A Comparison of Two Approaches in Teaching Mathematics to Special Education Students.

Herman Brooks Fullen Jr
Louisiana State University and Agricultural & Mechanical College

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A COMPARISON OF TWO APPROACHES IN TEACHING MATHEMATICS TO SPECIAL EDUCATION STUDENTS

The Louisiana State University and Agricultural and Mechanical Col. Ph.D. 1981

University Microfilms
International 300 N. Zeeb Road, Ann Arbor, MI 48106
A COMPARISON OF TWO APPROACHES IN TEACHING MATHEMATICS TO SPECIAL EDUCATION STUDENTS

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy in The Interdepartmental Program in Education

by

Herman B. Fullen
B.A., Northwestern State University, 1966
M.S., Northwestern State University, 1972
August 1981
ACKNOWLEDGMENTS

It has become very evident to me that a dissertation involves many individuals. I would like to thank Dr. B. F. Beeson, who has been my major professor the last four years at Louisiana State University. He has been tremendously helpful in his suggestions throughout the dissertation study. Appreciation is also extended to other members of the committee, Dr. Sam Adams, Dr. James Firnberg, Dr. Wesley McJulien, and Dr. David Yang, for their suggestions concerning the study. I would especially like to acknowledge Dr. Sam Adams for the assistance he has freely given concerning statistical analysis and Dr. James Firnberg for his suggestions in research techniques.
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ABSTRACT

This study had the purpose of comparing the effects of two approaches in teaching mathematics to secondary special education students. The study attempted to answer the following questions: (1) Were there significant differences between group means of mathematics achievement test scores for students in a diagnostic-prescriptive mathematics program compared to students using programmed mathematics? and (2) Were there significant differences between group means of self-concept scores for students in a diagnostic-prescriptive program compared to students using programmed mathematics?

Twenty-four secondary special education students enrolled at the East Baton Rouge Evaluation and Vocational Center were the subjects in this study. The study consisted of the following treatment conditions: (1) Adston Mathematics Skills Series, Working with Whole Numbers, and (2) Ken Cook Mark 9 Teaching Machines with mathematics slides and tapes. A control group received no special mathematics.

Thirty-eight subjects were administered the Key Math Diagnostic Arithmetic Test and Piers-Harris Children's Self-Concept Scale. After pretests were completed, the treatment conditions (Adston and Ken Cook
materials) were administered for approximately 20 minutes per school day for 12 weeks. Due to individual differences in mathematical ability some subjects finished the treatment condition before 12 weeks.

After the treatment conditions were completed posttests were administered to 24 subjects remaining from the original 38. Pretests and posttests scores were analyzed by analysis of covariance to determine if significant differences existed among group means of mathematics and self-concept scores. The following conclusions were reached from the analysis: (1) The results were significant between the adjusted group means on the addition subtest of the Key Math Diagnostic Arithmetic Test; both the Adston and Ken Cook materials had significantly greater gains when compared to the Control group; (2) the Adston group displayed significant gains for the subtraction subtest on the Key Math compared to the Control and Ken Cook groups; (3) The Adston group had significant gains on the multiplication subtest of the Key Math compared to the Control group; and (4) There were no significant differences on the Key Math division subtest or the Piers-Harris Children's Self Concept scores.

General conclusions from the study were the following: (1) A diagnostic-prescriptive mathematics instrument such as the Adston can significantly aid the teacher and student; and (2) Method of teaching mathematics did not significantly affect the secondary special education student's self-concept.
CHAPTER I

INTRODUCTION

There has been no research conducted comparing the effects of diagnostic-prescriptive mathematics materials with programmed mathematics at the East Baton Rouge Evaluation and Vocational Center. The special education students at this school have had a history of low performance in academic areas, especially the area of mathematics. Therefore, research studying the effects of two approaches in teaching mathematics was designed. The study had the purpose of comparing the effects of diagnostic-prescriptive mathematics with programmed mathematics materials on learning performance and self-concept of special education students.

Since there has been a growing concern for the special education student in many of the school systems in this country, research conducted relative to the effect of mathematical ability to self-concept at East Baton Rouge Evaluation and Vocational Center was needed. Although there have been no studies conducted in this particular facility in the areas of mathematics and self-concept, there has been reason to believe mathematical ability was related to self-concept.
Past studies have indicated that the ability to perform successfully in the mathematical area is related to the self-concept of males (Keeves, 1973). One reason given for this relationship was that there was a cultural expectation for males to perform successfully in mathematics. If the male can perform successfully, he should experience a higher self-concept.

Wylie (1971) has stated concerning a person's evaluation of himself that low self-concept is marked by a sense of personal inadequacy and an inability to achieve need satisfaction. Rosenberg's (1965) research explained the social conditions associated with diminished and enhanced self-concept. Another study indicated there are four major factors that contribute to the development of self-concept: (1) the accepting treatment received from significant others in the environment; (2) history of successes and status held by the individual; (3) aspirations achieved by the person concerned; and (4) the persons's manners of responding to devaluation (Coppersmith, 1967).

Rochlin's (1952) study also indicated that attitude towards mathematics is related to leadership potential in the male. Those making higher scores had a more favorable attitude towards mathematics. Another study suggested that high scorers on an attitude scale tended to be more self-controlled when mathematical ability was
statistically controlled (Aiken, 1964). High-scorers also
displayed more self-control and placed a higher value on
the theoretical than low scorers. This indicated that
attitude toward mathematics correlates with a constella-
tion of personality variables related to adjustment, self-
concept, and interest.

Jarvis (1964) stated that one of the important
issues in good arithmetic teaching should be to focus on
individual needs once they have been identified. The
Adston Mathematics Skills Series performs this by concen-
trating on individual needs after diagnosing the mathe-
matics weaknesses of individual students. Prescriptive
exercises to help estimate specific difficulties are then
utilized. If the mathematical ability of the student is
improved, a concomitant improvement in self-concept may
also result as Keeves (1973) suggested.

There have been no formal studies comparing the
effects of a diagnostic-prescriptive mathematics model
with programmed mathematics on student performance and
self-concept at the East Baton Rouge Evaluation and Vo-
cational Center. So, an experiment designed to study
these variables was planned with the Key Math Diagnostic
Arithmetic Test and Piers-Harris Children's Self Concept
Scale utilized as measures of achievement and self-
concept.
STATEMENT OF THE PROBLEM

The purpose of this study was to compare diagnostic and programmed mathematics on the learning performance and self-concept of secondary special education students. The study attempted to answer the following questions:

1. Were there significant differences between group means of mathematics achievement test scores for students in the diagnostic program compared to students using programmed materials?

2. Were there significant differences between group means of self-concept test scores for students in the diagnostic program compared to students using programmed materials?

DELIMITATIONS OF THE STUDY

This experiment was limited in the following respects: (1) the population was limited to students enrolled in the Motors class at the East Baton Rouge Evaluation and Vocational Center, (2) measurements of learning performance were limited to scores on the Key Math Diagnostic Arithmetic Test, and (3) self-concept evaluations were limited to scores on the Piers-Harris Children's Self Concept Scale.
DEFINITIONS OF TERMS

Adston Diagnostic Instrument. A series of mathematics tests that are diagnostic in nature in that they are designed to help the teacher and student locate specific difficulties in a minimum of time. These instruments are "criterion referenced" rather than "norm referenced." The series, Working with Whole Numbers was used in this study.

Ken Cook Mark 9 Automated Teaching System. Teaching machines that utilize audio visual lecture programs. The tapes and slides in mathematics were utilized in this study. Student worksheets on addition, subtraction, multiplication, and division accompanied the tapes and slides.

Key Math Diagnostic Arithmetic Test. This test was originally designed for testing educable mentally retarded children in the area of mathematics. It has become a standard part of many test batteries in the evaluation of special education children. In this study it was used as the measure of learning performance in mathematics.

Piers-Harris Children's Self Concept Scale. A quickly completed self-report instrument designed for a wide age range requiring approximately a third grade reading knowledge. In this study it served as the measure of self-concept.
IMPORTANCE OF THE STUDY

There has been a specific need for a study of this nature at the East Baton Rouge Evaluation and Vocational Center which trains secondary special education students (mostly educable mentally retarded). A research study comparing diagnostic and programmed materials in the area of mathematics has never been performed at this facility. Since special education students have a history of low scores in the areas of mathematics, any significant increases would be a positive contribution.

SOURCE AND TREATMENT OF DATA

The subjects for this study were 24 secondary special education students enrolled at the East Baton Rouge Evaluation and Vocational Center. The treatment conditions were: (1) Adston Mathematics Skills Series, Working with Whole Numbers (Appendix A), and (2) Ken Cook Automated Teaching Materials (Appendix B). A Control group was also utilized in this study.

All subjects were administered pretest (Key Math Diagnostic Arithmetic Test and Piers-Harris Children's Self Concept Scale). After pretests, the treatments (Adston materials and Ken Cook materials) were administered for a maximum of 60 days. Due to individual differences in mathematical ability, students finished at varying times.
After each student finished the materials, the posttests (Key Math and Piers-Harris) were administered.

The Control group received no special mathematics. However, the Control subjects did receive mathematics in other classes, but not the Adston or Ken Cook materials. Scores on these tests were the measures of the dependent variables, learning performance and self-concept.

An analysis of covariance was utilized to find if significant differences existed among group means for mathematics and self-concept scores. Conclusions and implications of the study were then drawn.

ORGANIZATION OF THE STUDY

Chapter 1 presents some previous research on the investigation and the general outline of the actual study.

Chapter 2 presents a review of the related literature in the areas of special education and mathematics.

Chapter 3 presents the experimental design, the selection of subjects, treatment descriptions, and statistical procedures.

Chapter 4 presents the data and analysis in tabular form.

Chapter 5 is a summary of the experiment with conclusions and recommendations derived from data results.

The bibliography follows this last chapter.
CHAPTER II

REVIEW OF THE RELATED LITERATURE

Several studies have been conducted to determine the concomitant variables associated with the special education student in mathematics. Ross (1964) studied 25 fifth and sixth-grade underachievers who were at least one year below grade level in achievement. His study included general academic performance, arithmetic performance, physical characteristics, intellectual abilities, and social judgment factors. Generally, Ross found specific deficiencies in basic arithmetical computation processes and in the solving of reasoning problems involving multiplication and division of whole numbers. Also, he found all processes involving common fractions were deficient for the underachiever. Eighty percent of the pupils were at least one year below grade level in reading plus underachieving in other school subjects. Fifteen displayed immaturity and retardation of general physical development and 13 were identified as having emotional problems. The students also displayed varying degrees of withdrawal and defeatist attitudes. The parents were usually from a low socioeconomic class and tended to blame the teachers for the child's shortcomings.
Concerning socioeconomic level Dunkley (1965) found that disadvantaged kindergarten children had achievement levels significantly below that of children from the middle-class areas. Another investigator studied 20 slow learners in grades 3 to 8 (Jerome, 1959). The results were similar to those of the previous study in the areas of achievement and social adjustment.

Cronbach (1967) summarized several studies conducted to investigate the affective domain in relation to cognitive learning (Atkinson and Reitman, 1956; Feather, 1961; Grimes and Wesley, 1961). This summary indicated that constructive students learned best when they were assigned moderately difficult tasks for their level and the immediate goals were not too explicit. Also, feedback needed to be provided for judging themselves rather than for motivation. However, defensive students functioned better when short-term goals were very explicit, a maximum of explanation and guidance was provided, and feedback occurred frequently. Cronbach (1967) emphasized that it was important to capitalize on the existing aptitudes of students and attempted to improve these aptitudes.

Schulz (1972) stated that slow learners have been defined in various ways, such as I.Q. scores, achievement levels, teacher grades, or a combination of these factors. The slow learners did display below average intellectual performance on the basis of at least one of the above
criteria and were very likely to be retarded in mathematical ability. Even though slow learners did have common problems in mathematics, the students were not alike. Each individual had his unique set of strengths and weaknesses.

Kirk (1972) studied growth patterns which were typical for the slow learner and the learning disabled child. His data came from a variety of informal and formal measures. Kirk stated that the slow learner exhibited an overall depressed growth pattern with this performance at least one or two years behind his grade-level placement. However, the learning disabled child possessed an uneven growth pattern. Differences within his growth pattern were more dramatic.

According to Lerner (1971), many characteristics that have identified learning disabled children have obvious implications for mathematics. The child's difficulties in spatial relationships affected his ability to perceive numerical relationships and visualizations of the number system. These problems began at an early age because the child had a short attention span, poor perception, or poor motor development. Also, he may not have had the manipulative experiences which would prepare him to build understanding of form, order, space, time, distance, and quantity.

Johnson and Myklebust (1967) also stated that the learning disabled child frequently had difficulty with
visual-spatial perception and understanding of nonverbal experiences. These authors stated that the child fails to comprehend relationships of quantity, order, size, and distance in the study of mathematics.

Utilizing a sample of 766 third graders in the Brentwood, New York Public Schools, Roberts (1968) established four major categories of failure strategies:

1. Wrong operation: The pupil attempts to respond by performing an operation other than the one that is required to solve the problem.

2. Obvious computational error: The pupil applies the correct operative but his response is based on error in recalling basic number facts.

3. Defective Algorithm: The pupil attempts to apply the correct operative but makes errors other than number fact errors in carrying through the necessary steps.


Roberts concluded that a remedial program in arithmetic must take into account more than the bare facts of the pupil's inability to do math. By analyzing the child's problem-solving method, the teacher should be in a better position to choose more specific measures designed to overcome learning difficulties and raise achievement level.

Cawley and Goodman (1968) studied mentally retarded pupils placed in special education classes. They found many significant correlations between achievement
in other content areas and achievement in arithmetic. The authors found that children in the age group from 12 to 14 years old had mean-grade-equivalent scores that ranged from the second month of grade two in grammar to the tenth month of grade three in computation.

Another study (Jarvis, 1964) involving 713 sixth-grade pupils in an investigation of arithmetic achievement had the following conclusions.

1. The overall range of differences in arithmetic achievement among sixth-grade pupils may vary as much as seven years.

2. Among the bright pupils with Intelligence Quotients of 115 or more the range of arithmetic achievement is about four years.

3. Pupils of average intelligence, that is those possessing Intelligence Quotients of 95 to 114, will vary in arithmetic achievement by about five years.

4. The dull children with Intelligence Quotients of 94 or less may vary as much as five to seven years in achievement.

Concerning the achievement levels of bright, average, and dull students, Jarvis had these conclusions:

1. When considering the arithmetic achievement levels of all types of pupils--bright, average, and dull--one may expect to find about 69 percent of them working above, 11 percent at, and 20 percent below grade level.

2. Among the bright students about 94 percent will be working above, 4 percent at, and 2 percent below grade level.

3. About 74 percent of the average students will be working above, 13 percent at, and 13 percent below grade level.
4. Approximately 37 percent of the dull pupils will be working above, 14 percent at, and 49 percent below grade level.

Jarvis stated that the teacher should not seek to eliminate the wide range of individual differences in the area of arithmetic. Instead the teacher should try to meet these individual needs once they have been identified. He stated that this is the important issue and should be the goal of good arithmetic teaching.

Concerning self-concept Cox (1966) in a detailed study of developmental processes correlated with peer acceptance-rejection, studied the network of relationships including (a) family background and social variables, (b) parental child-rearing attitudes and practices, and (c) characteristics of the child. He found that self-concept was significantly associated with the child's perception of each parent as loving. His analysis indicated that a major portion of the predicted variance in self-concept was associated with child-rearing practices and that family background variables played a much smaller role.

In the study of self-concept and special education groups, Mann, Beaber, and Jacobson (1969) primarily studied educable retarded boys. In a study to develop better self-concepts through counseling the authors found that scores on the Piers-Harris Scale did not increase significantly when compared to a control group. Lister (1975) compared the academic achievement and self-concept scores
of pre-adolescent black, male, educable mentally handicapped students in four different placement models. These were: (1) resource room, (2) regular class, (3) self-contained class in a regular school, and (4) self-contained class in a central facility. No significant differences in academic achievement or self-concept were found for any of these four models. The author listed some limitations which might have influenced results, but concluded that placement was not a primary determinant of academic achievement or self-concept in his study.

In summary, past research has indicated that each individual has a unique set of needs, strengths, and weaknesses (Kirk, 1972; Schulz, 1972) which should be emphasized in an attempt to improve aptitudes (Cronbach, 1967; Jarvis, 1964). Ross (1964) found specific deficiencies in basic mathematical computation processes in underachievers that also displayed withdrawal and defeatist symptoms. Concerning these weaknesses, Roberts (1968) stated the teacher would be in a better position to choose specific measures to overcome learning difficulties after analyzing the child's problem-solving method. Several studies (Atkinson and Reitman, 1956; Cronbach, 1967; Feather, 1961; Grimes and Wesley, 1961) have had results indicating that constructive students learned best when assigned moderately difficult tasks for their level. Defensive students
functioned better when short-term goals were explicit and a maximum of explanation was provided. Lerner (1971) stated that problems in the learning disabled child started at an early age due to poor motor development, short attention span, or poor perception. These problems needed to be met once they were identified (Jarvis, 1964). Many problems were found to be significantly correlated with self-concept; a major portion of predicated variance was associated with child-rearing practices (Cox, 1966).
CHAPTER III

DESIGN OF THE STUDY

This chapter presents the experimental design of the study and consists of the following sections: (1) selection of the population, (2) description of independent variables, (3) description of dependent variables, and (4) statistical analysis.

SELECTION OF THE POPULATION

This study was performed in the East Baton Rouge Vocational and Training Center, Baton Rouge, Louisiana. Approval to do this study was obtained from the following personnel: (1) principal at the East Baton Rouge Vocational and Training Center, (2) director of special education, East Baton Rouge School Board, and (3) director of research and program evaluation, East Baton Rouge School Board (Appendix C).

The study was performed during the spring semester, 1978, at the East Baton Rouge Vocational and Training Center. Subjects in the population were not randomized since entire classes were utilized. However, the classes were randomly assigned to groups (independent variables).
DESCRIPTION OF INDEPENDENT VARIABLES

The independent variables in this study were the Adston Mathematics, Working with Whole Numbers Series (Appendix A) and the Ken Cook Mathematics tapes and slides with Mark 9 Automated Teaching Machines (Appendix B). After pretests were administered, classes were randomly assigned to groups.

Table 1
Random Assignments of Classes to Groups

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<tr>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
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<tr>
<td>Adston Materials</td>
<td>Ken Cook Mark 9 Materials</td>
<td>Control Group, No Special Mathematics</td>
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</table>

Group I used the Adston Diagnostic Mathematics, Working with Whole Numbers series. This series diagnoses the mathematics weaknesses of individual students in the areas of adding, subtracting, multiplying, and dividing of whole numbers. They are also designed to help the teacher and student locate specific difficulties in a minimum of time.

Group II utilized Ken Cook Programmed Mathematics materials for the second treatment variable. This treatment consisted of tapes and slides which provided practice with the operations of addition, subtraction, multiplication, and division of whole numbers.
Group III received no special mathematics materials and served as the control group. However, this group did receive mathematics from other classes. They did not have the Adston or Ken Cook materials in these classes.

DESCRIPTION OF THE DEPENDENT VARIABLES

The dependent variables in this study were the following: (1) Changes in performance on the Piers-Harris Children's Self Concept Scale, and (2) Changes in performance on the Key Math Diagnostic Arithmetic Scale.

The Piers-Harris Self Concept Scale is a quickly completed self-report instrument designed for a wide range requiring approximately a third grade reading knowledge. It might be used below that level on an individual basis. The authors state that the scale was primarily designed for research on the development of children's self-attitudes and correlates of these attitudes (Piers and Harris, 1969).

The Key Math Diagnostic Arithmetic Test was designed for the preschool through grade six range and was originally developed for testing educable mentally retarded children (Connally, Nachtman, and Milo, 1971).

In a test review (Buros, 1978) concerning the Key Math Diagnostic Arithmetic Test, Bannatyne (1973) stated the following:

It is standardized on a sufficient sample and has good reliability and validity. The manual is excellent. It provides clear instructions, a wealth
of background information, and behavioral objectives for each item...Without a doubt Key Math should become a standard part of the test battery of everyone concerned with evaluating and treating learning disability children.

STATISTICAL ANALYSIS

The subjects in this study were randomly assigned to treatment conditions by classes rather than by individuals. Therefore, an analysis of covariance was utilized as the primary statistical procedure in analyzing the data (Garrett, 1971). The Key Math pretest scores served as the covariate in the analysis of data testing for significance between treatment groups in the area of mathematical learning performance. The pretest scores on the Piers-Harris Children's Self Concept Scale were used as the covariate in the analysis of data for significance between groups for self-concept. The posttest scores served as the measure of the dependent variables, changes in mathematical learning performance and self-concept. If the analysis of covariance was significant, a "t-test" was computed to locate where the significant differences occurred.
CHAPTER IV

ANALYSIS OF DATA

The purpose of this chapter was to present and analyze the data. The data were obtained by the use of two instruments: (1) The Key Math Diagnostic Arithmetic Test and (2) The Piers-Harris Children's Self Concept Scale. A pretest and posttest were utilized for both instruments.

Thirty-six subjects (Ss) were administered the pretest for both instruments. However, only 24 subjects remained at the end of the semester. The pretests and posttests for these 24 Ss provide the raw scores utilized in the analysis of data for this study. The analysis was carried out by the use of analysis of covariance and calculation of adjusted Y means as explained in Garrett (1971).

The study of the dependent variable, learning performance, utilized pretest and posttest scores on the Key Math Diagnostic Test. The addition, subtraction, multiplication, division subtests were analyzed using analysis of covariance. Throughout this chapter Ss that received the Adston Math materials (Working with Whole Numbers) were referred to as Group I. The students that utilized the Ken Cook Programmed Materials were referred to as Group II.
and the control Ss were Group III.

The first computation presented was a summary table of adjusted Y means of the three groups for the Key Math subtests of addition, subtraction, multiplication, and division (Table 2). The adjusted Y means for the Key Math addition subtest were the following: Group I (Adston), 12.01; Group II (Ken Cook), 11.66; and Group III (Control), 9.30. The adjusted Y means for the Key Math subtraction subtest were the following: Group I (Adston), 9.72; Group II (Ken Cook), 8.11; and Group III (Control, 7.52).

The adjusted Y means for the Key Math multiplication subtest were the following: Group I (Adston), 5.50; Group II (Ken Cook), 5.10; and Group III (Control), 4.29. The adjusted Y means for the Key Math division subtest were the following: Group I (Adston), 3.38; Group II (Ken Cook), 3.38; and Group III (Control), 2.45.

An analysis of covariance was computed for each Key Math subtest using Garrett (1971) as reference. If the F-ratio was significant, a "t-test" was then computed to locate where the significant differences occurred.

The analysis of covariance for the Key Math Arithmetic subtest (Table 3) resulted in an F-ratio of 12.64 which was significant at the .01 level of confidence for a df of 2/20. The differences between adjusted group means for the addition subtest were displayed in Table 4. The largest difference was between Group I and Group III. This difference was 2.71 and significant at the .01 level.
Table 2

Adjusted Means of Key Math Subtests

<table>
<thead>
<tr>
<th>Groups</th>
<th>Addition</th>
<th>Subtraction</th>
<th>Multiplication</th>
<th>Division</th>
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</thead>
<tbody>
<tr>
<td>I (Adston)</td>
<td>12.01</td>
<td>9.72</td>
<td>5.50</td>
<td>3.38</td>
</tr>
<tr>
<td>II (Ken Cook)</td>
<td>11.66</td>
<td>8.11</td>
<td>5.10</td>
<td>3.38</td>
</tr>
<tr>
<td>III (Control)</td>
<td>9.30</td>
<td>7.52</td>
<td>4.29</td>
<td>2.45</td>
</tr>
</tbody>
</table>
Table 3

Analysis of Covariance for Addition Scores on the Key Math Arithmetic Test

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SSx</th>
<th>SSy</th>
<th>SSxy</th>
<th>SSy·x</th>
<th>MSy·x</th>
<th>SDy·x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among Means</td>
<td>2</td>
<td>1.14</td>
<td>42.71</td>
<td>6.31</td>
<td>31.86</td>
<td>15.93</td>
<td></td>
</tr>
<tr>
<td>Within Groups</td>
<td>20</td>
<td>130.19</td>
<td>135.29</td>
<td>119.69</td>
<td>25.25</td>
<td>1.26</td>
<td>1.12</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>131.33</td>
<td>178.00</td>
<td>126.00</td>
<td>57.11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
F_{y·x} = \frac{15.93}{1.26} = 12.64
\]

Table F (df: 2/20)
- 3.49 (.05 level)
- 5.85 (.01 level)
Table 4

Differences Between Means for Key Math Addition Subtest

<table>
<thead>
<tr>
<th></th>
<th>Group I Adston</th>
<th>Group II Ken Cook</th>
<th>Group III Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (Adston)</td>
<td></td>
<td>0.35</td>
<td>2.71*</td>
</tr>
<tr>
<td>Group II (Ken Cook)</td>
<td>0.35</td>
<td></td>
<td>2.36*</td>
</tr>
<tr>
<td>Group III (Control)</td>
<td></td>
<td>2.71*</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .01 level of confidence.
of confidence. The difference between Group II and Group III (2.36) was also significant at the .01 level of confidence. There was no significant difference between Group I and Group II.

The analysis of covariance for the Key Math subtraction subtest yielded an F-ratio 9.85 (Table 5) which was significant at the .01 level of confidence. Table 6 displayed the difference of adjusted Y means for the subtraction subtest. The difference between Group I and Group II was 1.61 which was significant at the .01 level of confidence. The difference between Group I and Group III was 2.20 which was also significant at the .01 level of confidence. The difference between Group II and Group III (0.56) was not significant. Therefore, the null hypothesis was rejected for this comparison.

The analysis of covariance for the Key Math multiplication subtest (Table 7) yielded an F-ratio of 4.44 which was significant at the .05 level of confidence. The differences between group means for multiplication were displayed in Table 8. The difference between Group I and Group III was 1.21 and was significant at the .01 level of confidence, so the null hypothesis was rejected. The differences between Group I and Group II (0.40) and between Group I and Group III (0.81) were not significant. The null hypothesis was accepted for each of these comparisons.

The analysis of covariance for the Key Math division subtest was computed (Table 9) and yielded an F-ratio
Table 5

Analysis of Covariance for Subtraction Scores on the Key Math Arithmetic Test

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SSx</th>
<th>SSy</th>
<th>SSxy</th>
<th>SSy·x</th>
<th>MSy·x</th>
<th>SDy·x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within Groups</td>
<td>20</td>
<td>211.27</td>
<td>169.62</td>
<td>178.21</td>
<td>19.30</td>
<td>.97</td>
<td>.98</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>220.50</td>
<td>218.00</td>
<td>199.00</td>
<td>38.40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ny·x = 9.55 = 9.85

Table F (df: 2/20)
3.49 (.05 level)
5.85 (.01 level)
Table 6
Differences Between Means for Key Math Subtraction Subtest

<table>
<thead>
<tr>
<th></th>
<th>Group I Adston</th>
<th>Group II Ken Cook</th>
<th>Group III Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (Adston)</td>
<td>1.61*</td>
<td>2.20*</td>
<td></td>
</tr>
<tr>
<td>Group II (Ken Cook)</td>
<td>1.61*</td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td>Group III (Control)</td>
<td>2.20*</td>
<td>0.59</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .01 level of confidence.
Table 7

Analysis of Covariance for Multiplication Scores on the Key Math Arithmetic Test

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SSX</th>
<th>SSy</th>
<th>SSxy</th>
<th>SSy·x</th>
<th>MSy·x</th>
<th>SDy·x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among Means</td>
<td>2</td>
<td>20.05</td>
<td>38.85</td>
<td>26.90</td>
<td>5.24</td>
<td>2.62</td>
<td></td>
</tr>
<tr>
<td>Within Groups</td>
<td>20</td>
<td>147.91</td>
<td>150.15</td>
<td>143.10</td>
<td>11.70</td>
<td>0.59</td>
<td>0.76</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>167.96</td>
<td>170.00</td>
<td>170.00</td>
<td>16.94</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ \text{Fy·x = } \frac{2.62}{0.59} = 4.44 \]

Table F (df: 2/20)
- 3.49 (.05 level)
- 5.85 (.01 level)
Table 8
Differences Between Means for Key Math
Multiplication Subtest

<table>
<thead>
<tr>
<th></th>
<th>Group I Adston</th>
<th>Group II Ken Cook</th>
<th>Group III Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (Adston)</td>
<td>0.40</td>
<td></td>
<td>1.21*</td>
</tr>
<tr>
<td>Group II (Ken Cook)</td>
<td>0.40</td>
<td></td>
<td>0.81</td>
</tr>
<tr>
<td>Group III (Control)</td>
<td>1.21*</td>
<td>0.81</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .01 level of confidence.
### Table 9

#### Analysis of Covariance for Division Scores on the Key Math Arithmetic Test

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SSx</th>
<th>SSy</th>
<th>SSxy</th>
<th>SSy·x</th>
<th>MSy·x</th>
<th>SDy·x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among Means</td>
<td>2</td>
<td>4.90</td>
<td>6.14</td>
<td>3.36</td>
<td>4.18</td>
<td>2.09</td>
<td></td>
</tr>
<tr>
<td>Within Groups</td>
<td>20</td>
<td>83.06</td>
<td>87.19</td>
<td>79.47</td>
<td>11.15</td>
<td>0.56</td>
<td>0.75</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>87.96</td>
<td>93.33</td>
<td>82.83</td>
<td>15.33</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ F_y \cdot x = \frac{2.09}{0.56} = 3.73 \]

**TABLE F (df: 2/20)**

- 3.49 (.05 level)
- 5.85 (.01 level)
of 3.73 which was significant at the .05 level of confidence. The differences between adjusted group means for division were presented in Table 10. There was no difference in adjusted means between Group I and Group II. The difference between Group I and Group III was 0.93. This was significant at the .05 level. Due to the low N of this study the null hypothesis of no significant difference was accepted for this comparison. The difference between Group II and Group III was also 0.93 which was significant at the .05 level. The null hypothesis was accepted for this comparison due to the low N.

The analysis of covariance for the Piers-Harris Children's Self Concept Scale (Table 11) yielded an F-ratio of 1.22. This indicated that there were no significant differences in this study between group means of self-concept scores for special education students in the Adston, Ken Cook, or Control groups. Therefore, the null hypothesis was accepted for this variable.

Since there was no significant difference between group means on the Piers-Harris Children's Self Concept scores, only the pretest and posttest means were computed following the F-ratio. These means were as follows: (1) Pretest Piers-Harris Children's Self Concept mean = 56.6; and (2) Posttest Piers-Harris Children's Self Concept mean = 62.2.
Table 10

Differences Between Means for Key Math Division Subtest

<table>
<thead>
<tr>
<th></th>
<th>Group I Adston</th>
<th>Group II Ken Cook</th>
<th>Group III Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (Adston)</td>
<td>0.00</td>
<td></td>
<td>0.93*</td>
</tr>
<tr>
<td>Group II (Ken Cook)</td>
<td>0.00</td>
<td></td>
<td>0.93*</td>
</tr>
<tr>
<td>Group III (Control)</td>
<td>0.93*</td>
<td>0.93*</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 level of confidence.
Table 11

Analysis of Covariance for Piers-Harris
Children's Self Concept Scale

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SSx</th>
<th>SSy</th>
<th>SSxy</th>
<th>SSy·x</th>
<th>MSy·x</th>
<th>SDy·y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among Means</td>
<td>2</td>
<td>45.21</td>
<td>151.67</td>
<td>41.04</td>
<td>114.42</td>
<td>57.21</td>
<td></td>
</tr>
<tr>
<td>Within Groups</td>
<td>20</td>
<td>1896.62</td>
<td>1644.95</td>
<td>1160.96</td>
<td>934.30</td>
<td>46.72</td>
<td>6.83</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>1941.83</td>
<td>1796.62</td>
<td>1202.00</td>
<td>1052.58</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\frac{F_y.x = 57.21}{46.72} = 1.22
\]

Table F (df: 2/20)

3.49 (.05 level)
5.85 (.01 level)
CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to evaluate the impact of diagnostic and programmed mathematics on the learning performance and self-concept of secondary special education students.

SUMMARY

The subjects of this study were 24 secondary special education students enrolled at the East Baton Rouge Evaluation and Vocational Center. The study consisted of the following treatment conditions: (1) Adston Mathematics Skills Series and (2) Ken Cook materials. A control group received no special mathematics.

Thirty-eight subjects were administered the Key Math Diagnostic Arithmetic Test and Piers-Harris Children's Self Concept Scale. After pretests were completed, the treatment conditions (Adston and Ken Cook materials) were administered approximately 20 minutes per school day for 12 weeks. Some Ss finished before this time due to individual differences in aptitude.

After treatments were completed, posttests were administered using the same instruments as pretests.
However, only 24 subjects remained from the original 38. The scores from the remaining 24 subjects were used as the measure of the dependent variables, learning performance and self-concept.

These scores were used to compute an analysis of covariance to determine if significant differences existed among group means for mathematics and self-concept scores. Conclusions of the study were ascertained from results recorded in tabular form.

FINDINGS

1. The difference between adjusted group means of Group I and Group III was significant at the .01 level of confidence on the Key Math addition subtest. Also, the difference between Group II and III was significant at the .01 level of confidence on this test. This indicated that both the Adston treatment and Ken Cook Mark 9 treatment effects had significantly greater gains in addition when compared to control subjects that had no treatment conditions. Therefore, the null hypothesis was rejected for these comparisons.

2. The difference between the adjusted group means of the Adston Group and Control Group on the Key Math subtraction subtest was significantly different at the .01 level of confidence. The difference between the adjusted group means was also significantly different at the .01 level between the Adston Group and the Ken Cook Mark 9
Programmed Mathematics Group. This indicates that those students receiving the Adston Math materials had significantly greater achievement than the students receiving programmed math or students receiving no math, so the null hypothesis was rejected for these comparisons.

3. The difference between the adjusted means of Group I and Group III on the Key Math multiplication subtest was significant at the .01 level of confidence. This indicated that the group receiving the Adston materials had significantly higher achievement than the group that received no special mathematics. The null hypothesis was rejected for this comparison. There was no significant difference between Group I and Group II or between Group II and Group III, which indicated the programmed group did not gain significantly on achievement during the treatment period. Therefore, the null hypothesis was rejected for this comparison.

4. The difference between adjusted group means of Group I and Group III was significant at the .05 level of confidence for the Key Math division subtest. Also, the difference between the adjusted group means of Group II and Group III was significant at the .05 level of confidence. However, due to the final N in this study, the null hypothesis of no significant difference in achievement for the division subtest was accepted.

5. The F-ratio on the analysis of covariance for scores on the Piers-Harris Children's Self Concept
Scale was not significant. This indicated that method of teaching arithmetic did not significantly change self-concept between groups in this study. The null hypothesis was accepted for this variable.

CONCLUSIONS

The main conclusion from this study was that a diagnostic-prescriptive mathematics instrument such as the Adston Mathematics Skills Series can significantly aid the teacher and student in the area of learning performance. The Adston was primarily designed to locate specific difficulties in a minimum amount of time with remediation of the problems following in a direct process. Remediation in this study was greatly enhanced by the prescriptive sets which accompanied the diagnostic instruments. These remediation sets were keyed to the diagnostic instruments in whole numbers. Therefore, the process of identifying student problems and correcting them were practically working together. The Ken Cook mathematics materials did produce significant changes in learning performance compared to the control group. However, the special education students in this study had difficulty handling the tapes and slides that accompanied the Mark 9 machines.

The secondary conclusion of this study was that method of teaching mathematics did not significantly affect the secondary special education student's self-concept. This agreed with past research which stated that self-
concept was primarily formed in the early years and that various techniques utilized after these early years had little effect. The secondary student's self-concept was not significantly changed in this study when Piers-Harris Children's Self Concept scores were analyzed.

RECOMMENDATIONS

On the basis of this study, the following recommendations were proposed:

1. Students who were administered the Adston Mathematics materials had equal or significantly higher achievement gains when compared to a programmed or control group. Therefore, it was recommended that a relatively inexpensive instrument such as the Adston could be utilized for a diagnostic-prescriptive instrument in the remediation of student's mathematical problem areas.

2. Additional research should be performed in the area of special education at the secondary special education level utilizing the Adston Mathematics Skills Series.

3. The self-concept scores did not significantly change for the secondary special education students which agreed with past research in this area. However, it was recommended that more research was needed in this area for the special education student.
REFERENCES CITED

PERIODICALS


39


BOOKS


OTHER SOURCES


UNPUBLISHED SOURCES


APPENDIX A
THE ADSTON DIAGNOSTIC INSTRUMENTS (WORKING WITH WHOLE NUMBERS)

The Adston Diagnostic Instruments (Working With Whole Numbers) are part of a series of such tests. All the tests in this series are diagnostic in nature. They are designed to help the evaluator or teacher locate the student's specific difficulties in a minimum time span. The Adston diagnostic and prescriptive materials may be used with any mathematics program on the elementary level. Each of the series contains a diagnostic instrument, a prescriptive set of skill-development activities, a teacher's guide, and progress charts.

The Adston Mathematics Skills Series, Working With Whole Numbers is "criterion referenced" rather than "norm referenced." The student's achievement is not compared to a norm group, since the authors believe this would serve little purpose. However, they state there is need for information on where the student's difficulty is located and that once the problem is identified, the design of a remedial program is direct and straight-forward.

The instruments on whole numbers do not require any reading. However, the prescriptive sets in this series contain a certain amount of reading matter. The authors state that if a student is handicapped by a deficiency in
reading skills, the teacher can help the student in the reading involved in this series.

To order a complete set of this series or more information on other tests write:

Adston Mathematics Skills Series
National Educational Laboratory Publishers
P. O. Box 1003
Austin, TX 78767
APPENDIX B
THE KEN COOK MARK 9 AUTOMATED TEACHING SYSTEM

The programmed mathematics materials for this study utilized tapes and slides (Set-ALFT-A03; Set ALFT-A04) that go with the Ken Cook Mark 9 Automated Teaching System. The Mathematics materials (including worksheets) included 161 slides that covered addition, subtraction, division, and multiplication of whole numbers. The program is designed where the student is presented a problem with multiple choice answers. If the student makes the correct choice, he then goes on to the next problem. The mathematics worksheets are in conjunction with the programmed tapes and slides on this program. The programs can be presented to individuals or groups to permit discussion. Individual study with the program was emphasized in this study. For information concerning these programs write:

Automated Teaching Systems
Ken Cook Transnational
Milwaukee, WI 53225
December 19, 1977

Herman B. Fullen
East Baton Rouge Evaluation
and Vocational Center
2875 Michelli Drive
Baton Rouge, LA 70805

Dear Mr. Fullen:

I have examined your dissertation proposal and found it to be interesting. It is my understanding that it has the approval of Mr. Hatchell and Mr. McLean. I see no reason, therefore, why you shouldn't proceed with the study.

I would caution you that the data you collect is confidential and should not be released in any form that would identify individual students.

Sincerely,

D. L. Hoover, Director
Research and Program Evaluation

DLH/ssy

cc: George S. McLean
    Dayle Hatchell
VITA

Herman B. Fullen was born February, 1933, in Beaumont, Texas. He attended schools in Texas and Louisiana, graduating from Hahnville High School in 1950. After working for nearly a year, he enlisted in the U.S. Army, serving two infantry tours in Korea, 1951-1953. He received his discharge from the 82nd Airborne Division, Fort Bragg, N.C. in 1959.

Mr. Fullen worked for Kaiser Aluminum at Chalmette, Louisiana, The Boeing Company, New Orleans, Louisiana, and attended college until 1966, when he graduated from Northwestern State University, Natchitoches, Louisiana. He worked for several construction companies and taught secondary mathematics until 1970 when he returned to work on a Masters degree. He received his M.S. in 1972. Since then, Mr. Fullen has attended the University of Southern Mississippi for one year, performed psychological evaluations at Nicholls State University for two years, and taught in the East Baton Rouge Parish School System for six years. Also, he has attended the Graduate School, Louisiana State University since 1977. Presently, he is employed at the East Baton Rouge Evaluation and Vocational Training Center. His wife, Patricia, also teaches in Baton Rouge. They have two children, Rebecca and Jonathan.
EXAMINATION AND THESIS REPORT

Candidate: Herman B. Fullen

Major Field: Education

Title of Thesis: A Comparison of Two Approaches in Teaching Mathematics to Special Education Students

Approved:

[Signatures]

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

July 15, 1981