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An investigation of the arithmetic computation ability and word problem solving ability of elementary educable mentally retarded children

Carol Lajuan Clarke Wesley

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RESEARCH PAPER ABSTRACT

AN INVESTIGATION OF THE ARITHMETIC
COMPUTATION ABILITY AND
WORD PROBLEM SOLVING ABILITY OF
ELEMENTARY EDUCABLE MENTALLY
RETARDED CHILDREN

BY

Carol LaJuan Clarke Wesley

Fifteen educable mentally retarded children attending one elementary school in the Atlanta Public School System were the subjects of this study. They were in regular classroom grades second through sixth and attended the educable mentally retarded resource room on a daily basis for one and one-half hours. The IQ range was 54 to 83.

The purpose of the study was to determine the effects teaching methods had on the development of skills that elementary educable mentally retarded children need to solve arithmetic computation and word problems. For eight weeks, the subjects were instructed by various teaching methods. At the end of this experimental period, each subject was administered a test on sixty arithmetic computation problems and fifteen word problems. For the next eight weeks, no instruction was presented to the subjects. They were free to work in the mathematics learning center.
At the end of the eight week period under the control conditions, the subjects were retested with the same test used at the end of the experimental period.

The test data were analyzed and presented in terms of the mean scores under both the experimental and control conditions. For both test scores the experimental mean was found to be significantly greater than the control mean.

The results of this study indicated that there was a relationship between the methods used to teach elementary arithmetic skills to educable mentally retarded children and the development of these skills.

The implications of this study were presented in terms of their significance for the regular classroom and the special education teachers. Recommendations for future studies and changes in the present arithmetic curriculum for educable mentally retarded children were given.
AN INVESTIGATION OF THE ARITHMETIC COMPUTATION ABILITY
AND WORD PROBLEM SOLVING ABILITY OF
ELEMENTARY EDUCABLE MENTALLY
RETARDED CHILDREN

A RESEARCH PAPER
SUBMITTED TO THE FACULTY OF THE SCHOOL OF EDUCATION,
ATLANTA UNIVERSITY IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
SPECIALIST IN EDUCATION

BY
CAROL LAJUAN CLARKE WESLEY

SCHOOL OF EDUCATION
ATLANTA UNIVERSITY
ATLANTA, GEORGIA

JULY, 1977
DEDICATION

This study is dedicated to the honor of my parents, Mr. and Mrs. James E. Saunders and a devoted aunt, Mrs. Juanita S. Cole, who have made me what I am today and what I will be in years to come. Their patience and guidance will always be appreciated.

It is also dedicated to the memory of my maternal grandmother, Mrs. Lena M. Marlow, who departed this world on January 19, 1977. The determination to complete a job well that I 'inherited' from her, has resulted in the production of this paper.

C.L.C.W.
ACKNOWLEDGMENTS

Deep and sincere appreciation is extended to my friend and advisor, Dr. A. Jean DeVard. Her devotion and encouragement over the years has been 'exceptional.'

I wish to say a 'special thank you' to Dr. Damaris H. Ouzts and Dr. James F. Doyle for their assistance and guidance in the preparation of this paper. In addition, I sincerely appreciate the concern of Dean Huey E. Charlton.

Without the patience, encouragement and love of my husband, H. C. Wesley, and the encouragement of many friends and relatives, the work put into this paper would not have been possible.

Finally, I wish to express my appreciation to my students, for without them, this research would not have taken place.

Carol C. Wesley
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CHAPTER I

INTRODUCTION

Rationale

Mental retardation is a concept which has been in society since the beginning of time. However, the term 'mental retardation' has not always been used to denote those persons who are subnormal in mental ability.

The American Association of Mental Deficiency defines mental retardation as:

"... referring to subaverage intellectual functioning which originates during the developmental period, and is associated with impairment in adaptive behavior."

Under the heading of mental retardation are listed various degrees of retardation. Among these is listed the 'educable mentally retarded.' The Report on Study Projects for Trainable Mentally Handicapped Children described the educable mentally retarded as:

"... those who, because of slow mental development, are unable to profit sufficiently from the program of the regular elementary school. They can, however, learn many things in a special class. Their retardation is such that they are able to learn some of the

academic skills such as reading, writing, and arithmetic. This is why they are called 'educable.' They are capable of acquiring second, third, or fourth grade achievement by the age of sixteen. They can learn to work and in most instances can become self-supporting at the adult level. In general, they have the following characteristics:

1. they are able to learn second to fourth grade subject matter by age sixteen

2. they do not learn to read or to understand formal arithmetic until some time between ten and twelve years of age

3. they develop mentally from one-half to three-fourths as fast as an average child

4. their progress in school is likewise about one-half to three-fourths the rate of the average child. After they begin to read, for example, they progress about half as fast as the normal child. If they begin to learn to read at the age of ten, they probably can gain three or four grades in the next six years

5. although their vocabularies will be limited, their speech and language will be adequate in most ordinary situations

6. in most instances, they can learn to get along with people

7. they can learn to do unskilled or semi-skilled work and can usually support themselves at the adult level

This description is most inclusive and contains the characteristics described by most researchers in the field. For the purpose of this paper, the terms 'educable mentally

retarded,' 'mildly retarded' and 'educable mentally handicapped' will be synonymous.

Children are observed, evaluated, tested with the parent's consent and as a result of the psychometrist's report from a standardized test staffed accordingly. If the staffing indicates that the child should be attending the educable mentally retarded resource room for special or additional instruction, the teachers of the child work out a schedule to meet his needs.

It has been found that labeling children at an early age frequently develops additional fears, frustrations and hence, poorer academic and social achievement. One of the major problems that special education teachers face is helping the student develop a better self-concept by removing frustrations, fears and negative feelings about the self.

Many teachers, especially mathematics teachers, do not recognize the need for teaching mathematics to the low achieving student. If they would realize that they are attempting to prepare the educable student to meet the needs of the society, their task would not be so difficult. The Preliminary Report of the Conference on the Low Achiever in Mathematics stated:

"A teacher who accepts the fact that low achievers are teachable; a teacher who has a missionary spirit and a respect for the worth of pupils with limited ability; a teacher who is concerned and interested in individuals; a
teacher who can make a pupil feel he not only belongs but also is important; a teacher who can instill a sense of worthiness, responsibility, and desires to achieve; a teacher who cares enough to give his very best to the low achievers will make the program a success."

Classroom teachers are frequently guilty of failing the student. In addition, some resource teachers have not aided the student in developing a positive self-concept which leads to academic success. Perhaps the new law, Public Law 94-142, will assist in this area by requiring an education for all children regardless of their handicap.

Educable mentally retarded children will not be able to learn the skills necessary to compute arithmetical problems in the society on a daily basis, unless teachers assist in revising the curriculum and more emphasis is placed on problem solving skills. It is advantageous that revisions begin immediately.

Evolution of the Problem

Over a period of three years of observation as a resource teacher, the investigator has noted that most educable mentally retarded children prefer to perform arithmetical tasks to reading comprehension tasks. More spe-

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cifically, they prefer to do arithmetic computation tasks rather than word problem solving tasks. Research has shown that educable mentally retarded children perform better on arithmetic computation than on word problem solving.

The investigator perused the results of each subject's Iowa Tests of Basic Skills scores and found that they performed on a higher grade equivalency on arithmetic computation than on word problem solving. Their reading scores were also noted. It seemed that the subjects were lacking knowledge in the area of word skills. These grade equivalency levels are presented in Appendix A.

In many instances, if a subject was given an assignment to complete twenty addition or subtraction fact problems, the subject would begin to work immediately on his task. However, if he was given a silent reading assignment, he would procrastinate by stating that he did not have a pencil, he needed to use the restroom or that the problems were hard for him.

The investigator found that the educable mentally retarded child is more eagered to work problems in the resource room than in the regular classroom. The need for immediate reinforcement and small group instruction was important. Most subjects would immediately come to the investigator's desk after completing the first problem to have it checked.
If word problem solving tasks were assigned, the subjects seemed to spend the entire period, if possible, completing the tasks. Most of them mumbled and complained instead of attempting to read the problem and understand what had to be done to find the solution.

As a result of these observations, the investigator decided to place the subjects under a training program. It was for this reason that the study was developed.

**Statement of the Problem**

This study sought to answer the problem: is there a relationship between methods used in teaching elementary educable mentally retarded children the skills needed to work arithmetic computation problems and word problems?

The null hypothesis to be tested was: that there is no relationship between the teaching methods used in arithmetic computation and word problem solving and the development of these skills in elementary educable mentally retarded children. The independent variable was the teaching method and the dependent variable was the development of skills.

**Purpose of the Study**

The purpose of this study was to determine the effects teaching methods had on the development of the skills that
elementary educable mentally retarded children need to solve arithmetic computation problems and word problems.

**Research Method and Procedural Steps**

The following steps were employed in this study:

1. All students enrolled in the resource room in one elementary school in the Atlanta Public School System served as the subjects. The subjects had been psychologically evaluated by the Stanford-Binet Intelligence Test or the Wechsler Intelligence Scale for Children-Revised, and the Wide Range Achievement Tests. They were categorized as educable mentally retarded.

2. Each subject was evaluated by the resource teacher by the Basic Educational Skills Inventory.

3. Each subject was also evaluated by the resource teacher by a teacher-made test in arithmetic.

4. Mini case studies were written to ascertain background information.

5. Data was collected from the teacher-made test.

6. Methods of instruction were devised for each subject according to behavioral objectives based on the data collected.

7. Individualized and small group instruction was provided.

8. A teacher-made test on arithmetic computation and word problems was administered at the end of the experimental period of eight weeks.

9. The same test was administered at the end of the control period of eight weeks.

10. An analysis was made of the data according to statistical tests.

11. The findings were reported and conclusions were drawn.
12. Implications for the classroom teacher were given.

13. Recommendations for future studies and curriculum changes were given.

**Definition of Terms**

The following terms are defined as they related to this study:

1. **Educable Mentally Retarded** - are, for the most part, normal in intelligence but are functioning at a level approximately one-half to three-fourths that of normal children. Their IQ range is from 50 to 75 to 80.

2. **Intelligence Quotient (IQ)** - is an expression of an individual's ability level at a given point in time in relation to his age norms.

3. **Arithmetic Computation** - is the process of performing the required or indicated process for a given set of numbers.

4. **Problem Solving** - is the process of exploring and understanding a given question to which solution is desired.

**Methodology**

**Subjects**

Fifteen students who were enrolled in one elementary school in the Atlanta Public School System served as the subjects for this study. At the time the study began, only fifteen students were enrolled in the resource room.

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Each subject had been evaluated by a standardized intelligence test and a standardized achievement test within the past three years. One subject was administered the Stanford-Binet Intelligence Test and the other fourteen subjects were administered the Wechsler Intelligence Scale for Children-Revised by the school psychologist. All subjects were administered the Wide Range Achievement Test.

As a result of a staffing with members of the inschool team, each subject was recommended to attend the resource room. The subjects were in grades second through sixth. The subjects attended the resource room program for one and one-half hours each day.

The IQ range of the subjects was fifty-four to eighty-one with a mean IQ of seventy-one. Their chronological ages ranged from seven years and ten months to twelve years and eight months with a mean chronological age of nine years and six months. Their mental ages ranged from four years and four months to nine years. The mean of their mental ages was seven years and three months.

All of the subjects lived in a low socio-economic housing development. All of the subjects were black. There were three girls and twelve boys. Their experiences with books and magazines and reading for pleasure at home were very limited. Demographic data on each subject is presented in Appendix B.
Design

The design employed in this study was a repeated measures design. Each subject served as his own control. The independent variable - the teaching methods was applied to the subjects for eight weeks. At the end of the experimental period, the subjects were tested. No treatment was given for the next eight weeks. At the end of this control period, the subjects were administered the same test.

Assessment Instruments

Initially each subject was administered the Basic Educational Skills Inventory. After analyzing each subject's results on the Basic Educational Skills Inventory, the investigator designed a teacher-made test to determine the present level of achievement for each subject in arithmetic and reading.

As a result of the information gathered from this teacher-made test, behavioral objectives were written for each subject and lesson plans were devised accordingly. Lesson plans were designed for individualized and small group instruction.

This teacher-made test was designed according to the
following steps outlined by Reisman in making a diagnostic teacher-made test:

1. select the content for diagnostic test
2. isolate one concept to be diagnosed in depth
3. determine at what level of learning the individual is (or at what level the majority of the students are performing)
4. decide on the behaviors you want the child to display in order to show that he has acquired the particular concept
5. write a table of specifications which include the set of behaviors and the concept components to serve as the structure for your diagnostic test
6. build the test, asking the following questions:
   a. is it all pencil-paper?
   b. will you need concrete objects?
   c. will the testing situation parallel the teaching situation so that test items are a true reflection of instruction?
   d. will you show transfer of present knowledge to new situations?
7. interview the student(s) in regard to items missed in order to determine the validity of the items.

The test administered at the end of the experimental and control periods was devised with an attempt to include information which best related to the subjects' experiences and environment. This test is presented as Appendix C.

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Methods of Instruction

A ten to fifteen minute review period was scheduled daily at the beginning of each class period so that the subjects could study the basic facts of addition, subtraction, multiplication and division. Flash cards were available as well as a BINGO game. The language master drill cards, counting sticks and fact cards were also located in the mathematics learning center.

The teacher instruction period was for thirty to forty minutes during the scheduled resource class session. This teacher instruction was given daily.

A weekly sight word list was posted on a chart. The words were taken from the Dolch Basic Sight Word Lists. The subjects' names were displayed on the bulletin board in the room so that each subject would become familiar with his classmates' names.

On selected days, peer teaching was utilized. The investigator found that after a concept had been introduced once, some of the subjects were able to explain it to their peers the second time.

A list of words which would assist in determining the process to use when solving a word problem was provided on a chart and mobile. Words under the heading of 'addition' were; in all, many, together, both and total. Words under the heading of 'subtraction' were; left, many
more than, less and remaining.

At the end of each class period, each subject was given the opportunity to recite from memory the fact table that he had studied during that period.

After the first week of instruction, to assess the subjects' progress, one word problem was put on the chalkboard for them to read silently and work. Three problems were given at the end of the second week and three at the end of the third week. Five word problems were placed on the chalkboard each Friday for the next four weeks. Each subject had to read the problem silently and compute the answer. The investigator only assisted those subjects who appeared to be frustrated and not doing anything. These problems served as an assessment for the investigator during the experimental period.

As the weeks progressed, the subjects used the learning center more frequently. Each subject could select activity cards which contained arithmetic computation problems and word problems. Magnetic tapes of word problems and stories were made by the investigator. Each activity was coded according to the level of difficulty. The subjects knew at which level they were to begin working. The subjects' worksheets from the activity cards were marked by the investigator and placed in the subjects' folder. A duplicate copy was kept by the investigator.
The eighth week marked the end of the experimental period. Teacher instruction was discontinued at this time. Each subject was administered a test on arithmetic computation and word problem solving.

The test was administered on a group basis to each subject during his scheduled resource class period. The testing time was one and one-half period. A pencil was given to each subject who did not have one.

The test consisted of two parts. Part I consisted of sixty computation problems in addition, subtraction, multiplication and division. Part II consisted of fifteen word problems using the addition and subtraction processes.

The investigator distributed the tests and read the directions to the subjects. The subjects were asked to carefully look at each word, sound each word out and look for key words in the final question to help them decide whether to add or subtract.

At the end of the testing period, each subject returned to his regular classroom.

Beginning the next week, the group was under the control conditions. During this time, lesson plans were implemented to meet other behavioral objectives. This control period lasted for eight weeks. During this eight weeks, the subjects worked in the mathematics learning center and formal teaching methods on word problem solving
were not implemented.

At the end of this eight week period, the same test was administered to each subject during his scheduled one and one-half period in the resource room. The directions were read to the subjects and pencils were given to those who did not have a pencil. The investigator asked the subjects to read the problems carefully in Part II and look for the key word or words that would tell them which arithmetic process to utilize. The subjects were asked to take their time for both parts of the test so that they would not make careless errors.

At the end of the testing period, each subject was free to return to his regular classroom after he turned in his paper.
CHAPTER II

REVIEW OF RELATED LITERATURE

General Characteristics of Educable Mentally Retarded Children

According to Kirk, the educable mentally retarded child is unable to profit sufficiently from the regular elementary school program because of subnormal mental development. The educable mentally child is considered to have potentialities for development in three areas: 1) educability in academic subjects of the school at a minimum level, 2) educability in social adjustment to a point where he can get along independently in the community and 3) minimal occupational adequacies to such a degree that he can later support himself partially or totally at the adult level. As a child, his IQ may range from 50 to 75 to 80. Identification may not take place until after the preschool years. Usually a change in the normal developmental pattern will not be observed until poor learning ability shows up in school.

At the age of six years when the educable mentally retarded child enters school he is not prepared for all of the academic skills that await him. He may begin to acquire them by the time he is eight years of age or even
eleven years of age. This delay is due to his mental age, not his chronological age. He will continue to move at this pace - about one-half to three-fourths - that of his average classmate. By the end of a school year, he will not have covered a year's work. Depending upon his mental maturation and/or abilities, he may reach from as low as the second grade to as high as the sixth grade level at the end of his school career.6

Kirk further stated that personal and social characteristics tend to differ only slightly. The educable mentally retarded child has 1) a short attention span in the regular classroom and sometimes in the resource room, 2) a low frustration tolerance, perhaps due to repeated failures in life and in school, 3) social values and attitudes which correspond to the home and community environment, 4) play interest similar to children of the same mental age and 5) more behavior problems and delinquency.

Kirk emphasized that the educational program for the educable mentally retarded child should have the following specific objectives: 1) development of social competence -

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getting along with fellow men, his family, school mates and other community members, 2) development of personal adequacy - the ability to live with himself in some sort of equilibrium and 3) development of occupational competence - ability to support himself partially or totally in some productive activity. 7

Reading Characteristics of Educable Mentally Retarded Children

Even though the educable mentally retarded child enters school at a chronological age of six, his mental age is such that he may not be ready to read for three or four years. Frequently, he is forced to remain in the regular classroom for several years, continuously meeting tasks which develop fear of failure and failure in the reading situation.

Different methods have been studied for the development of the best reading skills in educable mentally retarded. A basic sight vocabulary and word attack skills are necessary.

Reading retardation is probably the earliest and most common sign of academic difficulties, and one of the most reliable preliminary indicators of poor scholastic aptitude. 8

7Ibid., p. 198.

Haring cited the following as a few of the guidelines to be followed when teaching reading to the educable mentally retarded child:

1. Mildly retarded children will be significantly behind other children of their same chronological age in reading achievement, and the older the child, the greater will be the retardation.

2. Many educable mentally retarded children will have failed miserably with traditional reading programs and thus, will have developed negative attitudes and habits of acting out in an aggressive manner.

3. Although as a group their achievement tends to be below that level, individually, the educable mentally retarded child should be expected to read up to his mental age expectancy in programs where reading is emphasized.

4. The causes of mental retardation seem to have a negative effect on reading achievement and the reading processes. However, teachers dealing with the neurologically impaired may have a slight edge over teachers dealing with the so-called cultural-familial retardates.

5. Mentally retarded boys tend to achieve below mentally retarded girls in all facets of reading and tend to be more erratic in their performance.

6. The mentally retarded children are more retarded in reading comprehension than in any other academic area with particular difficulties in grasping main ideas, locating meaningful facts, reaching conclusions and drawing inferences.

7. Mentally retarded children display inferior word attack skills. They require more words to be pronounced for them, make less use of contextual clues, mispronounce more vowel sounds, and make more omission of sound errors. They do tend to commit fewer errors involving additions and repetitions.

8. Educable mentally retarded children provided with a reading-readiness and language development program
until they attain a mental age of six or eight, tend to catch up with other educable mentally retarded children who began formal reading instruction when they reached the chronological age of six.

9. It is reasonable to expect mildly retarded children to progress in reading at a rate equivalent to two-thirds of a year's growth in one academic year.

10. The level of achievement will be a function of the degree of intellectual impairment, associated learning characteristics, and the quality of educational environment.

The general agreement among professionals in the field is that educable mentally retarded children need to obtain their maximum level in reading in order to master the other academic subjects. The following methodologies have proved to be effective as outlined by Haring.

1. One reading approach has not proved to be superior over another with educable mentally retarded children.

2. An eclectic approach has been effective.

3. The enthusiasm of the teacher and her competency with the approach is the key factor to success.

4. The teacher will have to deal with many diverse problems in the entire spectrum of reading disabilities.

5. Fresh approaches and novel teaching materials recommended to help overcome the chronic failure with traditional approaches and materials.

6. Behavior modification techniques are advantageous in teaching reading.

7. Individual children may benefit from specific approaches selected to meet their needs.
8. The heterogeneous composition of groups of educable mentally retarded readers support the value of the diagnostic-prescriptive approach.

9. The teacher must be competent in the application of various methods and skilled in the use of a wide range of materials.⁹

Dunn reported similar characteristics in educable mentally retarded children. These characteristics are:

1. The educable mentally retarded child does not read up to his mental age expectancy, but he comes closest to doing so in the regular grades, then in the special schools, special classes and residential facilities.

2. In oral reading, they are inferior to normals of the same mental age in word attack skills.

3. Studies in the use of teaching machines and programmed instruction in teaching reading are mixed. The value of this approach is dependent upon the teacher's abilities and proficiency.¹⁰

The following objectives for a reading program for educable mentally retarded children were cited by Smith.

1. Develop a basic sight vocabulary by building on the child’s existing speaking and listening vocabulary.

2. Develop word attack skills that are consistent with the child and any idiosyncratic characteristics such as auditory or visual strengths or weaknesses.

3. Develop reading as a skill that leads to the desire to read independently for information and pleasure.

⁹Ibid., p.356.

4. Develop a reading level that allows the child to effectively participate with society - socially and vocationally.

Smith indicated that no single approach has been developed for meeting these objectives.11

Woodcock and Dunn studies six approaches to reading instruction with 360 educable mentally retarded children with a mean chronological age of eight years and eight months, and a mental age of five years and six months. The six approaches studied were; 1) the basal reader, 2) the experiential story, 3) the experiential story with the Initial Teaching Alphabet, 4) programmed reading material, 5) basal reader with the Initial Teaching Alphabet, and 6) basal reader with a rebus symbol-word learning technique. Using seven dependent variables of reading, the study found no significant differences among any of the six instructional approaches utilized.12

Cawley, Goodstein and Burrow conducted a study to show the differences between mentally handicapped and nonmentally handicapped good readers and that differences between mentally handicapped and nonmentally handicapped poor readers would occur primarily on measures of reading; differences would not consistently occur on measures of psychomotor characteristics. Poor reading retarded children were substantially

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12Ibid.
inferior to other samples on measures of reading skills. Those children who were inadequate in one area seemed to be relatively inadequate in others. It is vital that teachers be sufficiently trained in educational diagnosis, the prevention of failure in individuals, and techniques through which children can proceed at their own rate. The research indicated that any significant differences between the retarded and average samples could be attributed to developmental factors, such as mental age.13

Apffel found that the moderately retarded could be taught a mini-sight vocabulary equally well using the rebus and traditional approaches and that those taught by the teacher made significantly greater gains than those taught by machine instruction.14

Jacobs and Pierce indicated that the main goal in the development of reading for the mentally handicapped is to meet his anticipated adulthood needs. He will need to know how to follow street signs, bus routes, names and numbers, directory numbers, dates on a calendar, names of groceries, hospitals and household items. He will need to be able to


sign and fill out applications, make out bills and read simple directions.

Kirk and Johnson suggested that stereotyped responses, poorer ability to adapt to changes in instruction, lack of autocriticism, poorer ability to generalize, and reliance upon concrete rather than abstract learning are characteristics which may affect the educable mentally retarded child's reading ability.

Stock pointed out the poor quality of language and experiential backgrounds that often complicate the readiness problems of the mentally handicapped. Dunn and others have shown that the reading ability of young retarded children appears to be affected by the nature of their environmental backgrounds. Adverse effects can be overcome, to a degree, through intensive language stimulation programs.

Goldstein, Jordan and Moss found that no significant differences existed in the reading achievement of retarded children randomly assigned to regular or special classes. They were studying the effects of special class training of mentally handicapped students. They concluded that special class placement was not academically beneficial to those higher IQ children who are often placed in mentally retarded classrooms.15

Arithmetic Characteristics of Educable Mentally Retarded Children

The place of mathematics in the curriculum for slow learners and educable mentally retarded children has been much less clear-cut than that of reading. However, as indicated in the general needs of the educable mentally retarded child, mathematics is needed for him to function at the adult level in the society.

Several researchers have studied the arithmetic characteristics of educable mentally retarded children. According to Kolstoe, an arithmetic program should involve not only teaching the skills of computation but also using these skills in solving problems and forming relational concepts.\(^{16}\)

As with reading, several researchers have studied the importance of guidelines for the teacher to remember in teaching mathematics to retarded children. Haring cited the following as essential to teaching mathematics:

1. Educable mentally retarded children will be significantly behind other children of their same chronological age in arithmetic achievement.

2. Negative attitudes will exist and are probably the result of prolonged failure in classrooms.

3. Mathematics materials or tests loaded with

reading materials will generally result in a lower level of performance.

4. Educable mentally retarded children tend to perform higher on measures of arithmetic computation than arithmetic reasoning.

5. Mentally retarded girls tend to be superior to retarded boys in mathematics achievement although their advantage is greater in arithmetic reasoning and is less in arithmetic computation.

6. Mentally retarded children tend to confuse relevant and extraneous facts, lack an understanding of the process of arithmetic, experience more difficulties when reading is involved, make careless mistakes, and have problems determining the process to be used in reaching a solution when solving problems.

7. Special difficulties with the measurement skills and particular problems may be anticipated with concepts of time.

8. The most significant difficulties in dealing with the abstract problems are noted for the educable mentally retarded child.

9. They do better with concrete and semi-concrete materials than with mere abstract approaches.

10. The mentally retarded child may be expected to demonstrate arithmetic skills between third and fifth grade equivalency on a standardized measure of achievement.

11. Mentally retarded children will only develop an understanding of the processes of arithmetic operations when the teaching method encourages understanding as opposed to memorization.

12. Special emphasis may need to be placed on vocabulary associated with mathematics.

13. In order to develop skills in form perception and establish the motor basis of quantitative skills, the importance of the perceptual-motor and visual-auditory discrimination skills must be emphasized in reading.\textsuperscript{17}

\textsuperscript{17}Noris M. Haring, \textit{Behavior of Exceptional Children}, p.359.
Dunn has outlined the following arithmetic characteristics in educable mentally retarded children:

1. The educable mentally retarded child tends to eventually work up to his expectancy level in arithmetic fundamentals but not in areas of reasoning where problem solving and reading are concerned.

2. Educable mentally retarded girls tend to score higher than boys.

3. In the adult world, retardates only need to know enough mathematics to handle money, basically.

4. Quantitative concepts develop in the mentally retarded child in the same manner as they do in the normal child, but at a much slower rate and somewhat later.

5. Educable mentally retarded children make more careless errors in solving problems, have more reading difficulties, count on their fingers and become more confused with extra information and have difficulty selecting the right information and process to solve the problem.

6. A with reading characteristics, the researchers have found few significant differences between endogenous and exogenous educable mentally retarded children, even though the tendency is for the exogenous retarded child to have more problems with mathematics.

7. The Distar Arithmetic, Stern's Structured Arithmetic and colored Cuisenaire rods are concrete materials that work well with mildly retarded children.

8. A combination of programmed instruction and good teacher tutoring brings about the best results with educable mentally retarded children.18

Vitello made the distinction between arithmetic and mathematics. He stated that arithmetics is the branch of mathematics which deals with the learning of notations and conventional algorithms which are used to express numbers and the operations performed upon them. While on the other hand, mathematics is concerned with the development of concepts, principles, rules and relationships in number and geometry. He continued that research on the quantitative abilities of educable mentally retarded children confirm the observations that they may be able to compute 1+3=4 easily, but when asked to prove this relationship at the manipulative level, they experience difficulty and often defeat.19

MacDonald studied slow learners and mathematics and found that children who are underachievers in mathematics need some meaningful remediation. Strategies which give the student concrete experiences with basic arithmetical properties need to be taught. The fundamentals will help increase number fluency and problem solving skills. Two noted causes of low achievement are the below average learning rate and insufficient exposure.20


Spradlin et al found that some skills that normal children have when they enter school are developed at home. The educable mentally retarded child does not have these skills when he enters school. Spradlin emphasized that since these skills were lacking, the teacher should begin to teach counting skills immediately. He added that the mentally retarded child's ability to hold a number while engaging in counting at the same time was also deficient.\textsuperscript{21}

Broome and Wambold studied the methods of teaching basic mathematics facts to educable mentally retarded children. They found that through weekly drill and small group instruction, individualized instruction, pupil teaming, contingency contracting and learning center activities, the pupils' comprehension levels increased. It was concluded that systematic approaches should and must be permeated in all areas of mathematical curricula.\textsuperscript{22}

Lovitt and Smith conducted an experiment on the effects of withdrawing positive reinforcement contingent upon the incorrect number of responses. Initially, withdrawal of the positive reinforcement caused a decline in performance.


Lovitt showed that when the treatment was removed after several trials, performance was maintained at a satisfactory level.23

Melnick, Bernstein and Lehrer designed a study to supply descriptive data regarding the relationship between performance on a broad range of Piagetian tasks and arithmetic skills among educable retarded children. The Arithmetic Concept Screening Test and the Arithmetic Concept Individual Test were administered to thirty-six students in primary level educable mentally retarded classes in Metro New York City. Both tests were designed to reduce specific deficits found by other researchers to hinder the performance of young educable mentally retarded children. These deficits were concrete thought, reinforcement, irrelevant stimuli and language position preferences. The Piagetian tasks were developed to test cognitive development. Higher test results on addition and subtraction than on prenumber skills indicated that the subjects relied on rote procedures.24


Once a child has mastered the skill of counting to five, planned work on word problems should begin. The following steps are suggested:

1. The sources for problems should be the child's everyday life situations.

2. Problems must be very simple and only one operation should be used at first.

3. Problems in earning and spending money should be included.

4. All problems should be oral at first.

5. All problems should be solved first with concrete objects.

Carkhuff and Dwight have studied problem solving. Carkhuff has developed several steps to the art of problem solving. Dwight stated that if the problem is read and understood and the relevant information extracted and put into a word sentence, the student only has to decide which process to use in completing the computation.

Otto, McMenemy and Smith stated that diagnosis in problem solving is more difficult than in computation. They suggested the following checklist to assist teachers in determining if the child has problem solving ability:

1. Can the child read the problem?

2. Can he listen effectively and see what is wanted?

3. Can he sort relevant and irrelevant materials?

4. Can he relate the elements of the problem?

5. Can he select a proper computational process and find the answer?
6. Can he check his answer?  

Cruickshank found that retarded children were most deficient in comparison to average IQ children in verbal problem solving, when the child was asked to extract the needed facts for a problem from extraneous information he could not perform the task.

Goodstein, Cawley, Gordon and Helfgott studied verbal problem solving among educable mentally retarded children and found that many educable mentally retarded children do not 'read' verbal addition problems, but rather select all the numbers contained in the problem and perform rote computation. The educable mentally retarded children, regardless of IQ, had difficulty with extraneous information in the problems.  

Haywood and Sewitzky also studied mentally retarded children in a similar setting. Their study showed that it is not necessarily abstracting ability per se that is deficient in mildly retarded children, but the apparent deficit in abstracting ability is related to a primary inefficiency at taking in relatively complex verbal


information and relating that information to abstract solutions which may in fact be available to such children.27

Schenck studied verbal problem solving among educable mentally retarded children using an indefinite quantifier 'some' instead of numbers. He found that the indefinite quantifier may have forced the subjects to use the pictures to find the numerical values. Schenck concluded that high mental age educable mentally retarded children perform better on verbal arithmetic problems with extraneous information when the problems are constructed with pictures and an indefinite quantifier rather than when the problems are constructed with pictures and numbers.28

Frankel and Tymchuk studied mathematical abilities of retarded children in an experiment on digit recall and noted that educable mentally retarded children had poorer accuracy of recall for strings of digits and that they cannot hold a number in their mind and then work on other numbers at the same time.29


Goodstein studied educable mentally retarded children in intermediate classes in Ohio and found that the absence of positive or negative cue words greatly influenced the subject's performance on the word problem solving tasks.  

Stephens and McLaughlin studied the reasoning ability and amount of gain over a two year period in retarded and nonretarded children. They found that 1) development which promotes acquisition of formal though processes appears to continue beyond the eighteenth year in persons of average intelligence, 2) development proceeds in retarded persons, sixteen to twenty, even though it is at a declerating tempo, and 3) significant differences which are not accounted for by chronological or mental age do exist between the operational thought of nonretarded and retarded persons.

In summary, the review of the pertinent literature revealed that educable mentally retarded children are more deficient in arithmetic word problem solving ability than arithmetic computation. These deficits are due to poor teaching of skills and slow development.


The reading and arithmetic grade equivalency levels on the Iowa Tests of Basic Skills for the subjects in this study were presented in Appendix B. Dunn stated that deficiencies in the educable mentally retarded child's ability to reason have been used as an explanation for his poor performance on standardized tests of number concepts and problem solving.
CHAPTER III

PRESENTATION AND ANALYSIS OF DATA

The purpose of the present study was to determine the effects teaching methods had on the development of skills needed to solve arithmetic computation problems and word problems of elementary educable mentally retarded children. The study employed a repeated measures design in which the same subjects were taught under both the experimental and control conditions.

Table 3 shows the analysis of the tests results for arithmetic computation. The mean of the group under the experimental conditions was 38 and the standard deviation was 15.09. The mean of the group under the control conditions was 35 with a standard deviation of 11.83. The mean difference between the performance under experimental and control conditions was 2.9 with a standard error of the mean difference of .771.

The t-test for correlated groups was used to determine if the differences observed under experimental conditions and under control conditions were attributable to chance. The value of t was found to be 3.76. This meant that with fourteen degrees of freedom at the .05 level of significance (P .05) and at the .01 level of significance (P .01), the null hypothesis was rejected.
## Table 3

Analysis of subjects' performance on the arithmetic computation test under the experimental and control conditions

<table>
<thead>
<tr>
<th>SUBJECTS</th>
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<th>$X_c$</th>
<th>$X_e - X_c$</th>
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<td>0</td>
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<tr>
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<td>0</td>
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<td>8</td>
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<tr>
<td>15</td>
<td>45</td>
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</tr>
</tbody>
</table>

| MEAN | 38 | 35 |
| STANDARD DEVIATION | 15.09 | 11.83 |
| MEAN DIFFERENCE | 2.9 |
| S.E. OF MEAN DIFFERENCE | .771 |
| t | 3.76 |
| p | .01 |

Table 4 shows the analysis of data for word problem solving. The mean of the group under experimental conditions was 7.7 and under control conditions was 5.1. The standard
deviation of the group under the experimental conditions was 4.24. Under the control conditions, the standard deviation was 3.87. The mean difference between the performance of the group under the experimental and control conditions was 2.6 with a standard error of the mean difference as .434.

The value of t was 5.99. For fourteen degrees of freedom, a t value of 5.99 rejects the null hypothesis at the .05 level of significance (P .01). It also rejects the null hypothesis at the .01 (P .01) and the .001 levels of significance (P .001).

TABLE 4

ANALYSIS OF SUBJECTS' PERFORMANCE ON THE WORD PROBLEM SOLVING TEST UNDER THE EXPERIMENTAL AND CONTROL CONDITIONS

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<thead>
<tr>
<th>SUBJECTS</th>
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<td>15</td>
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</table>
From the above analyses, it was concluded that there is some relationship between the teaching methods used in developing the skills needed for elementary educable mentally retarded children to solve arithmetic computation and word problems.
CHAPTER IV

DISCUSSION, SUMMARY AND RECOMMENDATIONS

Discussion

The results of this study suggested the finding that elementary educable mentally retarded children perform better on arithmetic computation problems than they do on word problem problems. This difference can be attributed to methods used in teaching problem solving ability.

Few teachers actually teach a child how to solve a problem. It is difficult to teach quantitative reasoning ability. Arithmetic computation is usually learned by rote memorization. Research by Cawley et al on the effects of concrete materials and problem solving ability in educable mentally retarded children have shown that educable mentally retarded children perform better when they have concrete items with which to work. In the math learning center, numerous articles were available for the subjects to use to solve word problems on the activity cards during the study. The investigator found that both individualized instruction and small group instruction were beneficial to most subjects.

The following steps were beneficial to the investigator
during the experimental period of this study. These steps were to:

1. have a goal which the child understood
2. divide tasks into units so that the child was able to reach his goal
3. devise practice that fitted into the above units, then give the child continued use of the materials
4. measure the child's progress frequently
5. changed practice in light of what the measuring program showed
6. arrange the lessons so that the child had some success every day.

The investigator observed that during the experimental period, the subjects were eagered to learn how to solve word problems. Even those subjects who normally had a short attention span, were attentive. The materials in the learning center were well utilized. The subjects performed well on the weekly assessment exercises.

During the testing period following the first eight weeks, several of the subjects became a little frustrated when working on the word problems on the test. The investigator moved about the room and tried to encourage those students to sound out each word and carefully look for the key words that had been studied in class. On Part I, the investigator observed that only a few subjects counted on their fingers and placed hash marks on their papers as com-
pared to the number of subjects that did this before the experimental period. In analyzing the scores on this test, it was noted that some careless errors were made in computation on Part I.

During the control period, the subjects seemed to work more arithmetic computational problems than on word problems in the learning center. The investigator emphasized the importance of working on both types of tasks.

Following the control period, each subject was administered the test that was used at the end of the experimental period. The investigator observed that the subjects, for the most part, appeared more uneasy and frustrated. The subjects did not appear to be reading the word problems. Some of the subjects just copied the numbers in the problem and added or subtracted without applying any thought or reasoning to what should be done. Even though the subjects had shown that they had mastered the words on the given sight lists during the experimental period, they did not seem to know them when they took the test. Only a few subjects were observed counting on their fingers and making hash marks. This observation indicated that they had learned the basic facts involved in the test.

Ar. R. Jenson in his study on Level I and Level II abilities and educable mentally retarded children, implied that educable mentally retarded children should not be
taught Level II abilities, just level I abilities. Level I abilities are associative abilities which do not require cognitive abilities which involve transformation of the information input. If Level II abilities can be developed in some educable mentally retarded children, teachers should assist them in developing these abilities.

Summary

The National Assessment of Educational Progress Report for March 1977 indicated that normal nine and thirteen year olds had difficulty solving word problems. It also stated that these children perform better on addition problems than on subtraction problems. Since educable mentally retarded children are only expected to perform at one-half to three-fourths that of average children, it seemed that the scores of the subjects in this study were at an expected level. However, the subjects did not measure up to their mental ages.

In reviewing the literature on reading and arithmetic characteristics of the educable mentally retarded, Goodstein, Cawley and Kirk indicated that the educable mentally retarded child's computation skills are more developed than his reasoning and quantitative thinking ability. Research and the results of this study have shown that one of the contributing factors was that teachers do not teach educable mentally retarded children how to process information to use it. The
curriculum is concerned with the development of arithmetic computation skills which are usually developed in educable mentally retarded children by rote memorization.

When an educable mentally retarded child can count and work computational problems to include the facts of five, word problems should be introduced on a small scale with just two numbers to compute.

Although a review of the literature indicated that there is a high correlation between reading and verbal problem solving, it has not been indicated what kinds of reading behaviors are necessary for a child to successfully solve a problem.

Different learning styles of children should be matched with different types of programs. The most effective program is one in which there is a matching compatibility of methods and materials to the learning style of the learner. Hence, for the educable mentally retarded child, learning would appear to proceed best from concrete, direct experience and materials. The creativity proficiency of the teacher plays an important role. The teacher should design methods to involve the child in some type of psychomotor-direct learning activity to facilitate the learning process. After each child has been assessed and individual programs prescribed, this can be done with ease.

In a study at the University of Connecticut on teacher preparation, it was concluded that since most of the train-
ing programs required a mathematics course and a general methods course which included the teaching of mathematics to educable mentally retarded children, additional coursework should be completed in the form of workshops, inservice practicums, microteaching and guided independent studies.

Hence, it is indicated that to implement a program for the educable mentally retarded child incorporating methods for teaching arithmetic computation skills and problem solving skills, the teacher must be prepared educationally to teach the program.

Implications and Recommendations

This study points toward the benefits that the classroom and resource teachers should utilize. Novel teaching materials and fresh approaches to teaching reading and arithmetic to educable mentally retarded children should be employed because traditional approaches have caused fear of failure. A variety of materials should be available. Some children are visual learners, while others are auditory learners.

Problem solving ability must be understood as a concept before the educable mentally retarded child can master the steps of problem solving.

Stephens and MaLaughlin's study on reasoning ability concluded that the absence of some cue words such as 'left' and 'remain' influenced the subject not to subtract when solving a word problem. Educable mentally retarded children
have to reach the level of reasoning where the absence of one cue word does not influence their decision.

It is therefore recommended that the arithmetic curriculum at the elementary school education level be revised to include a balance of conceptual mathematical learnings as well as rote arithmetical learnings.

A minimum skills checklist in arithmetic including word problem solving may be beneficial.

Workshops and inservice training should be available to every teacher so that he can better prepare himself to teach the educable mentally retarded child. A teacher should remember that understanding comes before drill and that good habits of work and attention must be established.

Finally, the results of this study implied that more research is needed in the area of problem solving ability for the elementary educable mentally retarded child.
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<th>IQ</th>
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### APPENDIX B

**IOWA TESTS OF BASIC SKILLS**  
**READING AND MATHEMATICS GRADE EQUIVALENCY LEVELS**

<table>
<thead>
<tr>
<th>SUBJECTS</th>
<th>READING G.E.</th>
<th>MATH COMPUTATION G.E.</th>
<th>MATH PROBLEMS G.E.</th>
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APPENDIX C

PART I
ARITHMETIC COMPUTATION PROBLEMS

DIRECTIONS: Look at each problem carefully and find the answer according to the sign given.

\[
\begin{array}{cccccccccc}
3 & 10 & 4 & 6 & 2 & 0 & 3 & 1 & 8 & 7 \\
+9 & +5 & +5 & +6 & +0 & +9 & +6 & +9 & +9 & +4 \\
\end{array}
\]

\[
\begin{array}{cccccccccccc}
7 & 8 & 0 & 5 & 2 & 6 & 5 & 7 & 10 & 2 \\
+7 & +3 & +0 & +3 & +8 & +9 & +5 & +6 & +2 & +9 \\
\end{array}
\]

\[
\begin{array}{cccccccccccc}
10 & 8 & 9 & 7 & 6 & 5 & 0 & 10 & 7 & 10 \\
-8 & -4 & -3 & -6 & -4 & -0 & -0 & -8 & -1 & -3 \\
\end{array}
\]

\[
\begin{array}{cccccccccccc}
6 & 9 & 7 & 3 & 2 & 6 & 10 & 1 & 5 & 9 \\
-0 & -9 & -5 & -2 & -0 & -3 & -9 & -0 & -2 & -4 \\
\end{array}
\]

\[
\begin{array}{cccccccccccc}
3 & 4 & 2 & 7 & 8 & 9 & 6 & 4 & 7 & 4 \\
x4 & x6 & x0 & x2 & x2 & x1 & x6 & x2 & x3 & x4 \\
\end{array}
\]

\[
\begin{array}{cccccccccccc}
0 & 10 & 6 & 2 & 5 & 5 & 7 & 8 & 5 & 7 \\
x0 & x1 & x3 & x3 & x4 & x2 & x4 & x3 & x3 & x6 \\
\end{array}
\]
PART II
WORD PROBLEMS

DIRECTIONS: Read each problem carefully. Decide which process should be used by looking at the key word or words in the question at the end of the problem.

1. Leslie's mother baked 8 pans of cookies on Monday. She baked 6 pans of cookies on Thursday. How many pans of cookies did Leslie's mother bake in all?

2. Joseph had 4 pencils, but he gave 2 pencils to Patrick. Now, how many pencils does Joseph have left?

3. Donna drank 2 cartons of milk for breakfast, 1 carton of milk for lunch and 3 cartons of milk for dinner. How many cartons of milk did Donna drink?

4. Sam walked 4 blocks to the store to buy some candy. He walked 4 blocks back home. How many blocks did Sam walk in all?

5. Carol got 10 words correct on her spelling paper last Friday. On Wednesday, she only got 6 words correct. How many more words did Carol get correct on Friday than she did on Wednesday?

6. Steve brought 9 sheets of paper to class today. He used 3 sheets to do his lesson and gave them to the teacher. How many sheets of paper does he have now?

7. Pat was sick last week. He stayed home for 3 days. This week he has been at home for 4 days. How many days has Pat been out of school?

8. Anita went to sleep at 4 o'clock yesterday. She woke up at 7 o'clock. How long was she asleep?

9. The teacher assigned 10 new spelling words on Monday. On Tuesday, she assigned 5 and on Wednesday, 3 more. Now, how many spelling words did the teacher assign?

10. In Mrs. Brown's class of 10 children, 5 were absent today. What is the total number of children present?

11. Charles had 6 erasers, but someone stole 4 of his erasers when he went to the bathroom. Now, how many erasers are left?
12. The candy lady sold 10 lollipops, 4 boxes of Now and Later, and 6 pieces of bubble gum to James this morning. How many pieces of candy and gum did James buy?

13. Teddy went over to this lady's house for 3 days last month. This month he has been over there for 2 days. How many days did Teddy spend at the lady's house?

14. Otis has a fish tank. His mother bought him 3 fish on Tuesday. On Friday, his auntie gave him 7 fish from her tank. Saturday, Otis bought 4 fish. Now, how many fish does Otis have?

15. Chris plays basketball. He won 7 games today. His brother only won 2 games. How many more games did Chris win?
BIBLIOGRAPHY

Books


Journals


