BASIS FOR THE ASSESSMENT OF READING DISABILITY AND SUGGESTED REMEDIATION THROUGH AN ADAPTED SCIENCE CURRICULUM

Abstract of Dissertation

Piaget's theory suggests that the development of intelligence is related to an ability to perform logical operations. For the child between 7 and 11 years of age, seriation and classification are operational forms of behavior originating in earlier actions. Since seriation and classification are important to the syntax and semantics of language, failure to develop fully operational seriation and classification abilities may result in certain deficits in the child's reading ability. If so, the science curriculum may be useful in facilitating the cognitive growth necessary to success in reading. Recommendations for adapting the science program for remediation conclude the study.

PROBLEM: It was the purpose of this study to (1) develop and apply a composite test instrument in order to (2) compare the academic performance and cognitive functioning of educationally handicapped and regular class boys.

PROCEDURES: The composite test instrument was composed of twelve subtests. Ten of the subtests were selected from standard tests; WISC, ITPA, WRAT and Gilmore Oral Reading Test. The remaining two subtests were developed as research instruments for this study to assess seriation and classification abilities.

The composite test was administered to 64 boys between 7 and 10 years of age. The scores on the twelve subtests were the dependent variables in the analysis of variance design. The major independent variable was class placement. Thirty-two of the subjects tested were educationally handicapped students and thirty-two subjects were in regular classes. Sex, IQ, age, family relationship and socio-economic level were controlled variables. In analyzing the data the .05 level of significance was employed.

FINDINGS:

1. Class placement of the subjects was a highly significant difference between the educationally handicapped and regular class boys. As related to academic functioning, oral reading skills were markedly lower in the educationally handicapped subjects.

2. The educationally handicapped subjects were significantly deficient in cognitive functioning when compared to regular class subjects on the Arithmetic, Information, Digit Span and Coding Subtest of the WISC.

3. The educationally handicapped subjects were significantly deficient in conceptual abilities compared to regular class boys on the Visual Association and Auditory Association Subtests of the ITPA.

4. The Seriation Subtest, developed for this study, demonstrated significant differences in the functioning of educationally

handicapped and regular class subjects. The educationally handicapped boys were markedly deficient in ordering ability.

5. The Classification Subtest, developed for this study, did not demonstrate significant differences in the two groups of subjects. The difficulty level of this Subtest appeared to be a major factor contributing to this lack of significance. If so, this finding may be interpreted as supporting Piaget's belief that animal pictures increase the difficulty level of tests designed to assess classification ability.

SUMMARY: The current study has provided evidence to support the theory that children who are severely deficient in reading skills, when compared to regular class children, are often also deficient in the ability to order, or seriate, and to classify, or form concepts. In accordance with Piaget's theory this finding supports the view that inadequately developed ordering and classifying abilities may represent, at least in part, the underlying cognitive skills necessary to cognitive maturation sufficient for mastering reading.

As a part of this research a composite test was developed to assess reading skill and seriation and classification abilities. The use of this test provides evidence that broadened insights into cognitive functioning may be gained by alterations in usual testing procedures.

In addition to providing evidence for the presence of underlying cognitive deficits in poor readers, the study has suggested that the elementary science curriculum may provide a valuable content area for the development of improved cognition. The child is provided with the opportunity to view science as an invention of man for ordering the universe. Through science the child is encouraged to interact with and act upon his environment.

Guidance for this interaction is provided through specific suggestions for teaching strategies which maximize opportunities for recognition of conceptual relationships by the child. These specific suggestions are supported by examples of teaching procedures. These examples are provided to more clearly indicate that Piaget's theory may be used as the basis for curriculum adaptation as well as assessment procedures.

ACKNOWLEDGMENT

The writer wishes to express her sincere appreciation to Dr. Heath W. Lowry, for his valuable assistance and guidance as Chairman of the Dissertation Committee, and to Dr. Jerald W. Nelson, whose earlier study of seriation inspired this research. Gratitude for counsel during the course of the investigation is also extended to the other members of the Committee: Dr. W. Preston Gleason, Adviser; Dr. John Schippers, and Professor Stanley Volbrecht.

The author is also indebted to Dr. Ralph Richardson, Director of Special Education for the San Juan Unified School District, Sacramento, California, and to the many principals and teachers of the San Juan District whose cooperation made this research possible. Special thanks are also expressed for the assistance in the analysis of the research data provided by Dr. Stanley France.

V. H. M.

TABLE OF CONTENTS

CHAPTER		PAGE
I.	THE PROBLEM AND DEFINITIONS OF TERMS USED	1
	Introduction	1
	The Problem	4
	Statement of the Problem	4
	Significance of the Study	5
	Description of the Study	7
	Assumptions and Limitations	7
	Assumptions	7
	Limitations	8
	Definitions of Terms Used	9
	Summary	11
II.	REVIEW OF THE LITERATURE RELATED TO THIS STUDY	13
	The Educationally Handicapped Child	13
	Nomenclature and Definition	14
	Influence of Maturation	15
	Educational Placement	16
	Remedial Planning	18
	Cognitive Correlates of Reading Disability	19
	Piaget's Theory of Seriation and Classification	20
	Multiplicative classification and seriations	21
	The importance of retroaction and anticipation to classification	21
	Seriation as a Cognitive Factor in Reading	23

CHAPTER PAGE

Theory and opinion 24

Research 25

Summary 29

Concept Formation as a Cognitive Factor in Reading 30

Theory and opinion 30

Summary 32

Research 33

Summary 38

Remediation of Cognitive Deficits 39

Theory and Opinion 39

Research 40

Summary and Conclusions 44

III. DESIGN AND PROCEDURES 47

Population Selection 47

Selection Criteria 48

Selection Procedures 51

Testing Procedures and Descriptive Data 52

Summary 54

Test Instruments 55

Selected Subtests Assessing Academic Functioning 56

Gilmore Oral Reading Test 56

The Wide Range Achievement Test 57

Selected Subtests Assessing Cognitive Functioning 58

Wechsler Intelligence Scale for Children 58

The Illinois Test of Psycholinguistic Abilities 59

Research Instruments 60

CHAPTER PAGE

The Research Design 65

Hypotheses 66

Major Hypotheses 66

Minor Hypotheses 67

Interaction Hypotheses 68

Summary 69

IV. PRESENTATION AND ANALYSIS OF THE FINDINGS 70

Comparisons Reflecting Academic Functioning 71

Summary of Academic Functioning 77

Comparisons Reflecting Cognitive Functioning 77

Summary 90

V. CONCLUSIONS AND RECOMMENDATIONS 94

Conclusions 95

Conclusions Related to Academic Functioning 95

Conclusions Related to Cognitive Functioning 96

Implications of the Conclusions 100

Recommendations for Adapting the Science Curriculum . . . . .

for Remediation 101

Introduction 101

Rationale for Science Curriculum Adaptation 102

An Instructional Model for Science Teaching 104

Science Curriculum Adaptation Summary 115

Recommendations for Further Study 117

Summary 118

BIBLIOGRAPHY 120

APPENDICES 126

LIST OF TABLES

TABLE		PAGE
I.	Number of Subjects Within Each Month EH Subjects	52
II.	Gilmore Accuracy Subtest	72
III.	Gilmore Comprehension Subtest	73
IV.	Gilmore Rate Subtest	75
V.	Wide Range Achievement Test Level I Reading Subtest	76
VI.	Wechsler Intelligence Scale for Children Information Subtest	79
VII.	Wechsler Intelligence Scale for Children Arithmetic Subtest	80
VIII.	Wechsler Intelligence Scale for Children Coding Subtest.	82
IX.	Wechsler Intelligence Scale for Children Digit Span Subtest	83
X.	Illinois Test of Psycholinguistic Abilities Auditory Association Subtest	85
XI.	Illinois Test of Psycholinguistic Abilities Visual Association Subtest	87
XII.	Research Instrument Seriation Subtest	89
XIII.	Research Instrument Classification Subtest	91

CHAPTER 1

THE PROBLEM AND DEFINITIONS OF TERMS USED

I. INTRODUCTION

Authorities in the field of learning disabilities have seen early educational deficits as related to a lag in the maturational process.[1] Such factors as genetic variations, biochemical irregularities, perinatal brain insults, and early sensory deprivations are seen as slowing the development of the central nervous system.[2] If the maturational lag theory is recognized as having validity, then consideration of a developmental theory of intelligence may provide a useful framework for gaining a greater understanding of the manifested disability. For example, reading disability may be considered as related to incomplete acquisition of certain intellectual abilities necessary to reading because of an underlying maturational delay.

A developmental theory of intelligence, utilized in this study, has been suggested by Piaget. In Piaget's theory the development of intelligence is related to an ability to perform logical operations, with certain operations developing in the child in a given sequence and at approximate age-intervals.[3] Piaget also suggests that knowledge is the

---

[1]Sam D. Clements, Minimal Brain Dysfunction in Children, Phase One, NINDB Monograph Number 3 (Washington: Government Printing Office, 1966), p. 13.

[2]Ibid., p. 10.

[3]Barbel Inhelder and Jean Piaget, The Early Growth of Logic in the Child (New York: W. W. Norton and Company, 1969), p. 282.

result of active interaction between the subject and his environment, with gradual changes in the modes of interaction occurring as the child develops.[4]

If Piaget's ideas are used as the basis for assessment of the functioning of the elementary age child, then the development of measures of basic intellectual operations, such as classification and seriation, may be useful in determining the child's developmental level. Piaget has suggested that classification and seriation are essentially operational forms of behavior reaching back to an origin in actions.[5] Since seriation and classification are important to the syntax and semantics of language, failure to adequately develop the bridge between primitive actions and operational seriation and classification may result in certain deficits in reading ability.[6] Therefore, in this study measures of classificatory and seriating ability have been developed for inclusion in an assessment of children demonstrating reading disability.

The development and application of classification and seriation based research instruments reflects Flavell's suggestion that Piaget's writings may provide a fruitful basis for diagnostic assessment of the child.[7] As described in Chapter III in this study, these research subtests have been combined with a battery of selected measures to form a composite test. The combined application of the research instruments and

---

[4]Ibid., p. 284.

[5]Ibid., p. 282.

[6]Ibid., p. 2.

[7]John H. Flavell, The Developmental Psychology of Jean Piaget (Princeton: D. Van Nostrand Company, Inc., 1963), p. 365.

the selected subtests as a composite test may be expected to produce some information about the accuracy of the assessment of the research instruments,[8] and to provide a framework for suggested remedial action.

The linking of test information with suggested action is necessary if the development and application of the test instrument is to be other than an isolated activity.[9] Therefore, this study has been developed in two parts, (1) assessment, and, (2) suggested implementation of remedial action. Implementation has been proposed through adaptation of portions of the elementary science curriculum for the purpose of remediation of underlying cognitive deficits necessary for reading success. Science was selected as a content area valuable in undertaking remediation for the following reasons: (1) A child who is not proficient in reading may, nevertheless, begin science study.[10] (2) In science thought processes may be developed under conditions which provide for moving from concrete experiences to those of increasing abstraction.[11] (3) The direct experience available in the science curriculum serves as a basis for language development.[12] Taken together, these ideas are relevant to Piaget's developmental theory of intelligence and provide a logical basis for suggesting science as useful in undertaking remediation in reading.

---

[8]Lester Tarnopol, Learning Disabilities (Springfield: Charles C. Thomas, 1969), p. 189.

[9]Sam D. Clements, "A New Look at Learning Disabilities," Learning Disabilities, ed. Tarnapol, op. cit., p. 35.

[10]Science Framework for California Public Schools, Preliminary Edition (Sacramento: California State Department of Education, 1969), p. 62.

[11]Ibid., p. 57.

[12]Doris J. Johnson and Helmer R. Myklebust, Learning Disabilities (New York: Grune and Stratton, 1967), p. 316.

In this introduction the value of Piaget's theory of the development of intellect is seen as important to understanding learning disabilities which are related to a maturational lag of the nervous system. Piaget's writings are used as the basis for suggesting the development of a research instrument for assessment of two operational behaviors of the elementary age child, seriation and classification. As part of a composite test of intellectual functioning, these research instruments contribute to suggested adaptation of science curriculum for reading remediation.

II. THE PROBLEM

Statement of the Problem

It was the purpose of this study to (1) develop and apply a composite test instrument for the purpose of (2) comparing the academic performance and cognitive functioning of educationally handicapped and regular class boys. The investigator used the composite test to gather data for the purpose of obtaining answers to the following questions:

1. Will there be significant differences in the academic performance of boys in educationally handicapped classes, compared to regular class boys on the composite test?

2. Will there be significant differences in the academic performance of younger and older boys in the educationally handicapped and regular classes on the composite test?

3. Will there be significant interaction between age versus type of class placement when exploring academic performance on the composite test?

4. Will there be significant differences in the cognitive functioning of boys in educationally handicapped classes, compared to regular class boys on the composite test?

5. Will there be significant differences in the cognitive functioning of younger and older boys in the educationally handicapped and regular classes on the composite test?

6. Will there be significant interaction between age versus type of class placement when exploring cognitive functioning on the composite test?

The answers to these questions concerning academic and cognitive functioning will serve as the basis for integrating test information with the science curriculum. Portions of the science curriculum will be adapted for the purpose of reading remediation.

Significance of the Study

This study seeks to answer questions which may have significance for the following reasons:

1. Reading is the most essential skill to be learned in school. Only reading is fundamental to comprehension in other subject areas in a society which demands constantly lengthening periods of education to prepare young people for increasingly complex adult roles.

2. The finding of the existence of a significant difference between younger and older boys in the educationally handicapped program, when compared to the regular class boys on the research instrument, may (a) lend support to Piaget's theory of intellectual development and may (b) lend support to maturational lag as an important factor in reading disability.

3. The development and application of a composite test for the assessment of the pupil's capabilities may contribute to the refinement of present test procedures and may expand them to include elements which account for difference in educability which elude presently existing tests when used with students having reading disabilities.

4. A theoretically based research instrument, developed to expand testing dimensions, may, as a part of a composite test, serve as a basis for suggesting a theoretically adapted curriculum useful in reading remediation. At the present time, after examining the published literature, the researcher has not found any studies which use theory as the basis for integration of remediation in reading with subject matter.

5. This study, linking assessment and remediation theoretically, should assist both psychologists and teachers in converting test information to the development of meaningful curriculum which is relevant to both the educationally handicapped and regular class child.

There is a need to survey actual populations of children designated under state regulations as having learning disabilities, and to compare these pupils with those remaining in the regular classes. There may be students in regular classes who show subtest patterns similar to educationally handicapped students, but who are not reading disabled. Studies of such children may lend new insight into reading disability and provide evidence of the accuracy of present identification methods.

III. DESCRIPTION OF THE STUDY

For the assessment purpose of this study a composite test was developed which combined selected subtests from standardized measures with two research instruments. The selection of the subtests was made upon the basis of the literature which linked reading disability with scores obtained upon tests of academic achievement and cognitive functioning.[13] Tests of academic achievement were the Gilmore Oral Reading Test and the Wide Range Achievement Test. Tests of cognitive functioning were the Wechsler Intelligence Scale for Children, the Illinois Test of Psycholinguistic Abilities, and the two research instruments developed for this study. These two research subtests were designed to reflect Piaget's belief that the ability to seriate and group multiplicatively is a vital step in the development of operational thought.[14]

The composite test was administered to educationally handicapped students between the ages of 7 and 10 years of age, in a large suburban school district. The educationally handicapped subjects were then matched

---

[13] Cf. infra., Chapter II.

[14] Inhelder and Piaget, op. cit., p. 279.

with subjects in regular classes and the composite test was administered to the regular class students. Variables relating to age, sex, intelligence, socio-economic level and family background were controlled prior to the selection and matching of all subjects.

Students in educationally handicapped classes were selected for the study, since in California they represent a population of normal intelligence who demonstrate marked learning disabilities.[15] Their failure to achieve academically is most often manifest in the area of reading skill.[16] Since most students seriously deficient in reading skills will be identified and placed in corrective programs after the third grade,[17] integration of remediation and academic curriculum seems necessary.[18] The final part of the study suggests the integration of reading remediation with the science curriculum.

IV. ASSUMPTIONS AND LIMITATIONS

Assumptions

From the onset of the study certain assumptions were necessary. They included the following:

1. Children in educationally handicapped classes have been selected and placed as directed by the California State Education Code.

---

[15] *Laws and Regulations Relating to Education and Health Services for Exceptional Children in California*, Section 6750 (Sacramento: California State Department of Education, 1969), p. 21.

[16] Tarnopol, *op. cit.*, p. 334.

[17] Leon Eisenberg, "Epidemiology of Reading Retardation," *The Disabled Reader*, ed. John Money and Gilbert Schiffman (Baltimore: John Hopkins Press, 1966), p. 19.

[18] Marianne Frostig, "Education of Children with Learning Disabilities," *Progress in Learning Disabilities*, Volume I, ed. H. R. Myklebust (New York: Grune and Stratton, 1968), p. 250.

2. Children in regular classrooms are of normal intelligence unless otherwise identified by school district testing procedures or teacher judgment. In the school district in which this study was conducted intelligence testing has been discontinued, unless the child is referred for individual assessment.[19]

3. Emotional disturbance of varying intensity accompanies learning disability and cannot be considered as a separate entity.[20] In this study the researcher has not considered the question of emotionality as cause or effect of learning disability.

4. The selected subtests used in this study accurately measured the dimensions of intellectual function which are specified by the literature cited in this study.

5. Piaget's description of the assessment of multiplicative seriation and classification provided an adequate basis for the development of the two research instruments used in this study.[21]

6. The descriptive information related to the child which is contained in the school record is valid for the purposes of this study. Specifically, the information recorded on the emergency card or in the child's cumulative folder regarding birth date, grade retention, father's occupation, number of siblings, marital state of the parents and the child's relationship to the father is accepted by the researcher.

7. Test data collected by qualified school district examiners and recorded in the child's school record is accepted as valid for the purposes of this study.

In addition to the above-stated assumptions the following limitations are noted as relevant to this study:

Limitations

1. Those inherent in the nature and scope of the devised

---

[19]For a discussion of the value of teacher judgment in assessing intelligence, see: Florence G. Roswell and Gladys Natchez, Reading Disability: Diagnosis and Treatment (New York: Basic Books, 1964), p. 27.

[20]Gilbert Schiffman, "Program Administration Within a School System." The Disabled Reader, ed. John Money and Gilbert Schiffman (Baltimore: Johns Hopkins Press, 1966), p. 254.

[21]Inhelder and Piaget, op. cit., chapters 6 and 10.

and assembled composite test.

2. Those inherent in the administration of an individual test to sixty children located in varying school settings and those variations due to uncontrollable time factors relating to the scheduling of individual examinations or large numbers of school children.

3. Those inherent in the presence of unidentified and uncontrollable variables in the matching of educationally handicapped and regular class children.

V. DEFINITIONS OF TERMS USED

Throughout the study the following definitions of terms have been used:

1. Composite test: An assessment device made up of twelve subtests compiled by the researcher for the purpose of individually testing elementary children on academic and cognitive factors which the literature suggests may indicate or relate to reading failure.[22] Ten of the subtests were selected from standard psychometric procedures and two of the subtests were research instruments developed for this study.[23]

   (A) Academic performance was assessed on the Level 1 Reading Subtest of the Wide Range Achievement Test,[24] and the Accuracy, Comprehension and Rate Subtests of the Gilmore Oral Reading Test, Form A.[25]

   (B) Cognitive functioning was assessed on the Visual and Auditory Association Subtests of the Illinois Test of Psycholinguistic Abilities;[26] the Information, Arithmetic, Digit Span and Coding Subtests

---

[22]Cf. infra., Chapter II.

[23]Appendix A includes a copy of the composite test summary sheet.

[24]J. F. Jastak and S. R. Jastak, The Wide Range Achievement Test, Manual (Wilmington: Guidance Associates, 1965).

[25]John V. Gilmore, Gilmore Oral Reading Test, Manual (New York: Harcourt, Brace and World, 1952).

[26]Samuel A. Kirk, James J. McCarthy, and Winifred D. Kirk, Illinois Test of Psycholinguistic Abilities, Revised Edition, Manual (Chicago: University of Illinois, 1968).

of the Wechsler Intelligence Scale for Children;[27] and the Classification and Seriation Research Subtests developed for the study.

2. Educationally handicapped: Those minors, other than physically handicapped or mentally retarded, who, by reason of marked learning or behavioral problems, or a combination thereof, cannot receive the reasonable benefit of ordinary education facilities.[28] To be eligible for admission to the educationally handicapped program the minor whose learning problems are associated with a behavioral disorder or a neurological handicap or a combination thereof must exhibit a significant discrepancy between ability and achievement.[29]

3. Multiplicative classification: The ability to group objects on two conceptual dimensions in a matrix. Each element is classed simultaneously in terms of two additive orders and four sub-classes result. The development of this ability roughly parallels that of multiplicative seriation and operational performance begins at the age of 7-8 years.[30]

4. Multiplicative seriation: The ability to order objects along the horizontal and vertical axes of a matrix based upon the simultaneous twofold ordering of a set of elements. The process evolves in stages in the child's development and the final stage begins at age 7-8 years.[31]

5. Normal intelligence: Students whose intellectual functioning has not been identified by standard school testing procedures or by teacher estimate as at the extremes of the intellectual range. In the frame of reference provided by the distribution of the standardization sample of the Stanford-Binet test the six percent of the population with the lowest and highest

---

[27]David Wechsler, Wechsler Intelligence Scale for Children, Manual (New York: The Psychological Corporation, 1949).

[28]Laws and Regulations Relating to Education and Health Services for Exceptional Children in California, op. cit.

[29]California Administrative Code, Title 5, Provisions Pertaining to Programs for Educationally Handicapped Minors, Section 3230 (Sacramento: California State Department of Education, November, 1969).

[30]Inhelder and Piaget, op. cit., pp. 251-252 and 290.

[31]Ibid., pp. 269-270.

ability has been excluded from this study.[32]

6. Reading disability: Subjects are identified as having a reading disability if they have a normal intelligence and are retarded in reading on the Gilmore Oral Reading Test one-half year in the second grade, or one year in the third and fourth grades.[33,34]

7. Regular class: The usual public school classroom located in the same school building as the educationally handicapped classroom and those children placed in it who are of normal intelligence according to teacher judgment or available test data.

8. Research instruments: Two subtests developed for this study from Piaget's descriptions. These subtests are designed to measure the stage-like development of the abilities of multiplicative classification and multiplicative seriation in elementary age children.[35]

9. Selected subtests: Ten subtests from four standardized tests as described under the definition of the composite test.

VI. SUMMARY

The first chapter of this research report has (1) given an introduction to the theoretical premise of the study (2) stated the problem (3) indicated the significance of the study (4) provided a descriptive outline of the study (5) stated the assumptions and limitations, and (6) defined the relevant terms.

Four additional chapters compose the remainder of the dissertation.

---

[32]Lewis M. Terman and Maud A. Merrill, Stanford-Binet Intelligence Scale, Form L-M Manual (Boston: Houghton Mifflin Company, 1960), p. 18.

[33]Charles A. Ullmann, "Prevalence of Reading Disability as a Function of the Measure Used," Journal of Learning Disabilities, 2, (November, 1969), p. 7.

[34]Corrine E. Kass, "Psycholinguistic Disabilities of Children with Reading Problems," Exceptional Children, 32 (April, 1966), p. 536.

[35]Inhelder and Piaget, op. cit.

Chapter II reviews the literature which has the most direct relationship to the study. Chapter III describes the research design and method used for the collection of the data. In Chapter IV the findings from the administration of the composite test are discussed. Chapter V concludes the study and consists of the following sections: (1) the conclusions based on the data, (2) recommendations for adapting the science curriculum for remediation, (3) recommendations for further study and, (4) a general summary of the study.

CHAPTER II

REVIEW OF THE LITERATURE RELATED TO THIS STUDY

Throughout this chapter the literature selected for review was that most directly related to the subjects of this study. Piaget's theory indicates that the cognitive functioning of children of normal IQ, within a given age range, differs from younger or older children, or adults. Therefore, the primary concern has been with opinions and research related to youngsters of normal IQ of elementary school age with reading disabilities.

On the basis of this criterion the relevant literature was reviewed in three specific areas: (1) that delineating the general characteristics of Educationally Handicapped children and their placement in California schools, (2) that concerned with the identification and assessment of those cognitive correlates of reading disability which relate to seriation and classification as described by Piaget, and (3) the research relative to the development of underlying cognitive processes as a part of reading remediation.

I. THE EDUCATIONALLY HANDICAPPED CHILD

California's program for Educationally Handicapped pupils was authorized by legislation enacted in July, 1963, and reflected an awareness of the need for extending educational services to children handicapped by a broad range of learning, behavioral, and emotional problems. Prior to 1963, the experience of school districts who had developed their own programs, and studies conducted within the state, made

it apparent that there was rarely a simple etiological explanation for the complex problems exhibited by children with serious learning, behavioral or emotional problems.[1]

Nomenclature and Definition

The fields of medicine, psychology, education and the language specialties have all given attention to the large number of individuals of normal intelligence who show deviations of intellectual functioning and behavior of such nature as to require special educational planning. Recently, a three-phase national project has attempted to clarify issues, nomenclature, identification and research related to this diverse area of education.[2] This national study revealed that a total of thirty-eight terms have been used to describe the condition termed minimal brain dysfunction by the national task force and educationally handicapped by the California State Department of Education. The task force definition of minimal brain dysfunction is of interest because it refers to both cognitive and academic deficits in the functioning of the pupil:

> ...children of near average, average, or above average general intelligence with certain learning or behavioral disabilities ranging from mild to severe, which are associated with deviations of function of the central nervous system. These deviations may manifest themselves by various combinations of impairment in perception, conceptualization, language, memory, and control of attention, impulse, or motor function.... During the school years, a variety of learning disabilities

---

[1]Allan Simmons and Margaret Scheffelin, California's Program for Educationally Handicapped Minors (Sacramento: California State Department of Education, 1969), p. 1.

[2]Clements, Minimal Brain Dysfunction in Children, Phase One, op. cit., p. 3.

> is the most prominent manifestation of the condition which can be designated by this term.[3]

The symptoms which the dysfunctioning child may exhibit in varying degree and combination include: (1) impairment of fine movement or coordination, (2) electroencephalographic abnormalities without actual seizures, (3) deviations in attention, activity level and impulse control, (4) specific and circumscribed perceptual, intellectual, and memory deficits, and (5) nonperipheral impairments of vision, learning, haptics, and speech.[4]

Influence of Maturation

Many of the above named characteristics tend to improve with the maturation of the central nervous system and, with maturity, various complex motor acts and intellectual differentiations develop, or are more easily acquired.[5] As interpreted by Piaget, maturation is contingent upon functioning, which is fostered by experience and training:

> But from the positive point of view, the maturation of the nervous system can do no more than create the conditions for a continual expansion of the field of possibilities. The realization of these possibilities demands not only the action of the physical environment (practice and acquired experience), but also the educational influence of a favourable social environment.[6]

Both Money and deHirsch correlate slowed maturation with reading difficulty. DeHirsch states, that although for most children chronological age does reflect maturation, other children with adequate intelligence suffer from maturational lags and have a high risk of reading

---

[3]Sam D. Clements, Minimal Brain Dysfunction in Children, Phase Two, Public Health Service Publication No. 2015 (Washington: Government Printing Office, 1969), p. 9.

[4]Ibid., p. 10. [5]Ibid., p. 13. [6]Inhelder and Piaget, op.cit., p. 5.

failure.[7] Money indicates that the most useful hypothesis relating brain function and reading disability is that of a maturational lag in the brain and nervous system. In fact, Money feels that the greatest majority of reading disability cases can be accounted for by this hypothesis.[8] However, both Money and deHirsch would agree with Piaget's belief in the influence of the child's experience and education on the maturational process.

Educational Placement

Diagnostic considerations are important for the determination of special educational placement for the educationally handicapped child, and these considerations develop out of the objectives of medical and educational viewpoints. The medical diagnosis is conducted to identify causative factors which may be ameliorated, while the educational diagnosis is concerned with the assessment of performance and capabilities, with the goal of determining appropriate remedial programs.[9] The medical diagnosis includes a medical, developmental, and family-social history in addition to a general and neurologic physical examination. The educational diagnosis encompasses an academic history and an evaluation of achievement related to reading, number concepts, spelling and writing. All of this information is correlated with a psychological evaluation of intellectual functioning.[10]

---

[7]Katrina deHirsch, Jeannette Jansky, and William Langford, Predicting Reading Failure (New York: Harper and Row, 1966), p. 73.

[8]John Money, Money and Schiffman, op. cit., p. 33.

[9]Clements, Minimal Brain Dysfunction in Children, Phase One, op. cit., p. 14.

[10]Ibid., p. 15.

In California, following the described diagnostic work-up, a district level admission committee, including a physician, psychologist, school administrator, nurse or social worker, and a teacher, determines eligibility for placement in an educationally handicapped program. All placements require the recommendation of an admission committee and written parental consent.[11] The type of program in which the child may be placed and its availability depends upon the district in which the pupil lives, since the California program functions on a permissive basis at both the elementary and secondary levels. Four types of programs are authorized and the range of handicap within these programs may be limited to students identified as either neurologically handicapped or seriously emotionally disturbed, depending upon the philosophy of the school district. The four types of programs are: (1) Special classes for pupils unable to function in regular classes. A maximum of twelve pupils is allowed in these classes. (2) Learning disability groups, designed to meet the needs of pupils who can function for varying periods in a regular class program, but who need some degree of individualized or small group instruction. (3) Home and hospital instruction for pupils unable to function in a school setting due to the severity of their problems. (4) Specialized consultation, available for teachers, counselors and supervisors relative to the learning disabilities of pupils requiring specialized services.[12] In California, children identified as educationally handicapped may, therefore, represent an educationally heterogene-

---

[11] Simmons and Scheffelin, op. cit., p. 3.

[12] Clements, Minimal Brain Dysfunction in Children, Phase Two, op. cit., p. 2.

ous group, whose educational management must be based on functional diagnostic information.

Remedial Planning

Reliance on such functional diagnostic information may mean that identification of an educational deficiency contributes strongly to remedial planning. From this viewpoint the curriculum becomes the standard setter for desired performance. "A learner has an educational disability when he cannot consistently meet the demands of the curriculum to which he is assigned."[13] By this criterion the child who shows marked discrepancy in progress in reading when compared with his age-matched group may be referred for placement and remedial action, which is aimed at attaining the standard of the curriculum.

Frequently, the result of such action is to subject the child placed in an educationally handicapped program to an intensification of the usual methods of reading instruction.[14,15] When usual remediation fails to produce satisfactory progress, the limitations of the customary techniques of remedial instruction may be recognized. Bond and Tinker suggest that the failure of these customary techniques places the child beyond the concern of education:

> The diagnostician should be on the alert to the possibility of neurological limitations, especially in cases that are high in intelligence and low in other organized learnings such as arithmetical computation. The reading diagnostician and remedial worker must be well aware of the fact that all human

---

[13] Ibid.

[14] Patrick Ashlock and Alberta Stephen, Educational Therapy in the Elementary School (Springfield: Charles C. Thomas, 1966), p. x.

[15] Guy Bond and Miles Tinker, Reading Difficulties (New York: Appleton-Century-Crofts, 1967), p. 169.

deficiencies cannot be corrected by education.[16]

Since there are many[17] bright children who fit Bond and Tinker's description, whose lives are burdened because of delay or failure in the acquisiton of reading ability, other authorities have suggested alternative remedial plans. Ashlock and Stephen suggest the augmentation of the customary remedial program by directing more attention to the specific deficiencies in the child's learning process and the remediation of these deficiencies.[18] Bateman indicates that an analysis of patterns of cognitive abilities could provide a basis for curriculum planning which would include the education of underlying abilities.[19]

II. COGNITIVE CORRELATES OF READING DISABILITY

Since the underlying premise of this study was Piaget's theory as it relates to seriation and classification, the cognitive correlates of reading disability considered relevant in a review of the literature were those related to seriation and classification. Piaget has provided such unique insights into the child's development of seriation and classification abilities, that the book, The Early Growth of Logic in the Child,[20] becomes the primary reference. In their exploration of the literature, Inhelder and Piaget indicate that there has been no systematic research on seriation. Classification, or concept formation, has

---

[16] Ibid.

[17] "A conservative estimate is that five to ten percent of the school population has severe enough reading problems to require special educational concern and provisions." Barbara Bateman, "Learning Disabilities--Yesterday, Today, and Tomorrow," Exceptional Children, 31 (December, 1964), p. 168.

[18] Ashlock and Stephen, op. cit. [19] Bateman, op. cit., p. 174.

[20] Inhelder and Piaget, op. cit.

been a concern of psychologists for over thirty years. However, Piaget's work is unusual in being a first in the systematic investigation of the developmental aspects of concept formation. To Piaget the classificatory behavior which is the foundation of reasoning is the abstraction of the criteria of classification. It is this premise which distinguishes Piaget's approach from the work of other psychologists. [21] Therefore, other works concerned with the descriptive approach to concept formation were not directly applicable to this study.

Piaget's Theory of Seriation and Classification

In Piaget's theory seriation and classification relate directly to the early development of the reasoning process. Seriation and classification precede the formation of systematic hypotheses and the verification of these hypotheses by a deduction of their implications. Piaget indicates that there is an underlying commonality in the development of seriation and classification in the child's cognitive growth, with seriation ability appearing somewhat earlier than classification. In the children Piaget studied, seriation and classification abilities were not operational before the age of 7 or 8 at the earliest.[22]

The two operations are similar in most respects, although classification demonstrates a higher degree of complexity. Language appears to play a greater part in the development of classification than in seriation, while perception is more important to seriation.[23] The impor-

---

[21] Ibid., p. xx.

[22] Ibid., p. 247.

[23] Ibid., p. 1.

tance of perception[24] to seriation appears to be the basis of the two main differences between seriation and classification which are (1) that, a relation can be perceived while a class cannot, and (2) a serial configuration constitutes a perceptually good form.[25]

Multiplicative Classification and Seriations. The logical operations of classification and multiple classification, and seriation and multiple seriation are closely linked to the more elementary actions of putting things into piles and separating these piles into groups. From these early beginnings, development is continuous and becomes more complex as the entire ordering process is internalized and generalized. The principal adjustment which occurs during this developmental progression is the growth of retroactive and anticipatory processes. It is this developed ability to use hindsight and foresight which makes multiplicative seriation and classification possible. Hindsight and foresight stem from one directional proaction, in which actions already performed tend to influence those that follow, and then pass into retroaction, and finally foresight.[26]

The importance of retroaction and anticipation to classification. Retroaction and foresight, or anticipation, may be better understood if they are explored more specifically in relation to their importance in classification. To accomplish this aim a general summary of Piaget's

---

[24]Piaget believes that perception is an outgrowth of all preceding activity. Environmental experience encompasses all other considerations. Ibid., p. 294.

[25]Ibid., p. 247.

[26]Ibid., p. xx.

views of classification is necessary.[27]

Piaget states that some kind of classification is implicit in most actions and in every judgment. The recognition that things may belong to categories of wider generality (such as apples to fruit) may occur very early in development. An advance over recognition is represented by the realization that things may belong, simultaneously, to two categories, one of wider generality than the other (a thing is both an apple and a fruit). However, classifications of this type can only provide the basis for correct inferences if there is adequate abstraction of the properties which indicate that the elements of one class also belong to another class of higher generality (but not vice versa).

Learning from experience is based upon the constant interpretation of new situations in the light of previous experience. The way which learning may gain from experience depends upon the sort of generalizations made, and upon how false generalizations are refined and corrected. In turn, the extent which experience contradicts expectation brings about a change in the generalizations or analogies that anteceded it, which were dependent upon the initial analysis of the experience. The condition for increasingly precise differentiation in analysis is the ability to view (or "turn round on") the initial generalization and to examine the criteria which motivated it. Or, stated another way, the tendency to assimilate the new to the familiar may lead to false analogies and predictions based on falsity may turn out to be at variance with the facts. To be able to detect such an error in initial reasoning

---

[27] Ibid. The discussion is based upon the introductory interpretations provided by one of the English translators of Piaget's book, E. A. Lunzer.

the criteria which determined the analogy must be kept in mind, in order for it to be reviewed.

The ability to retrace steps in reasoning is slow and gradual in development and the inability of young children to carry out ordering or classification tasks in a coherent way is because they deal with objects one at a time and the basis of their own behavior eludes them. They cannot retrace their own activity and abstract any single consistent criterion which governs the entire sequence. If the objects differ in only one characteristic they may be able to order or classify them, but they cannot do so when the differences are more varied. In terms of classification, its true significance to the cognitive development of the child is that the child who can classify can reason logically about the properties of things by adhering to unambiguous criteria. Lunzer has provided a summary of clarity:

> Classifications both covert and open play an important part in inference, but only insofar as (i)the subject can make such classifications unambiguous, and (ii)he is able to recognize the criteria of his own classifications, i. e. he knows wherein they are unambiguous.[28]

Seriation as a Cognitive Factor in Reading

An exploration of the literature related to the possible correlation of seriation ability with reading revealed that seriation, as described by Piaget, and sequencing ability are probably indistinguishable concepts. Dunsing and Kephart describe sequencing as follows:

> Sequence involves an ordering in time of dissimilar objects or events. Always there is a spatial-temporal translation involved here as the child explores and experiments with structured

---

[28] Ibid., p. xv.

> patterns of complex movement relationships in space. It is through such sequential structuring that the child learns finally to pull the elements of form together into a configuration. The same kind of temporal-spatial integration later enables him to deal with spatial configurations in a simultaneous manner.[29]

Theory and opinion. Although temporal order has frequently been recognized as important to educational activities, there has been less recognition of the importance of spatial order. Interestingly, Lashley suggests, that in terms of cerebral function, spatial and temporal functioning are difficult to distinguish and are almost completely interchangeable.[30] DeHirsch acknowledges the importance of both temporal and spatial concepts by stating that in learning to read the child functions both spatially and temporally, from sounds seen (a sequence in space), to sounds heard (a sequence in time).[31] To deHirsch any sequence represents an organization in time and learning to perceive, process, store and recall the serial order of information is necessary for later reading.[32] Therefore, difficulties in spoken, written and printed language all involve disturbances of sequential behavior which reflect deviations in the developmental process.[33]

Johnson and Myklebust stress that there are many dimensions to sequentialization which are vital to the learning process. Both auditory and visual sequencing are important in reading, since the child must learn

---

[29]Jack Dunsing and Newell Kephart, "Motor Generalizations in Space and Time," Learning Disorders, Volume 1, Jerome Hellmuth, ed. (Seattle: Special Child Publications, 1965), p. 116.

[30]K. S. Lashley, "The Problem of Serial Order in Behavior," Cerebral Mechanisms in Behavior, ed. Lloyd Jeffress (New York: John Wiley and Sons, 1951), p. 128.

[31]DeHirsch, op. cit., p. xiv. [32]Ibid., p. 88. [33]Ibid., p. xiv.

that letters in words remain in a specific order and that this activity correlates with the use of a spoken language in which sounds are patterned within a word, and words in a sentence. Even long after a child becomes fluent in reading sequential ordering problems may be evident in spelling errors.[34]

Klapper relates the visual and auditory discrimination abilities of poor readers to difficulties in temporal and spatial processing:

> The two sensory modalities involved in reading are vision and audition. In reading disabilities, visual cognition does not appear to be disturbed if the visual discrimination task is simple and does not involve sequential spatial or temporal arrangements. There are many studies reporting no relationship between reading disability and visual form perception. If such a disturbance is present it is generally found in the youngest children and is a transient problem....Problems arise when the dyslexic is confronted with spatially or temporally distributed visual stimuli and arrangement in sequence is required...
> A distortion in hearing clearly presents a major learning obstacle. Although some research specifies auditory discrimination as the disturbed process, this is not the primary impairment. Words are temporally distributed auditory stimuli and require assemblage at the receptor level. If the mechanism for processing the auditory input is deficient, the successive bits of information remain fragmented and unrelated.[35]

If Klapper's views are accepted, seriation may represent an underlying process important for the understanding of the failure of some reading disabled children to demonstrate adequate visual and auditory discrimination.

Research. Various investigators have conducted research which indicates that sequencing ability is important to reading. Much of this work has been done using the Wechsler Intelligence Scale for Children

---

[34]Johnson and Myklebust, op. cit., p. 168.

[35]Zelda Klapper, "Psychoeducational Aspects of Reading Disabilities," Pediatrics, 37 (February, 1966), pp. 369-370.

(WISC) as the assessment device. In all probability this is because of the wide use of the WISC in psychometric procedures. However, there is some indication in the literature that the Wechsler tests have a higher number of seriation associated items than the Stanford-Binet.[36]

1. Kinsbourne and Warrington Study. Kinsbourne and Warrington studied a group of patients selected on the basis of a WISC Verbal IQ more than 20 points higher than the Performance score. These subjects were found to have difficulty with tests of finger differentiaion and order, as well as with constructional tasks and mechanical arithmetic. These writers felt that the underlying problem was a developmental cerebral deficit based upon a difficulty in sequential ordering. This deficit was viewed as the cause of a delay in learning to read and write.[37]

2. Robeck Study. Robeck compared thirty-six Reading Clinic students with a mean age of 10-5 with the normative population of the WISC. She reported that the reading disability group showed weaknesses, significant to the .01 level of confidence, in four subtests, Digit Span, Arithmetic, Information and Coding. The thirty-six cases in this study included thirty-two boys and four girls with a Full Scale IQ range of 85 to 136 and a Full Scale IQ mean of 109.75. No explanation of the findings is offered by Robeck, but the study was conducted to determine whether problem readers had common characteristics in certain kinds of

---

[36]Robert Ginther, "A Study of Early Reasoning Skills in the Trainable Mentally Retarded: As Related to Piaget's Seriation Theory" (unpublished Master's thesis, University of the Pacific, 1970), p. 41.

[37]M. Kinsbourne and Elizabeth Warrington, "Developmental Factors in Reading and Writing Backwardness," British Journal of Psychology, 54 (1963), pp. 145-156.

intellectual functioning which might be related to causal factors of reading disability.[38]

3. Neville Study. In this study male retarded readers with an IQ of ninety or above were compared with male non-retarded readers. These boys were part of a Reading Clinic population and thirty-five pairs were investigated using the WISC. Scores of retarded readers were significantly lower than the scores of the non-retarded on the Information, Arithmetic, and Digit Span Subtests at the .01 level. The Coding Subtest was also lower for the retarded readers, but did not reach the .01 significance level. Neville concluded that retarded readers did poorest on the WISC Subtests which most nearly resembled school tasks.[39]

4. Kallos, Grabow and Guarino Study. In this study Reading Center boys who were reading at least two grades below age-grade expectations were tested with the WISC. The boys ranged in age from 9-0 to 14-0 and had Full Scale IQ's between 90 and 109. Differences, significant at the .01 level, were obtained when the high scores of the Block Design and Picture Arrangement Subtests were compared with the lowest Subtests--Arithmetic, Coding, and Information. The Digit Span Subtest was not administered. The researchers concluded that retarded development of motor-visual coordination, which is most involved in coding, may be an important cause of reading disability. The low Information and Arithmetic scores were interpreted as reflecting variables in the home and

---

[38]Mildred Robeck, "Subtest Patterning of Problem Readers on WISC," California Journal of Educational Research, 11 (May, 1960), pp. 110-115.

[39]Donald Neville, "A Comparison of the WISC Patterns of Male Retarded and Non-Retarded Readers," Journal of Educational Research, 54 (January, 1961), pp. 195-197.

school environment which promote reading disability.[40]

5. Bean Study. Bean compared twenty-five retarded readers from grades 7, 8 and 9 with an equal number of average readers. These subjects were administered a battery of tests designed to measure intelligence, reading ability, perceptual and visual motor skills, and memory. The data was submitted to statistical treatment which indicated that eleven factors accounted for 62% of the variance. The defect which appeared most critical to reading retardation was sequential memory as demonstrated on a number of measures, including the Digit Span and Coding Subtests of the WISC.[41]

The identification of sequencing ability as related to reading through psychometric assessment as reported by Bean has also been supported by the findings of Bannatyne in England. In Bannatyne's study, eighty-seven boys between the ages of 8 and 11 who were poor readers, were found to be lowest on the Digit Span, Coding, and Arithmetic Subtests of the WISC. These three subtests had been categorized by Bannatyne as Sequencing Ability Subtests and the low scores of the poor readers were interpreted as evidence of problems with auditory sequencing and discrimination.[42]

---

[40]George Kallos, John Grabow, and Eugene Guarino, "The WISC Profile of Disabled Readers," Personnel and Guidance Journal, 39 (February, 1961), pp. 476-478.

[41]William Bean, "The Isolation of Some Psychometric Indices of Severe Reading Disability," Dissertation Abstracts, 28 (February, 1968), p. 3012A.

[42]Alex Bannatyne, "The Etiology of Dyslexia and the Color Phonics System," Selected Papers on Learning Disabilities: Third Annual International Conference of the Association for Children with Learning Disabilities (Pittsburgh: Association for Children with Learning Disabilities, 1967), pp. 67-78.

Summary

A review of the literature indicates that sequencing ability may be highly correlated with reading success. In terms of cognitive functioning there was opinion which suggested that spatial and temporal ordering were indistinguishable, but vital processes necessary to both visual and auditory sequencing. Problems with auditory and visual discrimination and difficulty with tests of finger differentiation and order may be manifestations of sequencing disorders.

Considerable research with reading disabled subjects has been done with the WISC as the assessment device. In some of the research the subjects have been compared to the WISC normative population, while in other instances comparison has been made between good and poor readers in relation to subtest performance. Frequently, through either method of comparison, the Information, Arithmetic, Digit Span, and Coding Subtests were found to be significantly lower for the poor readers.

Various explanations have been provided for the high correlation between the depressed scores of the Information, Arithmetic, Coding and Digit Span Subtests and reading disability. Suggested interpretations include; the resemblance of these subtests to school tasks, the dependence of the skills measured by these subtests upon the home and school environment, and the importance of sequencing to success on these subtests. Since all of these interpretations are related to Piaget's theory of cognitive development, the use of these four subtests as part of the further exploration of the relationship between seriation and reading may be useful and suggests a hypothetically valid approach.

Concept Formation as a Cognitive Factor in Reading

There can be little doubt that Piaget uses the term classification as synonymous with concept. The introduction of Piaget's book refers to Vinacke's review of studies of concept formation as pertinent background for understanding the discussion of classification.[43] Vinacke's definition of a concept as a kind of selective system in the mental organization of a person which links previous experience and current states with stimulus objects is also descriptive of Piaget's discussion of classification.[44] This definition encompasses the idea that in conceptualization, the individual makes use of past experience through the identification and classification of objects; or, in the absence of the object, through symbolic responses which detach concepts from specific instances and allow them to be manipulated in many complex ways.[45]

A review of the literature relating concept formation and reading ability reflects a general theoretical agreement that there is a high degree of relationship. Concept formation is necessary to achieve success in reading. However, the research indicates that the exploration of the nature of this relationship is poorly understood and not commonly assessed.

Theory and opinion. Rappaport suggests that conceptualization is, like seriation, important to the child's world because of the ease and economy of mental manipulation which concepts provide. Through growth

---

[43]Inhelder and Piaget, op. cit., p. xi.

[44]W. E. Vinacke, The Psychology of Thinking (New York: McGraw-Hill, 1952), p. 98.

[45]Ibid., p. 105.

in ability to form concepts, the child becomes better equipped to explore and practice the ways in which experience can be expressed in action or language. The child also becomes better able to translate actions and experience into symbols, or symbols into actions. Growth in the level of conceptual development is necessary in order for reading, arithmetic, and other school subjects to be mastered.[46]

In describing learning disabilities, Myklebust and Johnson have stressed the importance of the child's ability to categorize, as well as the ability to abstract, to the conceptualization process. The critical factor, they feel, is the manner in which the experience is classified or categorized. The class or category that forms a concept is not in itself observable, but represents a group of experiences with a common denominator. It is this common denominator which is the basis of the association between experiences. In children's learning the possible deficit is in the process of recognizing the relationships among experiences. Hence any brain dysfunction may obstruct the ability to conceptualize, since conceptualization is at a high level of cognition which is dependent upon many other associations.[47]

Gardner agrees with Myklebust and Johnson in endorsing the belief that even mild brain damage may have severe effects upon concept formation. Impairments of the capacity to categorize and abstract effectively may be the most easily observed consequence of brain damage. Even the minimally brain damaged child may find it difficult to understand and remember the

---

[46]Sheldon Rappaport, Public Education for Children with Brain Dysfunction (New York: Syracuse University Press, 1969), p. 58.

[47]Johnson and Myklebust, op. cit., p. 44.

relationships among superficially dissimilar ideas.[48]

Barbe reports that Strauss identified disturbances in concept formation, in both thinking and reading, as one of the four basic deviations in the mental makeup of brain damaged children. In spite of normal intelligence, the children studied by Strauss demonstrated deficiencies in verbal reasoning.[49]

DeHirsch has provided evidence of the relationship of categorizing ability to success in early reading. Among the 37 kindergarten tests she evaluated in developing her predictive index of future reading success, 10 tests were found to be significantly related to end-of-second grade reading achievement. One of these 10 tests was a categorie test in which the child is requested to produce a generic name for word clusters. (For example, the words red, green and blue must be classed as colors.) In this classification test the child's ability to determine whether the ideas and objects belong together because of a common feature reflects the beginning of the generalization process.[50]

Summary. The opinions reviewed suggest that the process of classification is complex and may represent at least three other abilities; recognizing relationships among experiences, the abstraction of this relationship, and the expression of the abstracted relationship verbally.

---

[48]Riley W. Gardner, "The Needs of Teachers for Specialized Information on the Development of Cognitive Structures," The Teacher of Brain-Injured Children, ed. William Cruickshank (New York: Syracuse University Press, 1966), p. 145.

[49]Walter B. Barbe, The Exceptional Child (Washington: The Center for Applied Research in Education, 1963), p. 78.

[50]DeHirsch, op. cit., p. 24.

This apparent complexity in conceptualization may account for the lack of carefully focused studies, even though reasoning and generalizing are dependent upon the ability to form adequate concepts.

Research. Although the literature indicates that conceptual development is related to academic achievement, there appears to be little extant research on higher thought processes in children.[51] Very little work has been directly related to assessment of concept formation in children. This lack of research may be due to (1) the recognition that adults do not form new concepts in the same way as children,[52] (2) the comparatively recent availability of translations of Piaget's work concerned with concept formation in children, or (3) more probably, the lack of assessment of concept formation in children has been due to the failure of a test of this dimension of cognitive functioning to become a part of psychological procedures in the schools.

However, the process of conceptualization is related to the representational level of the Illinois Test of Psycholinguistic Ability.[53] Even though the ITPA is usually viewed as assessing linguistic functioning, the representational level is the meaningful level which mediates activities requiring conceptual knowledge of auditory or vocal symbols.

---

[51]Frostig, op. cit., ed. Myklebust, p. 254.

[52]Vinacke, op. cit., p. 100.

[53]Rachel Burkholder, "The Improvement in Reading Ability Through the Development of Specific Underlying or Associated Mental Abilities" (unpublished Doctoral Dissertation, University of Arizona, 1968), p. 11.

The association subtests[54] of the representational level require an ability to manipulate symbols internally and to relate verbal and visual analogies.[55] Since the ITPA has often been used to assess the functioning of children who are disabled readers and assesses conceptual understandings through the two association subtests, ITPA research findings have been reviewed.

1. Braun Study. Braun studied overachieving and underachieving readers in comparison with a randomly selected group of third, fifth, and seventh grade boys. The relationship between reading ability and concept formation was investigated. Conceptual ability was assessed by a test designed for the study which consisted of twenty concepts. Each concept was represented by six cards containing four words. One of the words had something in common with one of the words on each of the other five cards. The subject was asked to view the cards and verbalize the concept which appeared on all six cards.

The intelligence of each of the subjects was evaluated through the use of four selected WISC Subtests, with the Subtest selection based upon the four subtests described as the most reliable by the WISC Manual for the respective age groups. One of the conclusions of this study was the comparative lack of relationship between intelligence and concept form-

---

[54]The association subtests of the representational level are termed Auditory-Vocal Association and Visual-Motor Association in the Experimental Edition, 1961 and Auditory Association and Visual Association in the Revised Edition, 1968.

[55]Samuel A. Kirk and James J. McCarthy, "The Illinois Test of Psycho-Linguistic Abilities--An Approach to Differential Diagnosis," American Journal of Mental Deficiency, 66 (November, 1961), p. 403.

ation ability. Braun concluded that concept formation ability was highly related to reading and that conceptualization was either a separate intellectual process or a component of intelligence not weighted heavily by existing intelligence tests.[56]

2. Bruininks, Lucker and Gropper Study. In this study the ITPA was used to assess the functioning of children of normal intelligence taught to read traditionally and with the Initial Teaching Alphabet approach. At the end of the first grade the sixty-one children taught to read by traditional methods were tested with the ITPA. At the representational level the Auditory-Vocal Association and Visual-Motor Association Subtests reached the .05 level of statistical significance in differentiating good and poor readers. An evaluation of eighty-one children taught by the Initial Teaching Alphabet at the end of the first grade revealed that only the Auditory-Vocal Association Subtest differentiated good and poor readers at the .05 level of significance. In the evaluations, the poor readers demonstrated deficits. The researchers suggest that one explanation for the dissimilar findings with the two teaching approaches was the initial disparity of the mean reading scores of the two groups taught with the Initial Alphabet method.[57]

3. Frostig Study. Frostig evaluated the initial test scores of seventy-eight children, ranging in age from 6 through 9 years, who had

---

[56]Jean S. Braun, "Relation Between Concept Formation Ability and Reading Achievement at Three Developmental Levels," Child Development, 34 (September, 1963), pp. 675-682.

[57]Robert H. Bruininks, William G. Lucker, and Robert L. Gropper, "Psycholinguistic Abilities of Good and Poor Reading Disadvantaged First-Graders," The Elementary School Journal, 70 (April, 1970), pp. 378-384.

been referred to the Frostig Center for learning disabilities. All of the children had either a WISC Verbal or Performance IQ of 78 or above. The percentage of children evidencing difficulty on the ITPA was calculated on the basis of a performance .30 below the standard score of the subtest. Using this criterion, 46.2% of the children demonstrated problems on the Auditory-Vocal Association Subtest and 59.0% on the Visual-Motor Association Subtest.

The WISC was also administered to these children and deficiencies were reported on the Information, Coding, and Arithmetic Subtests. When the subtests were ranked by percentiles, based on a scale score of 8 or below, 52.6% were deficient on the Information Subtest, 48.7% on Coding, and 46.2% on Arithmetic. These findings, coupled with other testing information, caused Frostig to conclude that remedial approaches should be varied to meet the needs of the child. For developing higher thought processes Frostig has suggested exercises in classification, serialization, and perception of relationships.[58]

4. Graubard Study. The thirty-five subjects in this investigation were children receiving residential treatment because of their anti-social behavior. They ranged in age from 8-6 to 10-11 years. Although these children were essentially non-readers, the WISC Full Scale IQ mean was within the normal range of intelligence. All of the children were normal on tests for neurological damage. In Graubard's opinion the subjects' developmental levels were more comparable to 6 year olds than to

---

[58]Marianne Frostig, "A Treatment Program for Children with Learning Difficulties," Evaluation and Education of Children with Brain Damage. ed. Morton Bortner (Springfield: Charles C. Thomas, 1968), pp. 223-242.

10 year old children.

The ITPA was the major assessment instrument. At the representational level, the Visual-Motor Association Subtest showed a discrepency compared to the normative population at the .05 level of significance. Graubard concluded that reading should be viewed as a part of the total communication process, rather than as an isolated skill, so that deficits may be identified and remediated through special teaching.[59]

5. Smith Study. This study was conducted using subjects of similar age range and from the same school district as the present research. Smith compared forty Educationally Handicapped children between the ages of 7-3 and 10-3 with the normative population of the ITPA. The mean IQ of the tested population was 96.68 and their performance was a minimum of two years below grade level. The subjects were found to have difficulty on the majority of the ITPA subtests. Low scores on the Auditory Association Subtest were significant at the .05 level. Greater deficiencies were demonstrated on the Visual Association Subtest, since significance was at the .01 level of confidence. Smith attributed these associational problems to deficits in the use of analogous thinking, particularly thinking at the high level of abstraction required by the last portion of the Visual-Association Subtest.[60]

6. Kass Study. Kass' frequently quoted research was designed to

---

[59]Paul S. Graubard, "Psycholinguistic Correlates of Reading Disability in Disturbed Delinquent Children," The Journal of Special Education, 1 (Summer, 1967), pp. 363-368.

[60]Joan M. Smith, "Utilization of the Illinois Test of Psycholinguistic Abilities with Educationally Handicapped Children," (unpublished Doctoral dissertation, University of the Pacific, 1970).

discover the psychological correlates of reading disability. Twenty-one reading disabled children between the ages of 7-0 and 9-11 were the subjects. Their S-B IQ's were above 85 and there were no known defects of visual or auditory acuity. The ITPA, supplemented by other tests, was the major assessment instrument.

At the representational level of the ITPA the Auditory-Vocal Association Subtest scores were significantly depressed when compared to the normative population. Kass explained this deficit by suggesting that this Subtest may belong at the integrational level, where the subjects' other deficits were demonstrated.[61]

Summary

A review of the literature concerning the possible relationship of concept formation ability to reading success suggested that there was a high degree of unanimity in the belief that conceptual understandings are correlated with reading success. However, this relationship has not been fully explored by the available research. This research inadequacy may reflect the following difficulties: (1) Conceptual ability as a component of intelligence is not usually assessed. (2) When conceptualization ability is assessed, as with the Associational Subtests of the ITPA, low scores may not be interpreted as demonstrating a lack of conceptual development. (3) The complexity of the development of concept formation hinders assessment and meaningful interpretation of test results. Piaget's insights concerning the importance of the abstraction of an unambiguous criterion for classification may be a valuable guideline to future investigations of concept formation.

[61]Kass, op. cit., pp. 533-539.

III. REMEDIATION OF COGNITIVE DEFICITS

Strang,[62] Bateman,[63] and Gardner[64] have all suggested that an understanding of the underlying cognitive processes important to reading success is necessary for improvement of remedial procedures. However, a review of the literature related to deficits of sequential or conceptual abilities indicates that little research has been undertaken concerning the remediation of these deficiencies. Although, there is expert opinion which suggests that exercises based upon seriation and classification may be beneficial to reading progress.

Theory and Opinion

Bush and Giles[65] have suggested remediation related to ITPA subtest deficiencies in their book, Aids to Psycholinguistic Teaching. Unfortunately, they provide no theoretical basis for their suggestions, nor evidence of their effectiveness. However, their recommendations related to deficits on the Association Subtests are of interest. For example, second graders having auditory association problems are to be taught, (1) likeness and difference, (2) problem solving, (3) categorizing and classifying, and (4) predicting story outcome. For problems of visual association training in the ability to (1) classify, (2) sort objects,

---

[62]Ruth Strang, "Reaction to Research on Reading," Educational Forum, (January, 1962), p. 188.

[63]Bateman, op. cit., p. 220.

[64]Gardner, op. cit., Cruikshank, p. 139.

[65]Wilma Jo Bush and Marian Giles, Aids to Psycholinguistic Teaching, (Columbus: Charles E. Merrill, 1969).

(3) sequence, and (4) recognize the incongruities in pictures, is recommended.

Frostig has also developed training procedures based upon removing deficits identified by the ITPA. She provides no indication of their successful use which is supported by research. In her program, auditory-vocal association training should include finding (1) opposites, (2) relationships between words, and (3) differences in a grouping of items. Visual-motor association, she states, can be improved by sorting objects and classifying them by use, while demonstrating understanding through the verbalization of the category selected.[66]

Levi suggests that treatment of conceptualization deficiency in children with poor school performance should be based, in part, upon Piaget's theory. For example, a ten year old child who cannot organize what he apprehends or fit bits of reality into a plan is reacting at the level of a child of six or seven. Therefore, the goal is to assist the child in moving from pre-operational to operational thought. Movement toward operational thought can be facilitated by assisting the child in the attainment of the logic of classes and relations. The child is first trained in classifying materials according to a generic concept and then is taught more complex analogies based upon matrix relationships.[67]

Research

The literature reviewed above is clear in suggesting that remediation should be undertaken based upon the development of sequential and

---

[66]Frostig, op. cit., Bortner, pp. 238-239.

[67]Aurelia Levi, "Remedial Techniques in Disorders of Concept Formation," Journal of Special Education, 1 (Fall, 1966), pp. 3-8.

conceptual skills. Research which confirms this opinion is limited and of recent appearance in the literature. Levi is one of the few investigators who has provided a case study which describes the employment of a theoretical discussion.

1. Levi Study. Levi has reported a case study of an 11 year old boy, Steven, who was failing in his schoolwork. Steven's IQ was 88 with a 37 point discrepancy between his Verbal IQ of 106 and his Performance IQ of 69. Tests for perception and conceptualization showed marked impairment in functioning. These problems were accompanied by speech defects, mixed laterality and alternate use of the hands.

Steven's treatment was designed to determine if a less concrete, more abstract and categorical mode of thinking could be taught. The goals were to teach him the idea of category as an underlying, organizing principle and to train him to select the appropriate category upon which to generalize. To accomplish these goals category pictures were employed and discrimination was encouraged through repetitive auditory stimulation. After this method was successful in conveying the idea of categorization, it was related to inducing Steven to shift from one category to another, so that he learned to select the proper category by first analyzing the available choices.

A year after beginning treatment Steven was retested with a change in the Full Scale IQ to 101, with a Verbal of 121 and a Performance IQ of 79. The most dramatic improvement on the WISC was on the Similarities Subtest, a test considered to measure verbal concept formation. In school he was reported as doing average and above average work in all subjects.

after previously having experienced six years of failure.[68]

2. Burkholder Study. In this research ten experimental subjects between the ages of 7-0 and 9-11 with IQ's above 80 were matched with a control group. All of the subjects were deficient at least one year in scores on the Gray Oral Reading Test and were diagnosed as deficient in underlying abilities necessary for reading by the WISC or the ITPA. Practice exercises based upon results of the WISC and ITPA (and augmented by deficiencies suggested by the literature) were taught to the experimental subjects on a regular schedule in school for a three month period.

The practice exercises were developed on a percept-concept continuum and introduced tasks related to (1) perceptual skills, (2) visual memory and auditory memory, (3) visual and auditory closure, (4) sound blending, and (5) visual and auditory classification. After the three month training period the pupils were again evaluated in reading and with the WISC and the ITPA. Burkholder concluded:

> It would appear that training methods for improving cognitive skills thought to underlie the reading act can be developed, and that a rise in underlying skills can be accompanied by a rise in reading ability significantly beyond the chance level.
>
> It would appear that effective training materials for the development of cognitive skills thought to underlie the reading act can be developed for remedial purposes. It would seem advisable to develop similar materials for preventative purposes.[69]

Unfortunately, Burkholder's remedial suggestions, which are related to findings on the WISC and ITPA, have been supplemented by less

---

[68]Aurelia Levi, "Treatment of a Disorder of Perception and Concept Formation in a Case of School Failure," Journal of Consulting Psychology, 29 (August, 1965), pp. 289-295.

[69]Burkholder, op. cit., p. 87.

clearly focused suggestions from the literature. This addition has tended to obscure the value of the test instruments in defining remedial practices.

3. Nelson Study. Nelson conducted an investigation of the construct validation of the Seriation Test (ST) which he, with Scott and Dunbar, had designed to assess the development of seriation ability at the preschool, kindergarten and first grade level of development. Piaget's theory provided the theoretical background for the ST and the training materials which were developed in relation to it. As a part of the construct validation of the ST a number of studies were conducted, two of which are related to this research.

In one study seriation training was provided for ten kindergarten children, while the control group received traditional readiness training. The ST was given prior to, and following, the training which covered twelve half-hour sessions. A trend indicating gains in the seriation trained group was evident, although statistically significant results were not obtained. Nelson concluded that the lack of significance was due to the stability of the child's ability to order objects.

In another study three hundred sixty one culturally deprived kindergarten children were tested with the ST. After nearly two years all of these youngsters who could be located were given the California Achievement Test and the Primary Mental Abilities Test, with the expectation that the ST would predict scores on both achievement and intelligence tests. The findings confirmed these expectations. The predictive ability of the ST in terms of academic achievement was very high, with correlations ranging from 0.52 on reading achievement to 0.61 on arithmetic. Nelson concluded that the ST could be highly useful in predicting progress

in early skill development.[70]

The high correlations between the ST and reading and mathematical achievement may be viewed as supporting Piaget's belief in the importance of seriation to later symbolic activity. In addition there appears to be support from this study to the relationship between low scores on the Information, Arithmetic, Coding and Digit Span Subtests and low reading achievement.

Summary and Conclusions

In summarizing the related literature the researcher concluded:

1. There is overwhelming evidence to confirm the opinion that educationally handicapped children, as identified and placed in California, represent a selected population of children of normal intelligence who perform below expectations in reading.
2. There is widespread opinion which suggests that educationally handicapped children may suffer from a maturational lag of the central nervous system which affects academic achievement.
3. Piaget's theory suggests that the development of the ability to seriate and classify is a necessary antecedent of the systematic thought necessary to reading success.
4. There has been considerable research which indicated a positive relationship between certain subtests of the WISC and reading disability. There was also indication that these subtests

---

[70]Jerald W. Nelson, "Construct Validation of the Learning Readiness System-Seriation Test" (unpublished Doctoral dissertation, Indiana University, 1968).

(Information, Arithmetic, Coding, and Digit Span) are measures of sequencing ability.

5. Opinion and research supports the view that concept formation is an important facet of reading ability, although measures of conceptual abilities are not widely undertaken. Disabled readers have shown deficits on the conceptually based portions of the ITPA (the Association Subtests) and this test may be a valuable assessment instrument.
6. Although the training of the underlying cognitive abilities necessary for acquisition of reading skill has been recognized as an important step in remediation, little research involving children of normal intelligence has been conducted.
7. Further exploration of the importance of the processes of seriation and classification to reading deficits is needed. Since many of the studies have compared disabled children to the test's normative population, more studies involving a control group are needed.

After reviewing the related literature the researcher concluded that: (1) an exploratory study was needed to determine if a selected assessment battery would reveal sequentially and conceptually related deficiencies in children with reading disabilities when compared to regular class children, and (2) such a study would contribute to the larger investigation concerned with the underlying cognitive correlates of reading disability which might form a basis for the development of remedial techniques.

In this chapter the research pertinent to such an investigation has been reviewed. The procedure, the nature of the test instruments

and the procedure used in the present study will be explained in Chapter III.

CHAPTER III

DESIGN AND PROCEDURES

The theoretical basis of the study, the rationale for the selection of the major variables, and the relevant literature have been reviewed in Chapters I and II. The study proposed in the two initial chapters provided for the investigation of the cognitive and academic development of educationally handicapped students compared with regular class students. The class placement of the students and data provided by the scores on the composite test constituted the major variables of this study. The major independent variable was class placement, categorized as educationally handicapped or regular class. The scores on twelve subtests of the composite test comprised the dependent variables. The age of the student at the time of testing was the basis for dividing the study population into two groups, designated as younger boys and older boys. This division by age was regarded as a minor independent variable which might be significant in studying the developmental aspects of the suggested relationships between class placement and test scores.

In Chapter III the study is developed in terms of (1) the population selection and data gathering procedures, (2) the test instruments which comprised the composite test, and (3) the research design and the accompanying hypotheses.

I. POPULATION SELECTION

The study was conducted in the San Juan Unified School District, which is located in Sacramento County, north-east of Sacramento, Califor-

nia. Approval to conduct the study was gained from the Director of Special Education, and the plan for the study was then submitted to the Director of Research for the San Juan District. Final approval for the study was granted by the Superintendent's Cabinet, with the stipulation that permission forms for the testing (See Appendix B) were to be obtained from all parents of participating students.

The San Juan Unified School District enrolls approximately 53,000 students in grades K-12 and provides 45 classes for educationally handicapped students in this population. Thirty-two of the EH programs are located in the District's 65 elementary schools. At the elementary level, 16 of the programs are special classes which are ungraded and designed to meet the needs of primary students. The EH subjects who participated in this study were selected from these primary special classes.

Selection Criteria

Before the population pool of the study was identified and selected, however, attention was given to controlling variables extraneous to the purposes of the study. These extraneous variables were minimized, nullified or isolated in accordance with research procedures suggested by Kerlinger.[1] The rationale for the recognition of these variables was provided by Piaget, who has indicated that the child's cognitive development is strongly influenced by the nature of his opportunities for interaction with his environment.[2] The major variables recognized as important in terms of their influence upon environmental interaction, but extraneous

---

[1]Fred N. Kerlinger, Foundations of Behavioral Research (New York: Holt, Rinehart and Winston, 1964), pp. 284-286.

[2]Inhelder and Piaget, op. cit., p. 5.

to the purpose of the study, were; age, sex, intelligence, family relationships, and socio-economic level. These variables were controlled in the following ways:

1. Age. Since Piaget has indicated that the concrete operational stage may first appear at 7 or 8 years of age, the subjects were selected to range in age from 7 to 10 years. The three year age span was provided in order to explore the possible differences in performance on the composite test of younger and older boys.[3]
2. Sex. The study was limited to boys because of the generally recognized differences in maturation of boys and girls[4] and because girls could not be obtained in sufficient numbers from educationally handicapped classes to be included in the design of the study.[5]
3. Intelligence. Subjects with intellectual functioning considerably above or below the normal range of intelligence were excluded from the study. Gifted subjects were excluded because little is known about the way highly intelligent children compensate for learning disabilities and low children were excluded because they are not expected to master reading skills at the same rate as children of normal intelligence.[6] IQ

---

[3]Celia B. Stendler-Lavatelli, "Aspects of Piaget's Theory that Have Implications for Teacher Education," Journal of Teacher Education, 16 (September, 1966), p. 333.

[4]Frances Bentzen, "Sex Ratios in Learning and Behavior Disorders," American Journal of Orthopsychiatry, 33 (January, 1963), pp. 92-98.

[5]Louise Doyle, Director of EH Programs for the San Juan District, estimated that primary EH classes reflect a ratio of 10 boys to 1 girl.

[6]DeHirsch, Jansky and Langford, op. cit., p. 9.

scores from individually administered intelligence tests were available for the EH subjects, and teacher judgment and school records were used as the basis for judging intellectual functioning of regular class subjects.

4. Family relationships. In order to provide at least gross similarity in home background, selected subjects were those living with two parents, one of whom was the child's natural parent. On the basis of this criterion, subjects in one-parent homes, adopted, and foster children were excluded from the study. Although variables related to the influence of these factors are often unexplained,[7] their probable significance to variations in the child's environmental interactions seems logical.
5. Socio-economic level. The relatively high socio-economic level of the families living in the San Juan District, and the comparative homogeneity of the District's population, was reflected in the Census Tract Data which indicated few obvious gross population differences.[8] However, because of the importance of socio-economic level to seriation ability as reported by Nelson,[9] further control of this variable was gained by excluding subjects whose fathers were unemployed. Additional control of the socio-

---

[7]Larry B. Silver, "Frequency of Adoption in Children with the Neurological Disability Syndrome," Journal of Learning Disabilities, 3 (June, 1970), p. 310.

[8]U. S. Bureau of the Census. U. S. Census of Population and Housing: 1960, Census Tracts. Final Report PHC (1)-129 (Washington: U. S. Government Printing Office, 1962).

[9]Nelson, op. cit., p. 70.

economic variable through matching of subjects by father's occupation was not possible inasmuch as the District's population included large numbers of military personnel.[10]

The controlled variables described above were used as criteria for the selection of a population pool from the educationally handicapped student records available in the special Education Department of the San Juan District. All students who met the selection criteria were then included in a population pool. One of the 16 schools having primary classes was excluded, because the 4 children meeting the other control criteria were foster children living in one home.

Selection Procedures.

The principals and EH teachers in the remaining 15 schools were then contacted and assurance of cooperation with the study was obtained. Parent permission forms were then distributed to all EH subjects in the population pool. Seventy-four forms were returned and from these, through the use of a table of random numbers,[11] the researcher selected 32 educationally handicapped subjects for inclusion in the study. One of the 15 schools was entirely omitted from the study by the randomizing process.

After the selection of the EH subjects, records in the 14 schools enrolling the EH boys were searched for regular class boys who met the controlled variable criteria and were within thirty days in age of the selected EH subject. Parent permission forms were then distributed to

---

[10]Albert J. Reiss, Occupations and Social Status (Glencoe: The Free Press of Glencoe, Inc., 1961), p. 275.

[11]Richard P. Runyon and Audrey Haber, Fundamentals of Behavioral Statistics (Reading: Addison-Wesley Publishing Co., 1967), p. 276.

all regular class boys qualifying for possible inclusion in the study. From the returned permission forms, the regular class boy whose birthday was nearest the birthday of the EH subject was selected for the study. This final selection process resulted in two groups, designated by class placement, with 32 subjects in each group. Within these two groups the subjects were matched by age and met the criteria determined by the identified controlled variables.

Testing Procedures and Descriptive Data.

Each of the 64 subjects in the 14 schools was individually tested by the researcher using the composite test. This test was administered during the morning session of school in November and December, 1970. The administration of the composite test was conducted in accordance with standard psychometric procedures. A separate room in the school which the subject attended was the testing location.

The study population ranged in age from 7-3 to 9-10 years, with a median age of approximately 8-5. The distribution of the number of sub-

TABLE I

NUMBER OF SUBJECTS WITHIN EACH MONTH

EH SUBJECTS

Age	7-3	7-5	7-6	7-8	7-9	7-10	7-11	8-0	8-1	8-3	8-4
No.	1	1	1	1	1	1	1	2	1	4	2

YOUNGER BOYS

Age	8-5	8-6	8-7	8-9	8-10	9-1	9-2	9-3	9-7	9-8	9-9	9-10
No.	2	2	1	1	2	2	1	1	1	1	1	1

OLDER BOYS

jects for each month of the age range is shown in Table I. Since all the regular class subjects were within 30 days in age of their EH counterpart, no separate tabulation of ages of regular class boys has been provided.

The available records for the EH subjects indicated that the mean IQ for the subjects tested(after the exclusion of IQ extremes) was 103.2. Although individual or group IQ scores were not available for the regular class students in this study, Lorge-Thorndike group testing of all the sixth grade regular class students in the San Juan District in November, 1970 revealed a mean IQ of 103.[12] Based upon this testing of slightly older regular class students, there appeared to be a high probability that the EH and regular class boys included in this study had similar IQ means and that they represented essentially the same population in terms of intelligence.

Further evaluation of the descriptive data, obtained at the time of testing, indicated that the EH and regular class boys were not significantly different populations, with the exception of differences related to the greater number of EH boys who had repeated a grade. Twenty-three of the 32 EH boys had been retained, while only 3 of the regular class boys were repeaters. This difference, which is significant beyond the .001 level of Chi square evaluation, was expected, and attributed to the severe academic difficulties experienced by subjects subsequently identified as educationally handicapped.

A Chi square analysis of the data related to hand preference, birth

---

[12]Statement by Phillip Oakes, Research Director, San Juan Unified School District.

order, and relationship of the boy to the father (previously controlled as a natural son or stepson) revealed no significant differences at the .01 level of confidence. Hand preference was observed during testing. Two of the 32 EH boys were observed to be left-handed as were 3 of the 32 regular class subjects. The total of 5 left-handed subjects is statistically not significant, and is within the 5 to 10 per cent normal range of hand preference in the adult population.[13]

Birth order was analyzed by grouping the boys as first-born, middle (all boys not first or last-born) and last-born. When grouped in this way, no significant differences were found between the birth order of the EH and regular class boys. All of the boys in the study were from homes having at least one other sibling.

A final comparison of the populations was in terms of the relationship of the father to the boy. Since this factor was a previously controlled variable, the comparison was made between the number of natural sons and step-sons. Four of the 32 EH boys were step-sons, while 1 of the 32 regular class boys was a step-son. This difference was not significant when a Chi square comparison was carried out.

Summary.

In this discussion of the selection of the study population, (1) the controlled variables, (2) the method of selection, and (3) testing procedures were described. In addition, the descriptive data obtained at the time of testing was presented. A Chi square analysis of this descrip-

---

[13]Aaron Smith, "Neuropsychologic Aspects of Learning Disorders," Learning Disorders, Vol. 3, ed. Jerome Hellmuth (Seattle: Special Child Publications, 1968), p. 71.

tive data indicated that the EH and regular class subjects represented essentially the same population, since the only significant differences obtained were related to in-grade retention. This retention appeared to clearly reflect the academic difficulties related to class placement of EH children, and would, therefore, be expected in a comparison of EH and regular class boys.

II. TEST INSTRUMENTS

The test instruments, selected and developed for this study, were chosen to meet three criteria: (1) their capacity to identify characteristics of educationally handicapped and regular class subjects who fell within the limitations set by the experimental design, (2) their competency in measuring underlying cognitive abilities related to reading disability, and (3) their capacity to measure the academic ability of reading skill in a highly diverse population. The composite test, designed to meet the requirements of these three criteria, was constructed specifically to assess (1) cognitive functioning related to the development of sequencing ability and concept formation, and (2) academic achievment related to reading skill in word identification and oral paragraph reading.

All of the selected subtests used in this study were measures which have been identified by the National Task Force concerned with learning disabilities as being the most widely used assessment instruments.[14] When these tests have been used to compare the functioning

---

[14]Clements, Minimal Brain Dysfunction in Children, Phase Two, op. cit., pp. 18-20.

of educationally handicapped and regular class children they have provided information which may serve as a base line for altering curriculum. Studies which have compared the achievement of learning disabled pupils with the normative data for the test have been less valuable to curriculum adaptation. This is largely because the standardizing population frequently excludes learning disabled children.[15]

Selected Subtests Assessing Academic Functioning

The assessment of oral reading skills was included in the study to provide an indication of the level at which the child could read. The validity of the appraisal of oral reading skills for assessing the child's reading level is supported by Natchez and Roswell.[16] Schiffman has indicated that both the ability to recognize words presented in isolation and in context are important aspects of oral reading which should be appraised.[17] The standardized tests selected for use in this study contained a number of words or paragraphs of gradually increasing difficulty suitable to the assessment of children whose reading skills were expected to demonstrate wide variation.

Gilmore Oral Reading Test (Form A).[18] This test is comprised of 10 paragraphs, graded in difficulty from grades 1 through 8. The paragraphs are graded in vocabulary, sentence structure, and interest. Following the timed oral reading of each paragraph, during which the examiner

---

[15]Morton Bortner, Evaluation and Education of Children with Brain Damage (Springfield: Charles C. Thomas, 1968), p. 79.

[16]Florence Roswell and Gladys Natchez, Reading Disability: Diagnosis and Treatment (New York: Basic Books, 1964), p. 29.

[17]Schiffman, op. cit., Money and Schiffman, p. 252.

[18]Gilmore, op. cit.

notes errors, comprehension questions are answered. On the basis of errors made and the time required for reading, the test can be interpreted in terms of accuracy of oral reading, comprehension, and rate.[19] The manual provides conversion tables for determination of grade equivalency.

The Gilmore Oral Reading Test was selected as a measurement device because of its carefully graded construction and the wide ability span for which it is suitable. The use of a picture stimulus which relates to a continuous story about episodes in a family provides an approximation of classroom reading situation. In addition, when compared with other oral reading tests, the Gilmore can be administered and scored in a more objective fashion.[20]

The Wide Range Achievement Test (Revised Edition).[21] The WRAT has been recognized as the most frequently used individual test of academic ability.[22] The Level I Subtest of reading assesses word recognition and pronunciation through a 75 word list of increasing difficulty, supplemented, at the pre-reading level, with 25 items of letter recognition. This subtest was designed for use with children between the ages of 5 and 12 years of age. The test was selected as a valuable addition to the Gilmore because of its emphasis upon word recognition and its ability to evaluate students reading below first grade level.

---

[19]In this study the accuracy, comprehension and rate scores are termed subtests when included in the composite test.

[20]Maynard C. Reynolds, "Gilmore Oral Reading Test," The Fifth Mental Measurements Yearbook, ed. O. Buros (Highland Park: Gryphon Press, 1959), p. 672.

[21]Jastak and Jastak, op. cit.

[22]Clements, Minimal Brain Dysfunction in Children, Phase Two, op. cit., p. 7.

Selected Subtests Assessing Cognitive Functioning

Cognitive functioning related to sequencing and concept formation abilities was assessed by subtests selected from two frequently used standardized tests, the WISC and the ITPA. Those subtests selected to form a part of the composite test are described below.

Wechsler Intelligence Scale for Children.[23] The four subtests from the WISC selected for use in this study were those which the literature suggested were most closely associated with reading disability. In addition, these subtests have been identified in the literature as closely related to the ability to sequence, or to seriate. The emphasis of the current study upon the assessment of sequencing ability through the use of the Information, Arithmetic, Coding and Digit Span Subtests of the WISC has purposefully ignored other possible individual subtest interpretations of a more specific nature. A description of the four subtests follows:

1. Information. This subtest consists of 30 questions arranged in ascending order of difficulty. The type of question included requires a response using facts regarded as generally available to children within our society.
2. Arithmetic. This portion of the WISC includes 16 timed problems which utilize the four basic arithmetic operations of addition, subtraction, multiplication, and division. Most of the items involve simple numerical skills and are orally administered.
3. Coding. This test consists of two forms, simple (Coding A) for children under 8 years, and advanced (Coding B) for older

---

[23]Wechsler, op. cit.

pupils. This subtest requires the child to copy symbols related to simple shapes or numerals within a time limit of 120 seconds.

4. Digit Span. The Digit Span test is administered in two parts. The first section requires the oral repetition of digits ranged in a series, while the second part assesses the ability of the subject to repeat backwards, digits ranged in a series.

The Illinois Test of Psycholinguistic Abilities (Revised Edition).[24] The two subtests from the ITPA selected for this study were the Association Subtests, since both subtests are based upon an understanding of analogies and require reasoning and judgment originating in conceptual comprehensions. These Association Subtests require the manipulation of concepts and linguistic symbols internally. The correctness of internal manipulation is assessed through vocal and motor expression by the subject and is reflected in the name of the subtest.

1. Auditory Association. This subtest is an analogies test utilizing a sentence completion technique, with items of increasing difficulty. All of the 42 items making up the test are executed orally by the subject and the examiner.
2. Visual Association. The association process required in this subtest derives from a picture stimulus which has an analogous relationship with one of four pictures. The child points to the answer among the set of four pictures. There

---

[24]Kirk, McCarthy, and Kirk. op. cit.

are 42 items, the last 22 require a higher level of abstraction by the subject. These more difficult associations compel the child to abstract the relationship between two stimulus pictures and to hold this relationship in mind while evaluating a similar relationship between another picture and four alternative choices.

Research Instruments

Two research subtests, based upon Piaget's descriptions of the development of seriation and classification abilities in children, were developed by the researcher for this study. Although Piaget's accounts of his methods[25] have provided the guidelines for the development of the Research Subtests, the researcher adapted the developed subtests to the requirements of administration and scoring for inclusion in the psychometric test battery.

The researcher devised multiplicative tests, since evidence of the operational behavior was determined by requiring problem solution which displayed coordination of foresight and hindsight. Competency in matrix organization indicated that two simultaneous criteria were kept in mind, or that the first criterion for problem solution was remembered while the second was invoked. Therefore, both of the research subtests required matrix-based solutions.

The seriation subtest was developed by the researcher so that it could be ordered according to two size dimensions, the height and width of cylindrical objects. A description of the construction and admin-

[25]Inhelder and Piaget, op. cit.

istration of the subtest follows:

1. Seriation Subtest. This subtest makes use of a series of painted, green, wooden cylinders, varying both in height and diameter by 1/4 inch increments in five steps. The test materials consisted of these 25 cylinders ranging from the smallest, 3/4 by 3/4 inch, to the largest, 1-3/4 by 1-3/4 inches.

   The testor placed the 25 objects on end, randomly, in front of the subject and stated: "Arrange these objects as you wish. Put them in order." After the subject had arranged the pieces, they were scored and the examiner conducted a demonstration which provided clues to matrix organization. For the demonstration the examiner arranged the cylinders along both dimensions of the matrix table, leaving the remainder to be filled in by the subject. Since this action resulted in the seriation of one axis by height and the other by width, the demonstration provided clues to both size variations. The subject was then instructed: "Put the rest of the objects in order here." (The incomplete portion of the matrix was indicated by the examiner.)

   If, during either attempt, the subject succeeded in correctly completing the matrix arrangement, the previously described demonstration alignment was returned to. This was done by removing the 16 pieces which completed the matrix. The subject was then asked to replace one of the pieces correctly according to the two simultaneous criteria. This procedure provided the examiner with a check on the subject's actual understanding of

coordination process, since matrix construction through trial and error was no longer possible.

The examiner scored the test by assigning points for achievement which corresponded to Piaget's descriptions of the three stages in the development of seriation ability.

> We shall distinguish three stages, corresponding to the usual three levels. During stage I, there are no seriations in the strict sense. The child's constructions are intermediate between classification and seriation, and are usually based on graphic collections (alignments, etc.). During stage II, there is seriation, but only according to one of the criteria, or else the child switches from one criterion to the other, without achieving a multiplicative synthesis of the two. Finally, during stage III (starting at 7-8 years), the child reaches a multiplicative arrangement based on the twofold seriation of the set of elements.[26]

The total score on the test was the sum of the points awarded for evidence of completion of the stages described above and the check procedure. A copy of the score sheet used at the time of testing appears in Appendix C.

The classification subtest, which was administered immediately following the Seriation Subtest, was constructed and administered as described below:

2. Classification Subtest. Piaget's studies of classification based upon animal pictures indicated that the ability to classify animals systematically lags behind the development of the ability to classify flowers or geometric shapes. Subjects who demonstrate the operational abilities with other objects may only be able to classify animals in a primitive manner. Piaget explained this lag by suggesting that the child was compelled

---

[26]Inhelder and Piaget, op. cit., p. 270.

to rely on more upon purely linguistic concepts than upon prior experience when abstracting the criteria of classification.[27]

Therefore, the researcher selected animal pictures as the basis of the classification test which was developed with the expectation that the resulting test would be more difficult than the seriation test. This was done to circumvent the usually close developmental parallels Piaget has reported for seriation and classification. By decreasing this parallelism the researcher hoped to increase the likelihood of developing a subtest which would determine the presence of operational ability in children ranging in age from 7 to 10 years. Since the construction of the seriation and classification subtests was research oriented, this approach seemed to provide the greatest likelihood of maximizing the opportunity for gaining information which might be useful to this study and to future studies.

The investigator constructed this subtest by providing a series of 8 small colored pictures of animals mounted on 4 x 4 inch cards. Four of the pictures were of young animals, and 4 of adult animals. Each of the young and adult classes were further subdivided into 2 wild and 2 tame animals. The animals depicted were an adult elephant, tiger, cow and horse, and a young elephant, bear cub, calf and lamb. To facilitate the matrix organization of these pictures, a 14 x 17 inch cardboard, subdivided by intersecting black lines into four rectangles, was provided. An additional animal, an adult rein-

---

[27] Ibid., p. 110.

deer, was included in the testing materials to provide for a check on the subject's understanding of matrix organization.

In administering the test the examiner placed the large cardboard and the 8 animal pictures in front of the subject, who was then instructed: "These animals can be arranged so that they go together. Put the ones together that go well together." (The large subdivided cardboard was indicated by the examiner.) After the subject had completed the arrangement of the animals, he was asked to explain the criteria used for placement. This explanation was a demonstration of the subject's ability to abstract the relationships between the classified animals.[28] If the subject indicated that he recognized both the wild-tame and young-old concepts, but had not formed a matrix, he was asked: "Can you do something that will make it easy to look at everything at once?" A further check on the child's ability to understand the basis of classification was provided by asking children who were able to demonstrate matrix placement, to add the adult reindeer to the matrix correctly.

The investigator scored the test by awarding points for each paired placement which was correct. Additional points were added for the subject's ability to verbalize placement correctly, and for the accurate placement of the check animal. For example, if the adult elephant was placed with the baby elephant, two

---

[28]Inhelder and Piaget, Ibid., p. xv. To Piaget the ability to abstract the criteria of classification is especially relevant to the development of reasoning. This emphasis distinguishes Piaget's work on classification from that of other psychologists.

points were awarded. The ability to verbalize the relationship depicted as young-old added two additional points. Therefore, the total score achieved by the subject approximated progression through the stages which Piaget has suggested occur in the development of the ability to classify multiplicatively. However, Piaget indicated that the child progresses from the graphic collection of stage I to the ability to immediately cross classify, which characterizes stage III, by a series of gradual transitions make a more closely stage-related score impractical. A copy of the score sheet appears in Appendix C.

III. THE RESEARCH DESIGN

The design basic to the statistical comparison used in the current investigation was an analysis of variance of a 2 x 2 factorial design. Class placement and age were the independent variables. This design, based upon a randomized selection of subjects with a control group of matched subjects, was a variant of a design regarded by Kerlinger as among the best available designs for use in educational research.[29]

The two independent variables were selected because placement in an educationally handicapped program was regarded as indicative of poor reading ability and the age of the subject was recognized as a factor strongly influencing the outcome of scores on standardized tests. Class placement and age were identified as the major factors influencing the dependent variable or test scores. Kerlinger states that high correlation

---

[29]Kerlinger, op. cit., p. 303.

educationally handicapped boys on the Gilmore Rate Subtest.

4. Regular class boys will score significantly higher than educationally handicapped boys on the WRAT Reading Subtest.

5. Regular class boys will score significantly higher than educationally handicapped boys on the WISC Information Subtest.

6. Regular class boys will score significantly higher than educationally handicapped boys on the WISC Arithmetic Subtest.

7. Regular class boys will score significantly higher than educationally handicapped boys on the WISC Coding Subtest.

8. Regular class boys will score significantly higher than educationally handicapped boys on the WISC Digit Span Subtest.

9. Regular class boys will score significantly higher than educationally handicapped boys on the ITPA Auditory Association Subtest.

10. Regular class boys will score significantly higher than educationally handicapped boys on the ITPA Visual Association Subtest.

11. Regular class boys will score significantly higher than educationally handicapped boys on the Seriation Subtest.

12. Regular class boys will score significantly higher than educationally handicapped boys on the Classification Subtest.

Minor Hypotheses. Twelve hypotheses were developed to consider the minor independent variable of age. The 32 youngest subjects were termed younger boys, and the 32 older subjects were termed older boys for the consideration of this variable.

1a. Older boys will score significantly higher than younger boys on the Gilmore Accuracy Subtest.

2a. Older boys will score significantly higher than younger boys on the Gilmore Comprehension Subtest.

3a. Older boys will score significantly higher than younger boys on the Gilmore Rate Subtest.

4a. Older boys will score significantly higher than younger boys on the WRAT Reading Subtest.

5a. Older boys will score significantly higher than younger boys on the WISC Information Subtest.

6a. Older boys will score significantly higher than younger boys on the WISC Arithmetic Subtest.

7a. Older boys will score significantly higher than younger boys on the WISC Coding Subtest.

8a. Older boys will score significantly higher than younger boys on the WISC Digit Span Subtest.

9a. Older boys will score significantly higher than younger boys on the ITPA Auditory Association Subtest.

10a. Older boys will score significantly higher than younger boys on the ITPA Visual Association Subtest.

11a. Older boys will score significantly higher than younger boys on the Seriation Subtest.

12a. Older boys will score significantly higher than younger boys on the Classification Subtest.

Interaction Hypotheses. Twelve hypotheses were constructed to explore the relationship between age and class placement:

1b. There will be significant interaction between age and class placement on the Gilmore Accuracy Subtest.

2b. There will be significant interaction between age and class placement on the Gilmore Comprehension Subtest.

3b. There will be significant interaction between age and class placement on the Gilmore Rate Subtest.

4b. There will be significant interaction between age and class placement on the WRAT Reading Subtest.

5b. There will be significant interaction between age and class placement on the WISC Information Subtest.

6b. There will be significant interaction between age and class placement on the WISC Arithmetic Subtest.

7b. There will be significant interaction between age and class placement on the WISC Coding Subtest.

8b. There will be significant interaction between age and class placement on the WISC Digit Span Subtest.

9b. There will be significant interaction between age and class placement on the ITPA Auditory Association Subtest.

10b. There will be significant interaction between age and class placement on the ITPA Visual Association Subtest.

11b. There will be significant interaction between age and class placement on the Seriation Subtest.

12b. There will be significant interaction between age and class placement on the Classification Subtest.

Summary

In this chapter of the study, the writer has developed three sections:

I. the selection of the population, including

(1) the controlled variables,

(2) the collection of the data,

(3) data descriptive of the population,

II. the test instruments which were selected and developed for the study,

III. the research design used for the statistical analysis of the data collected and related interpretations.

CHAPTER IV

PRESENTATION AND ANALYSIS OF THE FINDINGS

As proposed in the initial chapter, the primary purpose of this study was to develop and apply a composite test to compare the academic achievement and cognitive functioning of educationally handicapped and regular class boys. Answers were sought for the following questions: (1) Do educationally handicapped boys differ from regular class boys in academic performance or cognitive functioning on the composite test? (2) Does the academic performance or cognitive functioning of younger boys differ from that of older boys on the composite test? (3) Does the interaction between age and class placement significantly effect the boys' academic performance or cognitive functioning on the composite test?

In this chapter the results for each of the subtests of the composite instrument, as described in Chapter III, are presented. Consideration is given to each of the thirty-six hypotheses, grouped in triads, as they were investigated by the twelve analyses of variance statistical treatments. Raw scores obtained from the testing provide the numerical data. In each instance (1) the null hypotheses are stated, (2) a table of mean scores is presented, (3) an analysis of variance table indicating the degree of significance is depicted, and (4) a discussion of the acceptance or rejection of the null hypothesis concludes the subtest discussion.

Comparisons Reflecting Academic Functioning

The comparison of the subtest scores related to academic functioning of educationally handicapped and regular class boys was primarily concerned with oral reading skills. These skills were assessed on the Gilmore Oral Reading Test and through the use of the Level I Subtest of the Wide Range Achievement Test. Presentation of the findings on these tests as they relate to the major, minor and interaction hypotheses follows:

Gilmore Accuracy Subtest. Table II presents the findings in which the Gilmore Accuracy Subtest was the dependent variable. Three null hypotheses were tested simultaneously in this design:

Hypothesis 1. Regular class boys will not score significantly higher than educationally handicapped boys on the Gilmore Accuracy Subtest.

Hypothesis 1a. Older boys will not score significantly higher than younger boys on the Gilmore Accuracy Subtest.

Hypothesis 1b. There will be no significant interaction between age and class placement on the Gilmore Accuracy Subtest.

From an analysis of the data the researcher found that only class placement produced differences which allowed rejection of the null hypothesis. These differences were highly significant and would be expected to occur less than once in a thousand times on a chance basis. The effects of age, and interaction between placement and age produced no significant results. Therefore these two hypotheses were accepted.

Gilmore Comprehension Subtest. Table III presents the findings resulting from the use of the Gilmore Comprehension Subtest as the dependent variable. The null hypotheses were:

TABLE II

GILMORE ACCURACY SUBTEST

PART A
MEAN SCORES BY PLACEMENT AND AGE

	EH BOYS	REGULAR BOYS	Totals
Younger	9.125	29.438	19.283
Older	10.313	26.625	18.469
Totals	9.719	28.033	18.875

PART B
ANALYSIS OF VARIANCE

Source	df	s.s.	m.s.	F	Sig.
Class Placement	1	5365.56	5365.56	62.647	.001
Age	1	10.56	10.56	.123	NS
Placement X Age	1	64.00	64.00	.747	NS
Within	60	5138.88	85.65		
Total	63	10579.00	167.92		

TABLE III

GILMORE COMPREHENSION SUBTEST

PART A
MEAN SCORES BY PLACEMENT AND AGE

	EH BOYS	REGULAR BOYS	Totals
Younger	11.625	26.375	19.000
Older	14.563	24.563	19.563
Totals	13.094	25.469	19.281

PART B
ANALYSIS OF VARIANCE

Source	df	s.s.	m.s.	F	Sig.
Class Placement	1	2450.25	2450.25	37.683	.001
Age	1	5.06	5.06	.078	NS
Placement X Age	1	90.25	90.25	1.388	NS
Within	60	2901.38	65.02		
Total	63	6446.94	102.33		

Hypothesis 2. Regular class boys will not score significantly higher than educationally handicapped boys on the Gilmore Comprehension Subtest.

Hypothesis 2a. Older boys will not score significantly higher than younger boys on the Gilmore Comprehension Subtest.

Hypothesis 2b. There will be no significant interaction between age and class placement on the Gilmore Comprehension Subtest.

The analyzed data indicated that only class placement resulted in differences which allowed the rejection of the null hypothesis. These differences were highly significant. The minor and interaction hypotheses were accepted.

Gilmore Rate Subtest. The findings based upon the Gilmore Rate Subtest are reported in Table IV. The three null hypotheses reflected in this analysis are:

Hypothesis 3. Regular class boys will not score significantly higher than educationally handicapped boys on the Gilmore Rate Subtest.

Hypothesis 3a. Older boys will not score significantly higher than younger boys on the Gilmore Rate Subtest.

Hypothesis 3b. There will be no significant interaction between age and class placement on the Gilmore Rate Subtest.

Class placement was again the significant factor in differences between educationally handicapped and regular class boys. This finding allowed rejection of the null hypothesis. The age and interaction hypotheses were accepted.

Wide Range Achievement Test, Level I Subtest. Table V reflects the scores obtained with the WRAT, Level I Subtest, used as the dependent

TABLE IV

GILMORE RATE SUBTEST

PART A
MEAN SCORES BY PLACEMENT AND AGE

	EH BOYS	REGULAR BOYS	Totals
Younger	25.875	78.750	52.318
Older	41.250	80.625	60.938
Totals	38.563	79.688	56.625

PART B
ANALYSIS OF VARIANCE

Source	df	s.s.	m.s.	F	Sig.
Class Placement	1	34040.24	34040.24	46.854	.001
Age	1	1190.24	1190.24	1.638	NS
Placement X Age	1	729.02	729.02	1.003	NS
Within	60	43591.50	726.53		
Total	63	79591.50	726.53		

TABLE V

WIDE RANGE ACHIEVEMENT TEST
LEVEL I READING SUBTEST

PART A
MEAN SCORES BY PLACEMENT AND AGE

	EH BOYS	REGULAR BOYS	Totals
Younger	35.188	53.500	44.344
Older	36.875	52.125	44.500
Totals	36.032	52.813	44.422

PART B
ANALYSIS OF VARIANCE

Source	df	s.s.	m.s.	F	Sig.
Class Placement	1	4505.76	4505.76	46.166	.001
Age	1	.39	.39	.004	NS
Placement X Age	1	37.52	37.52	.384	NS
Within	60	5855.94	97.60		
Total	63	10399.61	165.07		

variable. The null hypotheses related to this Subtest are:

Hypothesis 4. Regular class boys will not score significantly higher than educationally handicapped boys on the WRAT Reading Subtest.

Hypothesis 4a. Older boys will not score significantly higher than younger boys on the WRAT Reading Subtest.

Hypothesis 4b. There will be no significant interaction between age and class placement on the WRAT Reading Subtest.

The analyzed data provided the basis for the rejection of the class placement hypothesis. The remaining two hypotheses were accepted.

Summary of Academic Functioning

An analysis of the data related to the oral reading skills of the subjects indicated that class placement was a highly significant difference. Each of the four subtests supported the view that the educationally handicapped students' reading skills, as measured by the Gilmore and the WRAT, are academic differences which set them apart from the regular class subjects. This finding supports the belief that the educationally handicapped classroom contains a high proportion of disabled readers.

Comparisons Reflecting Cognitive Functioning

The comparison of the educationally handicapped and regular class boys related to cognitive functioning was directed toward assessment of sequencing and concept formation abilities. Four subtests of the Wechsler Intelligence Scale for Children, two subtests of the Illinois Test of Psycholinguistic Abilities, and two subtests developed as research instruments for this study were used in this comparison.

A report of the results from the testing of the major, minor and interaction hypotheses follows:

Wechsler Intelligence Scale for Children: Information Subtest. The findings from the use of the Information Subtest are included in Table VI. The null hypotheses tested were:

Hypothesis 5. Regular class boys will not score significantly higher than educationally handicapped boys on the WISC Information Subtest.

Hypothesis 5a. Older boys will not score significantly higher than younger boys on the WISC Information Subtest.

Hypothesis 5b. There will be no significant interaction between age and class placement on the WISC Information Subtest.

On this subtest class placement produced significant difference and resulted in the rejection of the null hypothesis. These differences could be expected to occur by chance only five times in a hundred. An analysis by age, and the interaction between age and class placement resulted in no significant findings and the null hypotheses were accepted.

Wechsler Intelligence Scale for Children: Arithmetic Subtest. The results from the use of the Arithmetic Subtest as the dependent variable are shown in Table VII. The null hypotheses were:

Hypothesis 6. Regular class boys will not score significantly higher than educationally handicapped boys on the WISC Arithmetic Subtest.

Hypothesis 6a. Older boys will not score significantly higher than younger boys on the WISC Arithmetic Subtest.

Hypothesis 6b. There will be no significant interaction between age and class placement on the WISC Arithmetic Subtest.

TABLE VI

WECHSLER INTELLIGENCE SCALE FOR CHILDREN
INFORMATION SUBTEST

PART A
MEAN SCORES BY PLACEMENT AND AGE

	EH BOYS	REGULAR BOYS	Totals
Younger	8.938	11.250	10.094
Older	10.313	10.938	10.626
Totals	9.625	11.094	10.359

PART B
ANALYSIS OF VARIANCE

Source	df	s.s.	m.s.	F	Sig.
Class Placement	1	34.52	34.52	6.547	.05
Age	1	4.52	4.52	.857	NS
Placement X Age	1	11.39	11.39	2.161	NS
Within	60	316.31	5.27		
Total	63				

TABLE VII

WECHSLER INTELLIGENCE SCALE FOR CHILDREN
ARITHMETIC SUBTEST

PART A
MEAN SCORES BY PLACEMENT AND AGE

	EH BOYS	REGULAR BOYS	Totals
Younger	5.313	6.938	6.126
Older	6.938	7.438	7.188
Totals	6.126	7.188	6.656

PART B
ANALYSIS OF VARIANCE

Source	df	s.s.	m.s.	F	Sig.
Class Placement	1	18.06	18.06	7.261	.01
Age	1	18.06	18.06	7.261	.01
Placement X Age	1	5.06	5.06	2.035	NS
Within	60	59.26	2.65		
Total	63	190.44	3.02		

An analysis of the results of the investigation led to the conclusion that on this variable both class placement and age produced significant differences. These differences had only a one percent liklihood of occurring by chance. The first and second hypotheses were therefore rejected. The interaction hypothesis was accepted.

Wechsler Intelligence Scale for Children: Coding Subtest. Table VIII portrays the analysis of the results of the Coding Subtest. The hypotheses tested by this variable were:

Hypothesis 7. Regular class boys will not score significantly higher than educationally handicapped boys on the WISC Coding Subtest.

Hypothesis 7a. Older boys will not score significantly higher than younger boys on the WISC Coding Subtest.

Hypothesis 7b. There will be no significant interaction between age and class placement on the WISC Coding Subtest.

The researcher found from the analysis of the data that class placement was a highly significant variable. Therefore, the first hypothesis was rejected. The minor and interaction hypotheses were accepted.

Wechsler Intelligence Scale for Children: Digit Span Subtest. The results from the use of the Digit Span Subtest as the dependent variable are depicted in Table IX. The tested hypotheses were:

Hypothesis 8. Regular class boys will not score significantly higher than educationally handicapped boys on the WISC Digit Span Subtest.

Hypothesis 8a. Older boys will not score significantly higher than younger boys on the WISC Digit Span Subtest.

TABLE VIII

WECHSLER INTELLIGENCE SCALE FOR CHILDREN
CODING SUBTEST

PART A
MEAN SCORES BY PLACEMENT AND AGE

	EH BOYS	REGULAR BOYS	Totals
Younger	23.313	34.688	29.001
Older	24.250	32.938	28.594
Totals	23.782	33.814	28.797

PART B
ANALYSIS OF VARIANCE

Source	df	s.s.	m.s.	F	Sig.
Class Placement	1	1610.02	1610.02	25.164	.001
Age	1	2.64	2.64	.041	NS
Placement X Age	1	28.89	28.89	.452	NS
Within	60	3838.81	63.98		
Total	63				

TABLE IX

WECHSLER INTELLIGENCE SCALE FOR CHILDREN
DIGIT SPAN SUBTEST

PART A
MEAN SCORES BY PLACEMENT AND AGE

	EH BOYS	REGULAR BOYS	Totals
Younger	6.813	8.250	7.532
Older	7.875	8.813	8.344
Totals	7.344	8.532	7.938

PART B
ANALYSIS OF VARIANCE

Source	df	s.s.	m.s.	F	Sig.
Class Placement	1	22.56	22.56	8.273	.01
Age	1	10.56	10.56	3.873	NS
Placement X Age	1	1.00	1.00	.367	NS
Within	60	163.63	2.73		
Total	63	197.75	3.14		

Hypothesis 8b. There will be no significant interaction between age and class placement on the WISC Digit Span Subtest.

An analysis of the data indicated that class placement was a significant independent variable. The major hypothesis was rejected, since the differences reported could only be expected to happen by chance once in a hundred times. The minor and interaction hypotheses were accepted.

Summary of the WISC Subtest Results. The four major hypotheses were rejected on the basis of an analysis of the data for each WISC Subtest. The Information Subtest findings were rejected at the .05 level of significance, the Arithmetic and Digit Span at the .01 level, and the Coding Subtest at the .001 level. The age of the subjects was significant on the Arithmetic Subtest at the .01 level, but did not demonstrate significant differences on the Information, Digit Span, or Coding Subtests.

Illinois Test of Psycholinguistic Functioning: Auditory Association Subtest. Data recorded in Table X illustrates the findings based upon the ITPA Auditory Association Subtest. The null hypotheses statistically analyzed were:

Hypothesis 9. Regular class boys will not score significantly higher than educationally handicapped boys on the ITPA Auditory Association Subtest.

Hypothesis 9a. Older boys will not score significantly higher than younger boys on the ITPA Auditory Association Subtest.

Hypothesis 9b. There will be no significant interaction between age and class placement on the ITPA Auditory Association Subtest.

An analysis of the data indicated that the null hypothesis

TABLE X

ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES
AUDITORY ASSOCIATION SUBTEST

PART A
MEAN SCORES BY PLACEMENT AND AGE

	EH BOYS	REGULAR BOYS	Totals
Younger	26.688	30.500	28.594
Older	29.688	30.813	30.251
Totals	28.188	30.657	29.422

PART B
ANALYSIS OF VARIANCE

Source	df	s.s.	m.s.	F	Sig.
Class Placement	1	97.52	97.52	4.099	.05
Age	1	43.89	43.89	1.845	NS
Placement X Age	1	28.89	28.89	1.214	NS
Within	60	1427.31	23.79		
Total	63	1597.61	25.36		

concerned with class placement could be rejected at the .05 level of confidence. The minor and interaction hypotheses were accepted. These findings agree with those of the Smith study[1] which reported difference at the .05 level of significance when comparing educationally handicapped and the ITPA normative population through the use of a T ratio. Since the Smith study was done in the same school district, with children of approximately the same age range, the probable validity of the reported findings is enhanced.

Illinois Test of Psycholinguistic Abilities: Visual Association Subtest. The comparison made through the use of the ITPA Visual Association Subtest is shown in Table XI. The null hypotheses tested were:

Hypothesis 10. Regular class boys will not score significantly higher than educationally handicapped boys on the ITPA Visual Association Subtest.

Hypothesis 10a. Older boys will not score significantly higher than younger boys on the ITPA Visual Asscciation Subtest.

Hypothesis 10b. There will be no significant interaction between age and class placement on the ITPA Visual Association Subtest.

From an analysis of the data it was found that class placement and age were significant differences. The major and minor hypotheses were rejected, at the .01 level of confidence. The interaction hypothesis was accepted. Again the findings were highly related to the Smith study, since her research reported significance at the .01 level using the T ratio to compare EH students with the ITPA normative population.[2]

---

[1]Smith, op. cit., p. 70.

[2]Smith, op. cit., p. 71.

TABLE XI

ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES
VISUAL ASSOCIATION SUBTEST

PART A
MEAN SCORES BY PLACEMENT AND AGE

	EH BOYS	REGULAR BOYS	Totals
Younger	20.813	26.938	23.876
Older	26.875	28.438	27.657
Totals	23.844	27.688	25.766

PART B
ANALYSIS OF VARIANCE

Source	df	s.s.	m.s.	F	Sig.
Class Placement	1	236.39	236.39	9.016	.001
Age	1	228.77	228.77	8.726	.001
Placement X Age	1	83.26	83.26	3.176	NS
Within	60	1573.06	26.22		
Total	63	2121.49	33.67		

Summary of the ITPA Subtest Results. The major hypotheses, concerned with differences related to class placement, was rejected by each of the ITPA subtests. The Visual Association Subtest revealed a higher level of significant difference than the Auditory Association Subtest. The reported differences were supported by the Smith study, which compared a closely analogous educationally handicapped population with the ITPA normative population. The similarity to the Smith study appears to enhance the probability of the validity of the reported significance of this research with the ITPA.

An additional finding for the Visual Association Subtest was that age was a significant variable. In this regard the findings resemble the Arithmetic Subtest of the WISC, which also allowed rejection of the null hypothesis concerned with age. The Visual Association and Arithmetic Subtests of the composite test demonstrated significance which was age related.

Research Instrument: Seriation Subtest: The findings related to the use of the Seriation Subtest are given in Table XII. The null hypotheses were:

Hypothesis 11. Regular class boys will not score significantly higher than educationally handicapped boys on the Seriation Subtest.

Hypothesis 11a. Older boys will not score significantly higher than younger boys on the Seriation Subtest.

Hypothesis 11b. There will be no significant interaction between age and class placement on the Seriation Subtest.

The analyzed data revealed that the major hypothesis could be rejected at the .01 level of confidence. The minor and interaction

TABLE XII

RESEARCH INSTRUMENT
SERIATION SUBTEST

PART A
MEAN SCORES BY PLACEMENT AND AGE

	EH BOYS	REGULAR BOYS	Totals
Younger	7.000	14.125	10.563
Older	7.438	12.250	9.844
Totals	7.219	13.188	10.203

PART B
ANALYSIS OF VARIANCE

Source	df	s.s.	m.s.	F	Sig.
Class Placement	1	570.02	570.02	15.541	.001
Age	1	8.27	8.27	.225	NS
Placement X Age	1	21.39	21.39	.583	NS
Within	60	2200.69	36.68		
Total	63	2800.36	44.45		

hypotheses were accepted.

Research Instrument: Classification Subtest. Table XII illustrates the statistical treatment of the data obtained from the use of the Classification Subtest. The null hypotheses tested were:

Hypothesis 12. Regular class boys will not score significantly higher than educationally handicapped boys on the Classification Subtest.

Hypothesis 12a. Older boys will not score significantly higher than younger boys on the Classification Subtest.

An analysis of the data revealed that no significant differences were found. The major, minor, and interaction hypotheses were, therefore, accepted.

Summary of The Research Subtest Findings. The analysis of the data indicated that the Seriation Subtest was able to determine highly significant differences between the educationally handicapped boys and the regular class boys. However, the Classification Subtest did not demonstrate significant differences between educationally handicapped and regular subjects. Neither of the research subtests produced significance which rejected the minor hypotheses.

Summary

This chapter has presented the data obtained from the use of twelve measures of academic achievement and cognitive functioning used to compare educationally handicapped and regular class boys. An analysis of variance design was used as the basis for computing the influence of three independent variables; (1) class placement, (2) age of the subjects, and (3) the interaction of age and class placement.

TABLE XIII

RESEARCH INSTRUMENT
CLASSIFICATION SUBTEST

PART A
MEAN SCORES BY PLACEMENT AND AGE

	EH BOYS	REGULAR BOYS	Totals
Younger	6.250	6.875	6.563
Older	6.813	6.000	6.407
Totals	6.532	6.438	6.484

PART B
ANALYSIS OF VARIANCE

Source	df	s.s.	m.s.	F	Sig.
Class Placement	1	.14	.14	.012	NS
Age	1	.39	.39	.033	NS
Placement X Age	1	8.27	8.27	.699	NS
Within	60	709.19	11.82		
Total	63	717.98	11.40		

When academic functioning was investigated through the use of four subtests assessing oral reading achievement, highly significant differences related to placement were revealed. This finding confirmed the expectation that placement in an educationally handicapped class is highly correlated with reading deficiency. Specifically, in four areas, (1) accuracy, (2) comprehension, (3) rate of reading words in paragraphs, and (4) recognition of words not in context were all clearly deficient in the educationally handicapped population.

An analysis of the data from the eight subtests used to assess cognitive functioning revealed that significant differences between educationally handicapped and regular class boys were related to class placement for all of the subtests, except the Classification Subtest. These findings strongly supported the expectation that subjects deficient in reading skill would also demonstrate concomitant problems with sequential and conceptual abilities.

The expected difference in the age variable was supported by only two of the subtests, the WISC Arithmetic Subtest and the ITPA Visual Association Subtest. These two subtests appear to have been the only measures sufficiently sensitive to age-related factors to successfully overcome a clustering in the middle year of the age range which occurred in the distribution of the tested population.

The statistical analysis of the final minor independent variable, interaction of age and class placement, revealed no significance on the F test. These data, however, were presented in the accompanying tables for informational purposes.

The final chapter of this Report will (1) present the conclusions based upon the statistical findings, (2) provide suggestions for

remediation of deficits in operational behavior related to seriation and classification skills considered as important in the structure of the science curriculum, and (3) make recommendations related to further research.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

This study was conducted to compare the academic and cognitive functioning of educationally handicapped boys with the functioning of regular class boys on a composite test. The composite test was constructed of subtests, selected and developed for the purpose of collecting data relating to reading skill and the sequential and conceptual abilities of the tested subjects. As described in Chapter III, an analysis of variance design was used to analyze the data for significant differences in the dependent variables as they were related to (1) class placement, (2) age of the subject, and (3) interaction between age and class placement. The results of this statistical analysis were reported in Chapter IV for each of the subtests.

The major independent variable, class placement, proved to be a significant factor in eleven of the twelve subtests. As a minor independent variable, age was found to be a significant variable on two of the subtests. No significance was discovered which was due to the interaction of age and class placement.

In Chapter V it was the purpose of the researcher to (1) formulate conclusions and implications related to the acceptance or rejection of the hypotheses presented in Chapter IV, (2) outline strategies which would allow use of the elementary science curriculum as an adjunct to cognitive development which may underly reading skill, and (3) propose recommendations for further research. A summary of the study concludes

Chapter V.

I. CONCLUSIONS

The following conclusions were based upon the statistical findings of the study. Two main subheadings are used to consider these conclusions: (1) Conclusions Related to Academic Functioning, and (2) Conclusions Related to Cognitive Functioning.

Conclusions Related to Academic Functioning

Four of the subtests were used to assess academic functioning. The Gilmore Oral Reading Test supplied the data for three of the subtests and The Wide Range Achievement Test furnished the data for the remaining subtest. Oral reading skills were evaluated by all of the subtests.

1. Class placement of the subjects was a highly significant variable in differentiating between EH and regular class boys. As related to academic functioning, oral reading skills were markedly lower in the educationally handicapped subjects. This finding was expected and indicates that the San Juan Unified School District has been effective in determining the placement of boys in educationally handicapped classes. It may therefore be concluded that the EH boys in this study were a population whose oral reading skills were significantly lower than their counterparts in the regular classes.

2. When assessed by this statistical design, the age of the subject was not found to be significantly related to the development of oral reading skill. However, the age distribution of the subjects, which resulted from the random selection of the subjects (Table I, page 52), placed the majority of the boys tested in the middle year of the three

year age range. This occurrence may have negatively influenced the expected appearance of improvement in reading skill within the three year age range of the study. Or, the increase in reading skill expected to result from the increased exposure to reading instruction of the older subjects may have failed to appear because of the nature of their reading deficit. For, if this reading deficit resulted from the presence of a highly stable underlying cognitive deficit, the usual instructional methods in reading may be relatively ineffective for remediation. Piaget's theory provides the hypothesis that such an apparently stable deficit may be present in individuals whose environmental interactions have failed to enable the child to learn to order his world.

Conclusions Related to Cognitive Functioning

Eight of the twelve subtests were regarded as assessing cognitive functioning. The researcher's belief that designated subtests could be used to assess ordering and classification abilities was developed as the result of an exploration of the literature. When the literature concerned with reading disability was related to Piaget's developmental theory, sufficient support for preparing the composite test was found. Four of the WISC Subtests and the developed Seriation Subtest were used to assess seriation ability. Conceptual ability was tested through the use of the two Association Subtests of the ITPA and the developed Classification Subtest.

The research in this investigation was designed to gather additional data to support the presently incomplete evidence linking reading disability with the existence of underlying cognitive deficits. Consideration of the existence of such underlying deficits and of their possible

importance to academic achievement has only recently been suggested in the literature. Therefore, conclusions more directly linking seriation and classification to reading achievement await further investigation. Such investigations, utilizing remedial techniques linking theory with practice, may result from studies such as this one, and will be discussed under Section III in this chapter.

The following conclusions have resulted from this study:

1. The educationally handicapped subjects were significantly deficient in cognitive functioning when compared to the regular class subjects on the WISC Subtests. This finding confirms the studies made by Robeck[1] and Neville[2] and lends support to Bannatyne's[3] beliefs. Piaget's theory endorses Bannatyne's suggestion that three of the subtests assess sequencing ability. The difficulties experienced by the EH subjects on these Subtests may be viewed as support for the theory that the development of operational sequential skill is part of the bridge between early environmental interactions and symbolic achievement.

2. The WISC Arithmetic Subtest reflected significant differences between younger and older subjects. Significant age-related differences were not found on the three other WISC Subtests. This finding may indicate that growth in mathematical skill is sufficiently age-related to overcome the tendency of the subjects in the study to be clustered within the eight to nine year age span.

3. As developed for this study the Seriation Subtest appeared to be successful in assessing the seriation ability of the subjects.

---

[1] Cf. supra., p. 26.

[2] Cf. supra., p. 27.

[3] Cf. supra., p. 28.

Significant differences were found between regular class and EH boys which strongly indicated deficits in ordering ability in the EH population. In addition, the observations of the subject's performance supported Piaget's theory of the stage-like development of this specific ability.

Boys able to demonstrate operational behavior (stage III) often indicated that they visualized both the height and width dimensions of the test objects before beginning the ordering process. Other boys were unable to carry two criteria in mind simultaneously (stage II), and ordered in only one dimension while verbalizing recognition of two dimensions. Some boys, operating at the same stage, arranged the test objects in accordance with one dimension, but then switched criteria and arranged the remaining objects by the second dimension. Stage I behavior was clearly shown by the boys who formed graphic collections or alighments--making letters, towers, forts, and trains with the test objects.

In addition, the apparently successful development and use of the Seriation Subtest in this study supports Flavell's[4] suggestion that Piaget's theory may provide a useful base for the broadening of assessment procedures. In the current study, the significant differences between the EH and regular class children on the Seriation Subtest may be seen as strengthening the probability that the WISC Subtests were also assessing a deficit in sequential ability in the EH children.

4. The ITPA Association Subtests do discriminate between certain conceptual abilities of the subjects which is significantly related to class placement. The EH boys experienced particular difficulty in the part of the Visual Association Subtest which required that a relational

---

[4]Flavell, op. cit., p. 365.

concept between two visual stimuli be abstracted and kept in mind while a comparison with other pictures was made. This observation appears to support Piaget's belief that the abstraction of the conceptual relationships between stimuli is an important aspect of conceptual development; as is the ability to hold one concept in mind while investigating another, additional relationship.

5. The significance in the age variable reflected in the Visual Association Subtest data appear to provide support for a maturational view of conceptual development. Since conceptual development is not a skill commonly taught in a grade-related manner in the school setting, maturational factors may furnish an explanation for the highly significant differences between younger and older boys demonstrated by this Subtest. Since the Auditory Association Subtest did not show similar age-related differences, development of the more complex abstracting abilities required by the Visual Association Subtest may be a reflection of an important developmental stage in the subjects within the age range of this study. If so, some support is provided for Piaget's developmental theory.

6. The Classification Subtest developed for this research did not discriminate between the EH and regular class boys studied. This finding appears to support the suggestion that the parallelism, reported by Piaget, between the appearance of seriation and classification abilities could be circumvented by the use of animal pictures. However, the resulting difficulty level of the test, coupled with the relatively few older subjects included in the study, seemed to place operational performance beyond the ability level of the boys tested. The observed difficulties the subjects experienced in failing to attain stage III, or fully

operational behavior on this test, confirmed Piaget's report. "Subjects who answered other questions at the level of stage III often gave replies equivalent of those of stage I when dealing with animals."[5] In other words, the difficulty level of this Subtest appeared to be a major factor which contributed to the lack of significance in differentiating the performance of the subjects of the age level included in this study.

Implications of the Conclusions

This study has provided additional support for Burkholder's[6] view that certain underlying abilities may be related to reading achievement. The recognition of the possible importance of specified cognitive abilities to reading success may have important implications for educational practice. The recognition of the importance of seriation and classification ability to reading, as suggested by Piaget's theory, leads to the following suggestions:

1. Students experiencing difficulties in the development of reading skill may benefit from practices designed to develop underlying cognitive abilities. In accordance with Piaget's theory students may be assisted in the attainment of operational behavior in seriation and classification with the expectation that symbolic achievement may be facilitated.

2. Educationally handicapped students could be expected to profit from a curriculum which has been systematized by focusing upon the ordering of the stimuli within the environment. Such a curriculum may be

---

[5]Inhelder and Piaget, op. cit., p. 112.

[6]Burkholder, op. cit., p. 2.

visualized as maximizing the opportunities for the student to recognize environmental relationships. The student may become operational as he internalizes a world ordered through emphasis upon the identification and relatedness of environmental stimuli.

3. Readiness for reading may be enhanced through supplemental activities concerned with providing opportunities for learning operational behaviors. Providing the student with direct experience in ordering and classifying may be a valuable part of the readiness program. If so, such a program may be preventive in terms of reading failure, if it is undertaken before reading is begun.

II. RECOMMENDATIONS FOR ADAPTING THE SCIENCE CURRICULUM FOR REMEDIATION

"Science facts do not constitute science; science exists only when relationships are discovered. Science is an invention of man which enables him to order information and conduct systematic search."[7]

Introduction

The suggested remedial practices are concerned with the adaptation of the elementary science curriculum for the purpose of (1) providing the child with an opportunity to act upon objects in his environment, (2) using these actions to assist the child in the recognition of the regularity or orderliness of the world which surrounds him, and (3) helping the child to develop a method of ordering new stimuli. As a part of these remedial practices the language concepts summarizing the performance and interpreting actions are emphasized. Nelson has suggested that

---

[7] Science Framework for California Public Schools. Kindergarten - Grades One through Twelve (Sacramento: California State Department of Education, 1970), p. 91.

such language concepts are important to learning, since they allow the teacher to recall past events to the child's mind and serve as the basis for more complex concepts.[8] Complex concepts become increasingly more abstract and depart from the presence of a concrete stimulus, and are, therefore, more language dependent.

In keeping with Piaget's theory, science, with its emphasis on discovered relationships and the development of systematic thought processes, may become the basis for moving the child toward increasingly more logical thought patterns. For the child at the concrete state of intellectual growth, it is the progressive development of the operational thought process which facilitates success in symbolic activities. The child who is unable to develop fully operational behaviors (who fails to coordinate foresight and hindsight) lacks the underlying cognitive structure necessary for reading success.

Rationale for Science Curriculum Adaptation

The rationale for use of the science curriculum for remediation of underlying cognitive deficits is based upon Piaget's theory as it has been interpreted for instructional practice. In discussing the implication of Piaget's work Duckworth has stated, "Contrary to the view most often attributed to him, he maintains that good pedagogy *can* have an effect on this development."[9] (The term *development* as used here refers to a preceding statement concerning intellectual development.) Duckworth

---

[8]Nelson, *op. cit.*, p. 2.

[9]Eleanor Duckworth, "Piaget Rediscovered," *Piaget Rediscovered: Report of the Conference on Cognitive Studies and Curriculum Development*, eds. R. E. Ripple and V. N. Rockcastle, *Journal of Research in Science Teaching*, 2 (1964), p. 172.

states that this intellectual development proceeds as partial understandings are revised, broadened and related to one another. Such changes in understanding cannot be brought about by talking to the child, which Duckworth indicates Piaget feels has too often been the customary practice in the school. Duckworth writes:

> Good pedagogy must involve presenting the child with situations in which he himself experiments in the broadest sense of that term--trying things out to see what happens, manipulating things, manipulating symbols, posing questions and seeking his own answers, reconciling what he finds at one time with what he finds at another, and comparing his findings with other children.[10]

Speaking at the same conference with Duckworth, Piaget explains the development of knowledge in terms of operation.

> Knowledge is not a copy of reality. To know an object, to know an event, is not simply to look at it and make a mental copy or image of it. To know is to modify, to transform the object, and to understand the process of this transformation, and as a consequence to understand the way the object is constructed. An operation, is thus the essence of knowledge; it is an interiorized action which modifies the object of knowledge. For instance an operation would consist of joining objects in a class to construct a classification. Or an operation would consist of ordering, or putting things in a series. Or an operation would consist of counting, or of measuring. In other words, it is a set of actions modifying the object, and enabling the knower to get at the structures of transformation.[11]

Piaget further explains that the concrete operations stage in the development of the child is the time of the appearance of the first operations. These operations are termed concrete because the child operates on objects and not on verbally expressed hypotheses.

In discussing the implications of Piaget's theory for teaching practice Flavell interprets a monograph by Hans Abeli. Abeli is a

---

[10] Ibid., p. 173.

[11] Jean Piaget, "Development and Learning," ibid., pp. 176-177.

psychologist and former school teacher who worked with Piaget in Geneva and sees Piaget as stressing two fundamental tenets relating to educational method. As described by Flavell, these two tenets are (1) the importance of engaging the student in direct action with the content, and (2) the value of group work in liberating the child from egocentrism. Flavell emphasizes point one, and suggests that the teacher's task is to analyze the content to be learned in terms of the operations implicit in it. And, then, the teacher should arrange the learning materials so that necessary operations are carried out by the student.[12]

Flavell also indicates that the teacher must assist the child in moving from performing only concrete actions to those requiring less direct support from the external stimulus. He suggests that movement toward greater internalization may first relate to operation upon physical entities, then to pictorial representations of the objects, and then to the final steps of cognitive foresight and hindsight. As a part of his discussion of Piaget's implications for teaching practice, Flavell briefly mentions that the internalization process may occur more easily as the result of activities undertaken in a group. Apparently, the pursuit of common projects and the related discussions provide opportunities for the student to compare his thought patterns with those of other students. The learner is thus better able to acquire some degree of rationality and objectivity in thought.[13]

An Instructional Model for Science Teaching

The researcher's recommendations for facilitating the growth of

---

[12]Flavell, op. cit., pp. 368-369.

[13]Ibid., p. 369.

cognitive abilities through the science curriculum are based upon the rationale outlined in the preceding section. These recommendations are related to specific strategies which are a part of the total teaching process. In order for these strategies or techniques to be more easily understood in terms of teaching, they will be considered within the context provided by the California Science Framework. The Science Framework suggests that instructional models are valuable in organizing and sequencing learning experiences.[14] Therefore, an instructional model is used to furnish a frame of reference for the teacher interested in implementing cognitive growth through science.

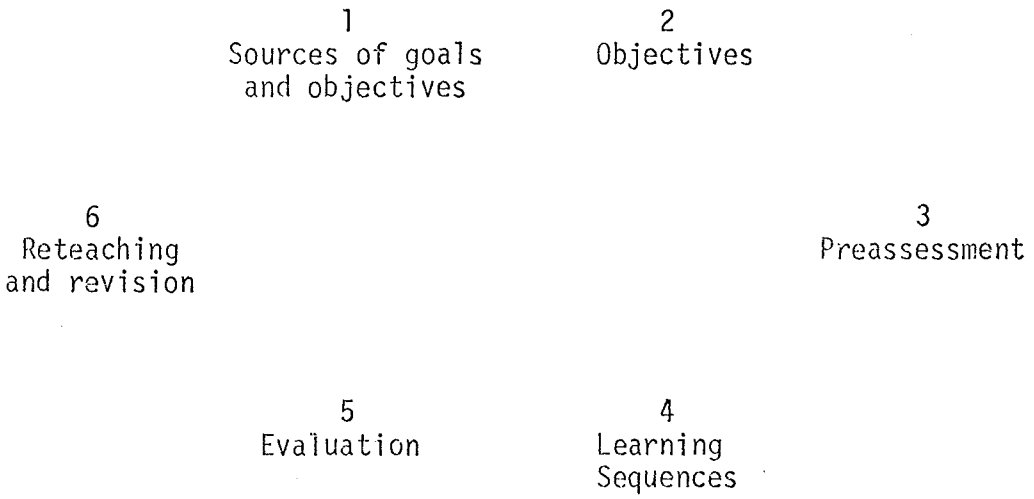

Figure 1

Planning/Assessment Instructional Model

One of the instructional models suggested in the Science Framework is an adaptation of the group instruction planning/assessment model

---

[14]Science Framework, op. cit., p. 59.

proposed by W. James Popham.[15] This adapted model indicates a teaching progression along a six point continuum (Figure 1, above). As discussed in the Framework a brief explanation of each of the six steps in the model is provided. In addition, the researcher's suggestions for teaching strategies are included under point 4 of the discussion which proceeds as outlined:

(1) Sources of goals and objectives: A brief explanation.

(2) Objectives: A brief explanation.

(3) Preassessment: A brief explanation.

(4) Learning Sequences: Three teaching strategies are suggested.

(a) Teaching strategy 1: Developing a simple concept in classification.

(b) Teaching strategy 2: Developing a simple concept in seriation.

(c) Teaching strategy 3: Developing a conceptual relatedness in classification.

(5) Evaluation: A brief explanation.

(6) Reteaching and revision: A brief explanation.

In following the sequence outlined no attempt has been made to limit the discussion to specified goals or grade levels within the elementary school. The teacher is allowed considerable flexibility in adapting the proposals to the needs of a particular class.

(1) Sources of goals and objectives. The California State Advisory Committee on Science Education has proposed four broad goals for the science curriculum from kindergarten through grade twelve. These goals,

---

[15] Ibid., p. 60.

stated in the Framework, are concerned with the development of the pupil in these areas: (1) Scientific attitudes, (2) Rational thinking, (3) Manipulative and communication skills, and (4) Knowledge.[16]

(2) Objectives. Each of the above goals may furnish a base for the formulation of teaching objectives. In actual practice, the four goals are closely interrelated and all contribute to the development of a well-balanced science program. However, for the recommendations in point 4, Learning Sequences, the Knowledge Goal provides the source of the more specific teaching sequences which are suggested. The Knowledge Goal as described by the Framework is, "To develop knowledge of specifics, processes, concepts, generalizations, and unifying principles, which leads to further interpretations and prediction of objects and events in the natural environment."[17]

Relevant to the development of Knowledge as a goal of science instruction, the Science Advisory Committee has selected seven broad conceptual ideas from the various science disciplines and has proposed that these concepts serve as guidelines for the selection of learning experiences for students. Two examples of the seven conceptual systems are:[18]

A. Most events in nature occur in a predictable way, understandable in terms of a cause-and-effect relationship; natural laws are universal and demonstrable throughout time and space.

B. Frame of reference for size, position, time, and motion in space are relative, not absolute.

The Advisory Committee has recognized that such broad conceptual

---

[16]Ibid.

[17]Ibid., p. 32.

[18]Ibid., p. 34.

systems are only the basis for long-range goals of instruction, and should be developed at increasing levels of understanding throughout the school years. The selection of more specific goals and related teaching strategies will reflect interim objectives for the unit or the year, and grow out of teacher judgment based upon preassessment, point 3 of the Instructional Model.

(3) Preassessment. At this point in the instructional process, the teacher diagnoses the status of the pupils in relation to a proposed knowledge category (which may be a unit), before additional preassessment related to a more specific learning objective. Such preassessments may be carried out through discussion, questioning, observation or trial teaching procedures. These preassessment procedures allow specific objectives to be based upon the instructional needs and skills of the class, the constraints imposed by the classroom environment, and the availability of time and equipment for science instruction. When preassessment has been carried out learning sequences may then be considered.

(4) Learning Sequences. It is in relation to the Learning Sequences of the Instructional Model, and within the broader Knowledge objective of point 2, that the researcher places the recommendations for the development of operational behaviors as previously described in Rationale for Science Curriculum Adaptation. In general, implementation of the teaching strategies should be carried out so that the student is encouraged to act upon actual environmental objects. Selection of such concrete experiences will depend upon the newness of the concept, the nature of the concept, the availability of materials, and, the inventiveness of the teacher.

Procedures useful in providing the student with the opportunity to

act upon objects include experiments, models, pictures, and observations. Such experiences assist internalization of the concept and assist both the teacher and student in avoiding the substitution of verbal fluency for learning. For example, if the seed is to be related to the concept of reproduction, observation of the embryo plant can be made by opening and inspecting a bean seed. Or, the child may plant the seed and observe the plant as it grows, flowers, and forms new seeds. During the period of plant growth, measurements may be taken which develop the concept of growth as well as reproduction.

The researcher believes that the following teaching strategies may be useful to the teacher planning to use the science curriculum as a vehicle for encouraging cognitive growth which results in operational behaviors:

A. Teaching Strategy 1. Concepts are an important method of acquiring knowledge since they are based on the ordering of facts and lead to generalizations and principles. If a concept is visualized as a system of classifying information, then a set of defining characteristics must be associated with each concept. To learn a concept the student must learn the defining characteristics so that in categorizing some features are noted while others are ignored. The strategy for assisting the student to gain an understanding of the properties of an object or idea is to provide for the abstraction of the commonalities from an investigation of several examples of the concept.

A paradigm for developing this strategy is depicted in Figure 2. As shown in this paradigm the concept is developed under object and description headings. The concept to be learned is illustrated by the objects selected by the teacher. The students then provide a description

of the object through experiments, observations, reading, listening to tapes or class discussion. When the descriptions have been completed the students summarize the description by identifying properties common to all the objects.

OBJECT	DESCRIPTION
1.	1.
2.	2.
3.	3.

COMMON PROPERTIES:

Figure 2

Identifying Defining Characteristics
for Learning Concepts

The strategy which has been suggested may assist the child in learning to order his environment through the recognition of commonalities of class. The ability to abstract the criteria of classification for a concept is, according to Piaget, a foundation of reasoning. Deficiency in this type of conceptual reasoning may have contributed to the significant differences in conceptual abilities between the educationally handicapped and regular class boys in this study.

A. Example: Teaching Strategy 1. In this example the concept fruit is to be developed. The instructional objective is for the child to abstract and identify the defining characteristics of fruit. The performance objective is for the child to select a fruit from among several fruits and vegetables and to explain the defining characteristics.

For this lesson the teacher has selected three examples of the concept; an apple, a pear, and an orange. Since the developed description is based primarily upon observation, both whole and cut samples of the fruits are supplied by the teacher. The students observe these examples and formulate a description. Finally, these descriptions are analyzed and the properties found in all of the three descriptions are abstracted and recognized. This example is illustrated in Figure 3.

OBJECT	DESCRIPTION
1. apple	1. red, has a peel over crisp pulp, has a core with seeds in it, round
2. pear	2. egg-shaped, green, has seeds, has a stem, has a peel, edible, has pulp.
3. orange	3. thick peel, round, orange, comes apart in sections, has juicy flesh in tiny sacs.

COMMON PROPERTIES: seeds, peels, pulp or flesh

Figure 3

An Example of Using Defining Characteristics
For Learning the Concept Fruit

B. Teaching Strategy 2. Concepts may have defining characteristics which are primarily relational. Relational concepts are those which cannot be clearly visualized except as a part of a frame of reference. For example, the concept tall cannot be viewed as having a consistent property, but exists primarily when there is a comparative relationship to short. The teaching of relational concepts may be simplified by

emphasizing ordering rather than categorization. The ordering process requires that comparisons be made among the objects to be ordered.

The educationally handicapped students assessed in this study were deficient in their ability to order, or sequence, when compared to regular class children. Science provides many opportunities for interactions which allow the child to recognize tactually, visually and verbally comparative relationships. Therefore, science may be structured to provide the developing child with many potentially valuable experiences for cognitive growth.

In science the importance of a relational frame of reference has been recognized by Conceptual System B (page 106) as one of the long range goals in science teaching. In this goal, size, position, time and motion are all recognized as relational. Nelson has stressed the importance of, whenever possible, using the child as the referent or center of the environment during the teaching of relational tasks.[19] When this teaching approach is used the child's involvement in the task is maximized.

B. Example: Teaching Strategy 2. In teaching the size concept, tall, the child may be led to discover that being "taller" is relational. For this lesson the instructional objective is for the child to discover that the concept tall is relational by comparing his own height with that of classmates. The performance objective is for the child to demonstrate his understanding of tall by standing next to an object in the room (such as a bookcase or desk) which he is "taller than" or "shorter than."

In structuring the lesson for teaching this relational concept,

---

[19]Nelson, op. cit., p. 126.

several children of varying heights may be placed in a line and the child moves along the line comparing himself with the heights of his classmates. He is then asked to describe if he is taller or shorter than a particular classmate.

The importance of measurement to the determination of tallness may also be included in teaching this concept. A large piece of butcher paper may be affixed to the wall and the children's heights recorded in marking pen. Measurements can then be made and recorded by the mark. These measurements can be correlated with the concepts of tallest, shortest, and middle-sized. In order to facilitate the recognition of these concepts the butcher paper may be cut and arranged from shortest to tallest. For children less advanced in skill, the ordering may be done by placing the children in a line of increasing height prior to marking the wall chart.

C. Teaching Strategy 3. The final strategy to be recommended is the recognition of the interrelatedness of concepts. This recognition can provide the teacher with a method of systematizing instruction so that learning in one context reinforces, or builds upon, related learning. In teaching, the value of one concept being a part of several others may provide the thread of continuity to a lesson or a unit.

In accordance with Piaget's theory multiple classification represents the ability to demonstrate hindsight and foresight, or to hold two ideas in mind simultaneously. On the Seriation Subtest the educationally handicapped students studies were significantly deficient in this ability. As suggested in the example which follows, the multiple roles filled by some concepts provides an opportunity to structure learning to facilitate the recognition of the importance of conceptual relatedness.

C. Example: Teaching Strategy 3. If, as noted in Figure 3, seeds have been previously identified as one of the characteristics of fruit then this concept may be used as the beginning idea for the development of the concept reproduction. (Seeds are recognized as important to understanding two other concepts--fruit and reproduction.) Or, beginning with the pulp or fleshy part of the fruit, the idea that the pulp is good to eat because it is sweet may be developed. If so, the sweetness present in the fruit may be related to the plant's ability to store sugar. In turn, sugars may be described in terms of the elements which they contain; carbon, hydrogen, and oxygen. Further exploration may consider the manner in which the tree obtains these elements from the soil and air and combines them to form sugar. This combining process then may be studied as an energy storing synthesis dependent upon light energy from the sun, termed photosynthesis.[20]

The use of this method of interrelating a lesson, or a teaching unit requires that conceptual relatedness be considered when planning is done. Such planning will allow the learner to systematize his thought patterns as learning proceeds in a continuous manner. Basing teaching upon conceptual relatedness should prevent the accumulation of fragmented facts and avoid the intellectual hopscotch often provided by undertaking a series of experiments or observations which may fascinate, but are soon forgotten.

(5) Evaluation. In the Instructional Model the effectiveness of

---

[20]Although these last concepts may appear to be too complex for the elementary child, they appear, in addition to many others, in the California State Series for Grade 4, Concepts in Science, ed. Paul F. Brandwein (Sacramento: California State Department of Education, 1967).

the learning sequence is determined by evaluation. In concept learning evaluation may be done by presenting the learner with new examples of the concept and asking the learner to categorize it. For example, in the concept fruit a new type of fruit is presented and the learner is asked to identify it as a fruit. Or, a fruit, a vegetable, and a nut may be presented and the student asked to examine the objects and identify the fruit. The student is also asked to explain his selection.

This type of evaluation indicates that concepts may be generalized. The child generalizes the newly learned concept to a variety of specific instances of the class which have not been previously utilized in the learning situation. At a more advanced level of understanding, the pupil may be requested to explain events in his daily life on the basis of his conceptual learnings.

(6) Reteaching and revision. Following evaluation procedures, teacher judgment leads to the reteaching of unachieved objectives with changed techniques or different materials. In some instances the original objectives will be modified to better meet the needs of the learners. When evaluation is made of the results of teaching strategies which are theory based, reteaching may be structured by returning to the theory for guidance.

For example, a teacher reviewing the rationale of cognitive growth may decide to revise a unit or lesson in a manner which allows more group work. If so, the decision may be based upon a reconsideration of Piaget's hypotheses which suggests that the internalization of logical thought is furthered through the exchange of ideas among students.

Science Curriculum Adaptation Summary

In this part of Chapter V the researcher has suggested ways of

facilitating the cognitive growth of the child by the design and structure of the science curriculum. The Knowledge Goal suggested by the State Science Framework has been used for suggesting specific teaching strategies within the context of an Instructional Model. Strategies have been recommended for assisting the child in learning to systematically approach and interrelate his world. These recommendations appear to be supported by Flavell, who states, ". . . intellectual development is an organization process, and what are organized are active, intellectual operations; their organization into systems with definable structure is the sine qua non for 'good' cognition, i.e., cognition of genetic maturity."[21]

The researcher has also stressed the importance of actively involving the child in acting upon the objects around him. The value in using the science curriculum for cognitive development has been summarized by Wohlwill.

> Providing the child with a broad base of experience which assures him extensive practice in abstracting structural similarities and common principles from diverse material contents or specific tasks may surely be expected to influence the development of his cognitive skills in a very favorable sense.[22]

In this study the correlation between the growth of cognitive skill and improved reading ability has been postulated. It has been suggested that certain underlying cognitive factors developed through science, may also prove to be valuable in the remediation of disabilities in reading demonstrated by some students. In order to further explore this

---

[21]Flavell, op. cit., p. 168.

[22]Joachim F.Wohlwill, "Cognitive Development and the Learning of Elementary Concepts," eds. R. E. Ripple and V. N. Rockcastle, op. cit., p. 226.

postulated relationship the following recommendations are made.

III. RECOMMENDATIONS FOR FURTHER STUDY

The following specific suggestions are deemed by the investigator as being most important for further study:

1. A longitudinal study comparing students with reading disabilities with regular class students is needed to determine if gains in reading achievement are accompanied by gains in composite test scores. Evidence of this type is needed to discover if reading skill can be more clearly linked with seriation and classification abilities.

2. Another study should be done utilizing the composite test to assess more clearly the age relatedness of the dependent variables. This could be done by controlling the number of subjects within each year of the age range to be studied.

3. Simplification of the Seriation and Classification Subtests would allow study of children of younger age levels. Such a study would be expected to identify early developers in seriation and classification. Once identified, the early developers could be studied to determine if they demonstrate early reading skill development. The presence of significant differences between early developers and late developers in seriation and classification abilities, which was also reflected by tests of reading skill, would furnish further evidence for the importance of Piagetian tasks to the development of symbolic skills.

4. The data from the present study revealed significant differences between groups of children, but analysis of the data for individual variations was not a concern of this study. Further understanding of the importance of seriation and classification ability to reading achievement may be gained by studies of individual children of normal intelligence.

5. Research directed toward comparing boys and girls in their development of seriation and classification abilities would be of interest, since Piaget's studies do not appear to reflect differential findings related to sex differences. If the frequently postulated maturational sex differences are present, and significant to the finding of a greater number of reading retardation cases among boys, then sex differences could be expected to be demonstrated on Piagetian tasks.

6. Evaluation techniques should be extended to appraise the child's environmental background. Information is needed which investigates the nature of the "hidden curriculum" provided by the child's home experiences prior to school entry. Piaget's theory which links the operational behavior of the concrete period with earlier environmental interactions suggests that the school should be increasingly concerned with development in the early years.

7. The suggested adaptations of the science curriculum should be carried out in the school and studies made to assess whether the students exposed to such a curriculum demonstrate cognitive growth reflected in gains in reading achievement.

IV. SUMMARY

The current study has provided evidence to support the theory that children who are severely deficient in reading skills, when compared to regular class children, are often also deficient in the ability to order, or seriate, and to classify, or form concepts. In accordance with Piaget's theory this finding supports the view that inadequately developed ordering and classifying abilities may represent, at least in part, the underlying cognitive skills necessary to cognitive maturation

sufficient for mastering reading.

As a part of this research a composite test was developed to assess reading skill and seriation and classification abilities. The use of this test provides evidence that broadened insights into cognitive functioning may be gained by alterations in usual testing procedures.

In addition to providing evidence for the presence of underlying cognitive deficits in poor readers, the study has suggested that the elementary science curriculum may provide a valuable content area for the development of improved cognition. The child is provided with the opportunity to view science as an invention of man for ordering the universe. Through science the child is encouraged to interact with, and act upon, his environment.

Guidance for this interaction is provided through specific suggestions for teaching strategies which maximize opportunities for recognition of conceptual relationships by the child. These specific suggestions are supported by examples of teaching procedures. The examples are provided to more clearly indicate that Piaget's theory may be used as the basis for curriculum adaptation as well as assessment procedures.

The research has raised many unanswered questions. Hopefully, the theoretical orientation of this study may lead to practices which assist in the prevention of reading failure. For, if cognitive growth can be demonstrably influenced by the provision for specific types of learning experiences for the growing child, then procedures may be undertaken which provide for the cognitive maturation required for reading prior to beginning reading. To this end, assessment techniques may be developed which are increasingly more accurate in determining when the child is ready to undertake the reading task with success.

BIBLIOGRAPHY

BIBLIOGRAPHY

A. BOOKS

Ashlock, Patrick, and Alberta Stephen. Educational Therapy in the Elementary School. Springfield: Charles C. Thomas, 1966.

Bannatyne, Alex. "The Etiology of Dyslexia and the Color Phonics System." Selected Papers on Learning Disabilities. Third Annual International Conference of the Association for Children with Learning Disabilities. Pittsburgh: Association for Children with Learning Disabilities, 1967.

Barbe, Walter B. The Exceptional Child. Washington: The Center for Applied Research in Education, 1963.

Bond, Guy, and Miles Tinker. Reading Difficulties. New York: Appleton-Century-Crofts, 1967.

Bortner, Morton. Evaluation and Education of Children with Brain Damage. Springfield: Charles C. Thomas, 1968.

Bush, Wilma Jo, and Marian Giles. Aids to Psycholinguistic Teaching. Columbus: Charles E. Merrill, 1969.

Buros, O. The Fifth Mental Measurements Yearbook. Highland Park: Gryphon Press, 1959.

Cruickshank, William (ed.). The Teacher of Brain-Injured Children. New York: Syracuse University Press, 1966.

deHirsch, Katrina, Jeannette Jansky, and William Langford. Predicting Reading Failure. New York: Harper and Row, 1966.

Flavell, John H. The Developmental Psychology of Jean Piaget. Princeton: D. Van Nostrand Co., 1963.

Gilmore, John V. Gilmore Oral Reading Test. Manual. New York: Harcourt, Brace and World, 1952.

Hellmuth, Jerome (ed.). Learning Disorders. Volume 1. Seattle: Special Child Publications, 1965.

_____. Learning Disorders. Volume 3. Seattle: Special Child Publications, 1968.

Inhelder, Barbel, and Jean Piaget. The Early Growth of Logic in the Child. New York: W. W. Norton and Co., 1969.

Jastak, J. F., and S. R. Jastak. The Wide Range Achievement Test. Manual. Wilmington: Guidance Associates, 1965.

Jeffress, Lloyd (ed.). Cerebral Mechanisms in Behavior. New York: John Wiley and Sons, 1951.

Johnson, Doris J., and Helmer R. Myklebust. Learning Disabilities. New York: Grune and Stratton, 1967.

Kerlinger, Fred N. Foundations of Behavioral Research. New York: Holt, Rinehart and Winston, 1964.

Kirk, Samuel A., James J. McCarthy, and Winifred D. Kirk. Illinois Test of Psycholinguistic Abilities. Revised Edition, Manual. Chicago: University of Illinois, 1968.

Myklebust, H. R. (ed.). Progress in Learning Disabilities. Volume I. New York: Grune and Stratton, 1968.

Money, John, and Gilbert Schiffman (eds.). The Disabled Reader. Baltimore: John Hopkins Press, 1966.

Rappaport, Sheldon. Public Education for Children with Brain Dysfunction. New York: Syracuse University Press, 1969.

Reiss, Albert J. Occupations and Social Status. Glencoe: The Free Press of Glencoe, Inc., 1961.

Roswell, Florence G., and Gladys Natchez. Reading Disability: Diagnosis and Treatment. New York: Basic Books, 1964.

Runyon, Richard P., and Audrey Haber. Fundamentals of Behavioral Statistics. Reading: Addison-Wesley Publishing Co., 1967.

Tarnopol, Lester (ed.). Learning Disabilities. Springfield: Charles C. Thomas, 1969.

Vinacke, W. E. The Psychology of Thinking. New York: McGraw-Hill, 1952.

Wechsler, David. Wechsler Intelligence Scale for Children. Manual. New York: The Psychological Corporation, 1949.

B. PERIODICALS

Bateman, Barbara. "Learning Disabilities--Yesterday, Today, and Tomorrow," Exceptional Children, 31:167-177, December, 1964.

Bean, William. "The Isolation of Some Psychometric Indices of Severe Reading Disability," Dissertation Abstracts, 28:3012A, February, 1968.

Bentzen, Frances. "Sex Ratios in Learning and Behavior Disorders," American Journal of Orthopsychiatry, 33:92-98, January, 1963.

Braun, Jean S. "Relation Between Concept Formation Ability and Reading Achievement at Three Developmental Levels," Child Development, 34:675-682, September, 1963.

Bruininks, Robert H., William G. Lucker, and Robert L. Gropper. "Psycholinguistic Abilities of Good and Poor Reading Disadvantaged First-Graders," The Elementary School Journal, 70:378-384, April, 1970.

Graubard, Paul S. "Psycholinguistic Correlates of Reading Disability in Disturbed Delinquent Children," The Journal of Special Education, 1:363-368, Summer, 1967.

Kass, Corrine E. "Psycholinguistic Disabilities of Children with Reading Problems," Exceptional Children, 32:533-539, April, 1966.

Kallos, George, John Grabow, and Eugene Guarino. "The WISC Profile of Disabled Readers." Personnel and Guidance Journal, 39:476-478, February, 1961.

Kinsbourne, M., and Elizabeth Warrington. "Developmental Factors in Reading and Writing Backwardness," British Journal of Psychology, 54:145-156, 1963.

Kirk, Samuel A., and James J. McCarthy. "The Illinois Test of Psycho-Linguistic Abilities--An Approach to Differential Diagnosis," American Journal of Mental Deficiency, 66:399-412, November, 1961.

Klapper, Zelda. "Psychoeducational Aspects of Reading Disabilities," Pediatrics, 37:368-376, February, 1966.

Levi, Aurelia. "Remedial Techniques in Disorders of Concept Formation," Journal of Special Education, 1:3-8, Fall, 1966.

_____. "Treatment of a Disorder of Perception and Concept Formation in a Case of School Failure," Journal of Consulting Psychology, 29:289-295, August, 1965.

Neville, Donald. "A Comparison of the WISC Patterns of Male Retarded and Non-retarded Readers." Journal of Educational Research, 54:195-197, January, 1961.

Ripple, R. E., and V. N. Rockcastle (eds.). "Piaget Rediscovered: Report of the Conference on Cognitive Studies and Curriculum Development." Journal of Research in Science Teaching, 2:167-266, 1964.

Robeck, Mildred. "Subtest Patterning of Problem Readers on WISC," California Journal of Educational Research, 11:110-115, May, 1960.

Stendler-Lavatelli, Celia B. "Aspects of Piaget's Theory that Have Implications for Teacher Education," Journal of Teacher Education, 16:329-335, September, 1966.

Strang, Ruth. "Reaction to Research on Reading," Educational Forum, 25:187-192, January, 1962.

Terman, Lewis M., and Maud A. Merrill. Stanford-Binet Intelligence Scale. Form L-M. Manual. Boston: Houghton Mifflin Co., 1960.

Ullmann, Charles A. "Prevalence of Reading Disability as a Function of the Measure Used," Journal of Learning Disabilities, 2:6-8, November, 1969.

C. UNPUBLISHED MATERIALS

Burkholder, Rachel. "The Improvement in Reading Ability Through the Development of Specific Underlying or Associated Mental Abilities." Unpublished Doctoral dissertation, University of Arizona, 1968.

Ginther, Robert. "A Study of Early Reasoning Skills in the Trainable Mentally Retarded: As Related to Piaget's Seriation Theory," Unpublished Master's thesis, University of the Pacific, 1970.

Nelson, Jerald W. "Construct Validation of the Learning Readiness System-Seriation Test." Unpublished Doctoral dissertation, Indiana University, 1968.

Smith, Joan M. "Utilization of the Illinois Test of Psycholinguistic Abilities with Educationally Handicapped Children." Unpublished Doctoral dissertation, University of the Pacific, 1970.

D. GOVERNMENT PUBLICATIONS

U. S. Bureau of Census. U. S. Census of Pupulation and Housing: 1960, Census Tracts. Final Report PHC (1)-129. Washington: U. S. Government Printing Office, 1962.

Clements, Sam D. Minimal Brain Dysfunction in Children. Phase One, NINDB Monograph Number 3. Washington: Government Printing Office, 1966.

_____. Minimal Brain Dysfunction in Children. Phase Two, Public Health Service Publication No. 2015. Washington: Government Printing Office, 1969.

California. Science Framework for California Public Schools. Preliminary Edition. Sacramento: California State Department of Education, 1969.

California. Science Framework for California Public Schools. Kindergarten - Grades One Through Twelve. Prepared by the California State Advisory Committee on Science Education. Sacramento: California State Department of Education, 1970.

California. Laws and Regulations Relating to Education and Health Services for Exceptional Children in California. Sacramento: California State Department of Education, 1969.

California. California Administrative Code. Title 5. Provisions Pertaining to Programs for Educationally Handicapped Minors. Sacramento: California State Department of Education, November, 1969.

Brandwein, Paul F. (ed.). Concepts in Science. California State Series, 4. Sacramento: California State Department of Education, 1967.

Simons, Allan, and Margaret Scheffelin. California's Program for Educationally Handicapped Minors. Sacramento: California State Department of Education, 1969.

APPENDICES

APPENDIX A

THE COMPOSITE TEST
SUMMARY SHEET

Name_____ School_____

Grade_____Retention_____ Class: EH_____ Regular_____

Yr. Mo. Day

IQ: WISC FS_____ S-B_____ Test Date _____ _____ _____

Hand Use: Right_____ Left____ Birth Date ____ _____ _____

Age ____ _____

Parent's Name_____

Father's Occup._____ Siblings: Older_____

Relationship: Step_____ Natural _____ Younger _____

TEST DATA	Score
ITPA - Auditory Association	_____
WRAT - Reading (Level I)	_____
ITPA - Visual Association	_____
WISC - Information	_____
Digit Span	_____
Arithmetic	_____
Coding	_____
GILMORE - Accuracy	_____
Comprehension	_____
Rate	_____
SERIATION	_____
CLASSIFICATION	_____

SAN JUAN UNIFIED SCHOOL DISTRICT
in Suburban Sacramento

FERD. J. KIESEL, Superintendent of Schools
JOSEPH R. FERREIRA, Assistant Superintendent, Special Services and Programs

RALPH RICHARDSON, DIRECTOR
SPECIAL EDUCATION DEPARTMENT
STARR KING EXCEPTIONAL SCHOOL
4848 COTTAGE WAY
CARMICHAEL, CALIFORNIA 95608
TELEPHONE: 484-2194

November 10, 1970

Dear Parent:

The San Juan Unified School District is participating in a program to evaluate and compare the academic abilities of boys enrolled in educationally handicapped classes with regular class boys. The findings will be used as the basis for suggesting adaptations of science curriculum for the development of reading skills.

In this program some youngsters will be asked to participate in an academic abilities evaluation which will take approximately one hour. This evaluation will be done at school, during school hours. It is expected that this study will begin around the middle of November and conclude in December, 1970.

If you have no objections to your child being included in a list from which this study group will be selected, please sign the consent form below and return it to the school at your earliest convenience.

Sincerely yours,

Ralph Richardson

RALPH RICHARDSON
Director of Special Education

I hereby consent to my boy being included for possible selection in the above-outlined program.

Child's Name	Parent's Signature
Birthdate	Address
School	Telephone Number

SAN JUAN UNIFIED SCHOOL DISTRICT
Special Education Department

To: Principals and Teachers of Educationally Handicapped and Regular Class Children

From: Ralph Richardson, Director of Special Education

Subject: EVALUATION OF ACADEMIC ABILITIES OF BOYS ENROLLED IN EDUCATIONALLY HANDICAPPED CLASSES COMPARED WITH REGULAR CLASS BOYS

Date: November 10, 1970

With the approval of the Superintendent's Cabinet and the cooperation of the Special Education Department, Mrs. Vivian McProuty will be conducting an evaluation and comparison of the academic abilities of boys in the Educationally Handicapped and Regular Class Programs. The findings will be used as the basis of a doctoral dissertation with the University of the Pacific. This project will suggest ways of adapting the elementary science curriculum for the improvement of reading skills. When completed, the portion of the study integrating reading skill development with science will be made available to participating schools.

If participation in this study meets with your approval, I would appreciate your taking the following action: Approximately forty educationally handicapped and forty regular class boys will be selected for evaluation during November and December. Listed below are the names of the students in your E.H. classroom who meet the criteria necessary for inclusion in the study.

Before selection of any of these children for evaluation, it is necessary that parent permission be obtained. It would be most appreciated if you would send the attached letter home for the above-named children. It is urgent that the signed parent permission forms be returned to the school by the 20th of November, 1970.

Thank you for your cooperation.

RR:hc
encl.

SAN JUAN UNIFIED SCHOOL DISTRICT
Special Education Department

To: Principals and Teachers of Educationally Handicapped and Regular Class Children

From: Ralph Richardson, Director of Special Education

Subject: EVALUATION OF ACADEMIC ABILITIES OF BOYS ENROLLED IN EDUCATIONALLY HANDICAPPED CLASSES COMPARED WITH REGULAR CLASS BOYS.

Date: November 19, 1970

With the approval of the Superintendent's Cabinet and the cooperation of the Special Education Department, Mrs. Vivian McProuty will be conducting an evaluation and comparison of the academic abilities of boys in the Educationally Handicapped and Regular Class Programs. The findings will be used as the basis of a doctoral dissertation with the University of the Pacific. This project will suggest ways of adapting the elementary science curriculum for the improvement of reading skills. When completed, the portion of the study integrating reading skill development with science will be made available to participating schools.

If participation in this study meets with your approval, I would appreciate your taking the following action: Approximately forty educationally handicapped and forty regular class boys will be selected for evaluation during November and December. Listed below are the names of the students in your regular classrooms who meet the criteria necessary for inclusion in the study:

Before selection of any of these children for evaluation, it is necessary that parent permission be obtained. It would be most appreciated if you would send the attached letter home for the above-named children. It is urgent that the signed parent permission forms be returned to the school by the 30th of November, 1970.

Thank you for your cooperation.

RR:hc
encl.

APPENDIX C

SERIATION SUBTEST

SCORE SHEET

First Trial: Award 5 points for each of the following stages which are successfully completed. Add 5 bonus points for correct placement of the check piece.

SCORE

Stage 1 - No seriations in the strict sense, usually graphic collections or alignments. _____

Stage 2 - Seriation, according to one criteria, or switching from one criteria to another. _____

Stage 3 - Multiplicative arrangement based on twofold seriation. _____

(Points Possible - 20) Bonus - check _____

Second Trial: Following the demonstration: count the pieces placed correctly. Divide this total by one-half (disregarding one-half points) and record. Award 4 points for correct placement of the check piece. _____

(Points Possible - 12) Bonus - check _____

The score on the subtest is the total of the points possible.

(Total Subtest Points Possible - 32) TOTAL _____

APPENDIX C

CLASSIFICATION SUBTEST

SCORE SHEET

After the subject has completed placement of the animals award 2 points for each placement which appears correct. The criterion for correctness in placement which appears to demonstrate recognition of either of the sub-classes (i.e., a child placing the baby elephant with the mother elephant receives two points). SCORE

(Points Possible - 8) _____

After the child has placed the pictures he is asked to explain (verbalize) his reason for placement. Award 2 points for each of the two concepts correctly identified. Correctness of wording is not judged, as long as the examiner feels that the concept has been identified (i.e., the child may say old and young or mother and babies; or, zoo and farm or wild and not wild).

(Points Possible - 4 _____

Award 2 points for correct placement of the check animal. Criterion for placement is to add the check animal to the section containing the adult elephant and the tiger.

(Points Possible - 2) _____

If the child achieves multiplicative synthesis either before or after being asked, "Can you do something that will make it easy to look at everything at once?" a 4 point bonus is added.

(Points Possible - 4) _____

The score on the subtest is the total of the points possible.

(Total Possible - 18) _____

VIVIAN HELEN McPROUTY

Birthplace:	Rouse, Colorado, January 5, 1927
Education:	Shenandoah High School, Shenandoah, Iowa, 1944 B.A., Coe College, Cedar Rapids, Iowa, 1948 M.T., Northwestern University Medical School, School of Medical Technology, 1949 M.A., University of the Pacific, 1970
Professional and Honorary Organizations:	American Personnel and Guidance Association National Education Association California Teachers Association California Association of Women Deans and Counselors Grant District Teachers Association Alpha Lambda Delta Phi Kappa Phi
Credentials:	Standard Secondary General Secondary Standard Designated Services/Pupil Personnel Services
Positions:	Medical Technologist, 1949-1953 Teacher, San Juan Unified School District, 1965-1968 Counselor, Grant Joint Union High School District, 1970-1971