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A study of the effectiveness of a direct instruction program in mathematics

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A STUDY OF THE EFFECTIVENESS OF A DIRECT INSTRUCTION PROGRAM IN MATHEMATICS

by
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A Thesis

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Master of Arts Degree
Of
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Approved by______________________________
Dr. Stanley Urban

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ABSTRACT

Jennifer A. Laurrell-Klotz

A STUDY OF THE EFFECTIVENESS OF A DIRECT INSTRUCTIONA

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1999

Thesis Advisor: Dr. Stanley Urban

Master of Arts in Learning Disabilities

The purpose of this project was to determine if participation in a year long mathematics direct instructional program would accelerate the rate of mathematical achievement in a group of learning disabled children. The subjects of this study were comprised of five, eleven-year-old fifth grade students who were classified as Learning Disabled. Outcome measures utilized included teacher assigned report card grades, a basic skills test, a two-step word problem assessment and the Key Math Diagnostic Arithmetic Test-Revised as a functional measure.

The results of this study indicate that, when utilizing formal and functional measures, students make greater progress acquiring facts and problem solving skills in a direct instruction program as implemented in *Connecting Math Concepts* than in a traditional basal mathematics curriculum.

MINI-ABSTRACT

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A STUDY OF THE EFFECTIVENESS OF A DIRECT INSTRUCTION PROGRAM IN MATHEMATICS

1999

Thesis Advisor: Dr. Stanley Urban

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The purpose of this project was to determine if participation in a year long mathematics direct instructional program would prove beneficial to students acquiring mathematical achievement. Teacher assigned report card grades, a basic skills test, a two-step word problem assessment and a functional measure indicated that the direct instructional program was beneficial in acquiring computation facts and problem solving skills in mathematics.

ACKNOWLEDGEMENTS

To my husband, Frank, for his support, reassurance and love during my graduate studies.

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Chapter One

Introduction

Need

The issue of poor math performance of students in the United States has been the focus of considerable research over the past four decades (Parmer & Cawley, 1994). Teaching mathematics for problem solving, communication, and successful everyday living skills has been recommended by the National Council of Teachers of Mathematics (NCTM) (Cawley & Parmar, 1990). However ensuring that students acquire these skills may be a difficult task because of the structure of the textbooks that represent the mathematics curriculum known as the spiral curriculum. (Engelmann, Carnine & Steeley, 1991). It is the intent of this researcher to show that a traditional basal mathematics curriculum that utilizes the spiral curriculum will cover topics such as arithmetic operations, story problems, measurement, fractions, decimals and interpreting data in a superficial manner. The goal of this research is to examine a Direct Instruction program, such as *Connecting Math Concepts (SRA)* to determine if the program will sufficiently meet the needs of diverse learners and attain the goals and strategies set forth by the NCTM. These goals are identified in Engelmann, Carnine & Steeley, 1991 as:

1. Methods and tasks for assessing students should be aligned with the curriculum, a factor that also suggests that the curriculum will ultimately be aligned with the developmental characteristics of the child.
2. The broad content of mathematics should be organized by age rather than grade level.
3. An overall tone that concepts and problem solving should be stressed over routines and drill practice.
4. Mathematics concepts and procedures should be presented in a variety of contexts and formats.

Purpose

The purpose of this study is to determine if a group of eleven year old learning disabled students make greater progress acquiring mathematical skills in Direct Instruction as implemented in *Connecting Math Concepts* (CMC) than a traditional basal mathematics curriculum.

Research Question

To accomplish the general purposes of this study, the data obtained is used to answer the following general research question:

Do learning disabled students make greater progress acquiring basic facts and problem solving in direct instruction as implemented in *Connecting Math Concepts* than in a traditional basal mathematics curriculum?

The following specific questions will be answered:

Question 1: Will learning disabled children who participate in a year long direct instruction program utilizing the *Connecting Math Concepts* materials demonstrate increased rates of mathematical acceleration in their addition, subtraction, multiplication and division facts and problem-solving skills?

Question 2: Will learning disabled children who participate in a year long direct instruction program utilizing the *Connecting Math Concepts* materials demonstrate increased rates of learning in their problem solving skills compared to rates of learning previous to the introduction of the Direct Instruction program?

Value of the Study

Teaching Learning Disabled children mathematical skills represents a formable challenge. This study investigated the effectiveness of the *Connecting Math Concepts* program as an effective way to help learning disabled students tackle problems successfully. Hopefully, this program will assist them to understand mathematical relationships and develop self-confidence in their mathematical ability.

Definition of Terms

Connecting Math Concepts-a commercially available mathematics program that features:

a. flexible instructional grouping **b.** explicit explanations of mathematical concepts **c.** problem solving activities reinforced with manipulatives and application activities (Tarver & Jung, 1995).

Learning Disabled-corresponds to "perceptually impaired" and means a disorder in one or more of the basic psychological processes involved in understanding or using language, spoken or written, that may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations. It is characterized by a severe discrepancy between the student's current achievement and intellectual ability in one or more of the following areas: 1. Basic reading skills 2. Reading comprehension 3. Oral expression 4. Listening comprehension 5. Mathematical computation 6. Mathematical reasoning and 7. Written expression (NJSAC 6A:14-3.5)

Quality-Sameness Analysis-all mathematical generalizations are based on perceived sameness of quality (Engelmann, Carnine & Steely, 1991)

Spiral Curriculum- unmastered mathematical content is revisited year after year (Engelmann, Carnine & Steely, 1991)

Chapter Two

Review of the Literature

The National Council of Teachers of Mathematics introduced five goals required to help students prepare mathematically to live and work in the 21st century (Steen, 1989). These goals are identified in Engelmann, Carnine & Steely, 1991 as:

1. To value mathematics.
2. To reason mathematically.
3. To communicate mathematics.
4. To solve problems.
5. To develop confidence.

Students with mild disabilities:

- experience difficulty in basic skills, such as, counting, writing numerals and learning basic associations (Peters, Lloyd, Hasselbring, Goin, Bransford & Stein 1987).
- lack knowledge of how to attack a mathematical word problem (Fleischner, Nuzum & Marzola, 1987).
- show rates of progress approximately 1 year of grade equivalent growth for every 2 years they spend in school (Cawley, Kroczynski & Urban, 1992).
- tend to fall farther behind the longer they are in school (Parmer & Cawley, 1995).

In a study by Engelmann, Carnine and Steely (1991), they identified four weaknesses that negatively affect a student's performance in mathematics:

1. Math instruction is saturated with learning basic computational skills instead of problem solving and concept understanding.
2. Most of the topics covered received very little instructional time.
3. There is disagreement among teachers regarding how much time is actually spent teaching mathematics on a daily basis.
4. The spiral curriculum hinders mathematical performance. A given topic is repeated year after year with superficial, rapid coverage.

The spiral curriculum used in the United States is believed to be a significant cause of poor performance among learning disabled students (Engelmann, Carnine & Steely, 1991). The conventional mathematics curriculum needs to change in order for students to meet the challenges and goals of the 21^{st} century.

A review of literature conducted by Engelmann, Carnine & Steely (1991) identified six deficiencies in conventional mathematics textbooks used in school systems throughout the United States.

1. Many students do not have the relevant prior knowledge. It is assumed that a particular topic or key concept has been taught or learned from one grade level to the next.
2. The introduction of new concepts is too expedient.
3. Explanation and presentation of strategies often lacks coherence.
4. Instructional activities are not communicated in a clear, concise manner.
5. There is an inadequate amount of time between guided practice and working independently.
6. Reviewing previously taught materials is very sparse often occurring every one and a half months.

In a spiral curriculum, mathematical content is divided into units covering various topics. Typically the students will practice the skills necessary for a particular unit. Usually these skills are not reviewed again until the following year, when the corresponding unit is revisited. The amount of time spent practicing mathematics in the spiral curriculum is not sufficient for a learning disabled student to achieve mastery (Cawley & Parmer, 1990). If the spiral curriculum is not adequate to teach children to master mathematical goals then alternative approaches to the teaching, instruction, curriculum and design of mathematical textbooks needs to be investigated.

Direct Instructional Model

The Direct Instructional model is an alternative to conventional mathematical curriculum. The Direct Instruction philosophy is quite simple: "All students can learn if both the instructional material and the teacher's presentation are clear and unambiguous" (Stein, 1987). In a review of literature conducted by Engelmann, Becker, Carnine & Gersten (1988), they noted three assumptions underlying the Direct Instruction Model. These three assumptions are as follows:

1. All students regardless of socio-economic factors and/or classification can be taught.
2. The learning of basic skills and their applications to higher order thinking skills is important to a mathematical educational program.
3. Disadvantaged children must be taught at a rapid rate if they are to catch-up to their grade-level peers.

The Direct Instruction Follow Through Model was first implemented in 1968 (Engelmann, Becker, Carnine & Gersten, 1988). Daily lessons were sequenced in reading, arithmetic and language in 12 school districts. Eight more districts were added to the original pilot program in 1970. San Diego, California was added in 1980. Siegfried Engelmann and his associates designed the program. The programs are published by SRA under the trade name *DISTAR*. Two rules are the basis for this model (Engelmann, Becker, Carnine & Gersten, 1988). The rules are as follows:

1. Teach more in less time.
2. Control the details of what happens.

Components of a Direct Instructional Model

The components of this model include carefully-designed curriculum, increased teaching time, efficient teaching techniques, implementation of procedure and increased teacher expectations (Engelmann, Becker, Carnine & Gersten, 1988). Each of these components is discussed sequentially:

1. Curriculum- According to Engelmann, Becker, Carnine and Gersten (1988) the Direct Instructional Model curriculum in arithmetic includes:

- learning basic addition, subtraction, multiplication and division facts.
- learning a wide range of measurement concepts pertaining to time, money, length and weight.
- learning to derive unknown facts from known facts.
- solving complex story problems.

The Direct instructional Model to teaching mathematics uses the quality-sameness analysis designed by Engelmann. The quality-sameness analysis assumes that all "generalizations are based on the perceived sameness of quality" (Engelmann, Carnine & Steely, 1991). In a study conducted by Kelly, Carnine, Gersten and Grossen (1986) students received instruction based on the sameness quality. They were taught exactly how to interpret the numerator and the denominator of fractions. They worked with fractions that were greater and less than one. Seventy-five percent of students who received conventional basal mathematics instruction made mistakes representing a fraction of a shaded area. In contrast, only 8% of students made errors that received direct instruction.

2. Increased teaching time- Several principles are embedded in the Direct Instruction Model including an increase in time spent on teaching. A teacher's school day needs to be efficiently organized in order to produce desired outcomes. Adequate time needs to be scheduled for academic instruction. The Direct-Instructional Model emphasizes at least thirty minutes of small group direct instruction per subject area per day (Engelmann, Becker, Carnine & Gersten, 1988).

3. Efficient teaching- Another important principle is the efficient use of teaching time. A number of methods are utilized for increasing teaching efficiency in the Direct Instructional Model. These include scripted lessons, small-group instruction, positive reinforcement and corrections (Brent & DiObilda, 1993). The scripted lessons indicate exactly what the teacher will say during small group instruction. The script also gives the teacher directions on how to implement the lesson, examples and sequences of subskills. The Direct Instruction Model also uses positive reinforcement to help children succeed academically. Games, positive praise, increased self-esteem,

knowledge of results and point systems are utilized to optimize a student's performance. This program is also designed to prevent frequent, reoccurring mistakes. When a mistake occurs in direct instruction, students are encouraged to review the process to determine the correct answer.

4. Implementation-Staff development is an important component to properly implement the Direct Instructional Program (Wellington, 1994). This is usually accomplished through initial training programs and continuing inservice workshops.

5. Teacher Expectations- Teachers initially disliked the scripts and prescribed teaching techniques found in the direct instructional program (Engelmann, Becker, Carnine & Gersten, 1988). After six months, the teacher's attitudes changed because the students were reading at a level that the teachers thought was unattainable. Therefore, a high expectation is a key component to improve academic achievement in the Direct Instructional Model.

Studies Showing the Effectiveness of Direct Instruction

Tarver and Jung (1995), completed a study that compared a discovery learning program known as *Math Their Way* to a Direct Instructional mathematics program, *Connecting Math Concepts.* Data was gathered to determine the effects on achievement and attitudes towards mathematics with first graders exposed to these curriculums. Both programs emphasize real-world situations in very contrasting ways. In *Math Their Way*, instruction is based almost entirely on manipulatives. In *Connecting Math Concepts*, manipulatives supplement the teacher-directed instruction. In this study, they determined that students achieved significantly higher in mathematics when receiving Direct Instruction. They also found that students receiving Direct Instruction developed a more positive attitude towards mathematics. It was also determined that all students benefited from the *Connecting Math Curriculum*. In this study, they concluded that a Direct Instructional Model such as *Connecting Math Concepts* is a possible alternative for achieving the goals recommended by the National Council of Teachers of Mathematics.

Another study completed by Wellington (1994) evaluated the Direct Instructional mathematics program known as *Connecting Math Concepts*. A committee was chosen to study educational programs that would enhance learning in the Upper Darby School District in Pennsylvania. The initial program was implemented in first and fourth grades. This study concluded that the Direct Instructional curriculum resulted in equivalent mathematics performance for first grade students and superior performance for fourth grade students. No particular reason was found as to why the students were more successful in fourth grade. One explanation given in this study could be the complexity level of the material. In first grade the scope of concepts is much narrower. The *Connecting Math Concepts* program was expanded to districtwide adoption in grades 1-8 in the following year. The mean proportion of students performing above district-set criterion on district-developed tests increased 62% to 90%.

In a study completed by Brent and DiObilda (1993), Camden, New Jersey received a Follow Through grant to implement Direct Instruction in one elementary school. The Camden School District felt that the standardized test scores of its elementary pupils was too low.

They wanted to align the curriculum with the skills measured on the Comprehensive Test of Basic Skills (CTBS)-Form U, Level D. All elementary schools used an aligned curriculum except for one. They found positive effects attributable to the Direct-Instructional program. After a year, the Direct-Instruction group scored significantly higher in mathematics achievement compared to the conventional basal mathematics group on the CTBS.

Another study completed by Vreeland, Vail, Bradley, Buetow, Cipriano, Green, Henshaw and Galesburg (1994) examined implementing *Connecting Math Concepts* in third and fifth grade classrooms. Overall the *Connecting Math Concepts* students in both third and fifth grade performed better than students receiving a conventional mathematics curriculum (Addison-Wesley, 1985). They also outperformed students on the Iowa Test of Basic Skills, The Kaufman Test of Educational Achievement and a teacher-made problem-solving test. As a result of the study, the district implemented the *Connecting Math Concepts* program.

Summary

The Direct Instruction mathematics curriculum is sequenced so that new learning builds on earlier learning in a developing hierarchy of complex mathematical problem solving. In the Direct Instructional approach the teacher emphasizes applying knowledge to solve problems, groups children by skill-level and views learning as hierarchical (Grossen and Ewing, 1994). To prepare students for a future dominated by computers and technology, The National Council of Teachers of Mathematics in 1989 identified five goals for students to meet to compete in the 21st century.

Mathematics curriculum, teaching and testing must change in order to improve mathematics education in the United States. The majority of research cited the spiral curriculum used in the United States as causing extremely poor performance in mathematical achievement. The intent of the spiral curriculum is to cover many topics superficially in a small amount of time. Learning disabled students spend most of their time memorizing basic facts and computations. As a result, mathematical connectedness is rarely achieved. A majority of learning disabled children graduate from high school and enter the workforce with only a fifth to sixth grade achievement level in mathematics (Cawley, Kroczynski & Urban, 1992).

Connecting Math Concepts is an alternative to the traditional mathematical basal curriculums used in most school districts. *Connecting Math Concepts* is a six-level basal math program based on the Direct Instructional philosophy. Each level contains 120 lessons and takes approximately one school year to complete. In *Connecting Math Concepts* skills are organized into tracks. A track is an ongoing development of a mathematical concept. In each lesson, three to five tracks are presented. From lesson to lesson, students practice new skills in small steps. This will ultimately help a student achieve mastery of a concept without becoming overwhelmed with new information.

Many studies noted the positive effects of this program. Direct Instruction enables students to reach the NCTM goals and is more likely to meet the needs of a heterogeneous group of students than a traditional mathematical program. Finally, Direct Instruction was found to benefit all students, not just low-achieving individuals.

Chapter 3

Methodology and Procedure

Sample

A convenience sample was used with this study and consisted of five, eleven year old fifth grade students at Walter Hill Elementary School in Swedesboro, New Jersey who were classified as learning disabled. The sample consisted of three females and two males. The total school population is 531 students of which one hundred pupils receive special education and/or related services. The total fifth grade population within the elementary school is 82 students. Each student receives mathematics instruction in a pullout resource center at the fourth grade achievement level.

Instrumentation

The first method used to report data involved administering the Key Math Diagnostic Arithmetic Test-Revised (KeyMath) This norm-referenced instrument is an individually administered diagnostic test that converts raw scores to a grade equivalent. It can also be used as a criterion-referenced instrument because each item is keyed to a specific objective. The KeyMath can be described as follows:

> The KeyMath-R contains thirteen subtests distributed in three areas of basic concepts, operations and applications. A basic concept refers to the basic mathematical knowledge and concepts necessary to perform operations and applications. Operations subtests focus on the four operations of addition, subtraction, multiplication and division, as well as mental computation, which includes all four operations. The applications subtests evaluate the student's ability to use basic concepts and operations to solve problems dealing with time, money and measurement.
>
> Three methods were used to assess the reliability of the KeyMath. The alternate-form reliability for the total test was about .90 indicating that the two forms of the total test were similar. Alternate-form reliability for the three test areas ranged from .80 to .88. Split-half reliability is reported by grade. Reliability for the total test ranged from in the mid to high .90's and in the .70's and .80's for the three areas.
>
> Concurrent validity was demonstrated by correlating the KeyMath-R with the math subtest of the Iowa Test of Basic Skills and the Comprehensive Test of Basic Skills (CTBS). Correlations with the CTBS ranged from the .30's to .50's and from the .40's to the .50's with the Iowa tests (Luftig, 1989).

The second method used to collect data involved administering an informal basic arithmetic skill and problem-solving instrument.

Finally examining report card grades in mathematics during the fourth and fifth grade. In the fourth grade a conventional textbook was utilized compared to the direct instructional curriculum of fifth grade. The grades on the report card reflected the letters "A", "B", "C", "D", and "F".

Treatment

Connecting Math Concepts is a mathematics curriculum for grades 1 through 6. An overview of the program is as follows:

> In *Connecting Math Concepts* a concept that is introduced is developed, extended and systematically reviewed. The teachers are given sequenced lessons to follow. All of the skills are organized into tracks, which is an ongoing development of a particular topic. Within each lesson, a student will work on three to five tracks. An entire lesson usually takes 45-50 minutes. When a new skill is introduced it is developed a small step at a time. This helps the student not to be overwhelmed with new information. Students are also given the opportunity to practice mastered skills. Therefore, students learn quickly by acquiring new concepts and using the skills frequently. If a skill is introduced in one lesson, it will appear in later lessons. The new and mastered skills will be further developed into a full range of problem types. The premise of this curriculum is that skill development is continuous, review becomes automatic and reteaching becomes unnecessary as students use the skills in every lesson (Luftig, 1989).

Data Collection

On October 6, 1998 the KeyMath-R and the informal basic arithmetic skills and problem-solving instrument were administered to the five subjects. The treatment using the *Connecting Math Concepts* Curriculum Level D (fourth grade) was executed from October 1998 until February 1999, a posttest was administered on February 23, 1999 in order to measure growth.

Analysis of Data

This study will attempt to evaluate if a learning disabled student makes greater progress in the rate of acquiring skills as taught in *Connecting Math Concepts* than in a traditional basal mathematics curriculum. This will be accomplished by utilizing the KeyMath-R, informal tests and report card grades. Data will be reported in tabular form and rates of progress determined by ocular inspection.

Chapter 4

Results

The issue of poor math performance of students in the United States has been the focus of numerous studies over the past four decades. Studies have shown that the spiral curriculum used in the United States is believed to be a significant cause of poor performance among learning disabled students. Alternative approaches to the teaching, instruction, curriculum and design of mathematical textbooks needs to be utilized in order for children to be successful in mathematical programs.

The purpose of this study was to document the effectiveness of acquiring mathematical skills in direct instruction as implemented in *Connecting Math Concepts* than a traditional basal mathematics curriculum program in pupils identified as learning disabled. The focus of the study was the following general research question:

Will Learning Disabled students make greater progress acquiring basic facts and problem solving in a direct instruction program as implemented in *Connecting Math Concepts* than in a traditional mathematics curriculum?

Formal and informal outcome measures were utilized in order to determine the students' levels of academic achievement in mathematics. An analysis of these results provided evidence that resulted in academic achievement that is equivalent to or higher as measured by the functional assessment.

Teacher assigned report card grades was utilized as the informal measure of the pupil's achievement in mathematics; although subjective, they provide an accurate measure of the pupil's functioning in the classroom environment.

The results of the Key Math-R were utilized as the formal measure of math achievement. Results of the Key Math-R were reported as a grade equivalent. An inspection of Table 1 shows that all five students made progress in basic skills, operations and applications when instructed using a direct instruction program when compared to the traditional method of instruction. On the Basic Skills Tests as shown in Table 2 and the Two-Step Word Problem Assessment (Table 3) all five students made measurable gains during the period of this study. An additional measure of the students' programs are continued on Table 4-8.

Summary

An analysis of the formal measure and the informal measures indicate that when utilizing both measures, students make greater progress acquiring basic facts and problem solving in a direct instruction program than in a traditional mathematics curriculum.

TABLE 1

KeyMath-Revised

Results Reported in Grade Equivalency

	Basic Concepts T 10/98	Basic Concepts CMC 2/99	Operations T 10/98	Operations CMC 2/99	Applications T 10/98	Applications CMC 2/99
Student 1	4.4	4.9	3.9	4.2	4.4	4.9
Student 2	3.1	3.6	4.9	5.2	4.0	4.1
Student 3	2.2	2.9	4.5	4.5	3.0	3.5
Student 4	2.9	3.1	4.9	4.9	3.3	3.5
Student 5	1.4	1.6	1.5	2.0	2.1	2.3

T = Traditional 10/98

CMC = Connecting Math Concepts 2/99

TABLE 2

Basic Skills Test Results

	Traditional 10/98	Connecting Math Concepts 2/99	
Student 1	67%	96%	(+29%)
Student 2	85%	89%	(+4%)
Student 3	88%	96%	(+8%)
Student 4	88%	93%	(+5%)
Student 5	85%	100%	(+15%)

CMC= *Connecting Math Concepts*

TABLE 3

Two Step Word Problem Assessment

Assessment

	Traditional 10/98	Connecting Math Concepts 2/99
Student 1	80%	90% (+10%)
Student 2	70%	80% (+10%)
Student 3	70%	90% (+20%)
Student 4	50%	60% (+10%)
Student 5	50%	80% (+30%)

Table 4

Connecting Math Concepts Unit Tests

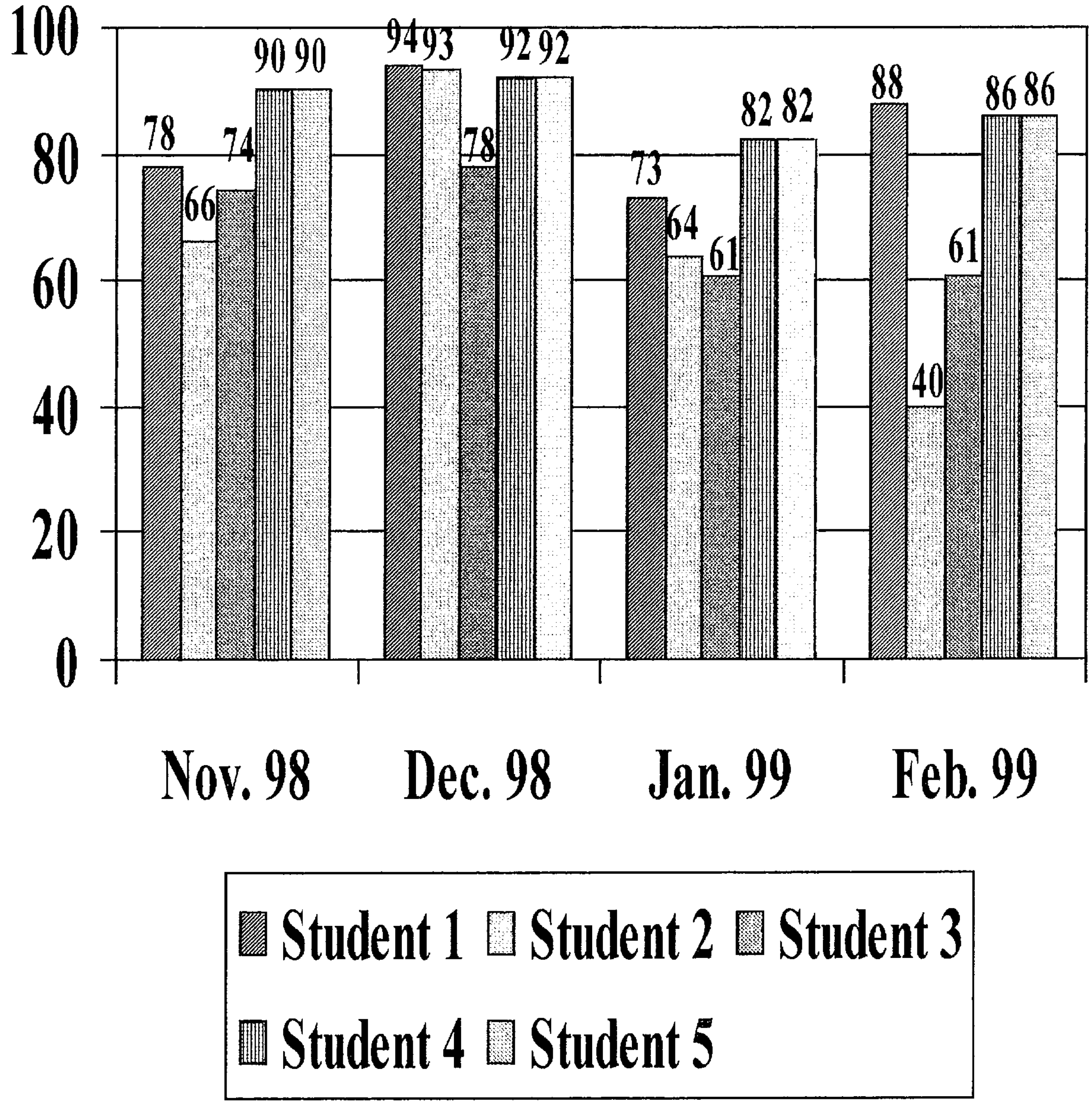


Table 5

Mathematics Academic Achievement

Student 1

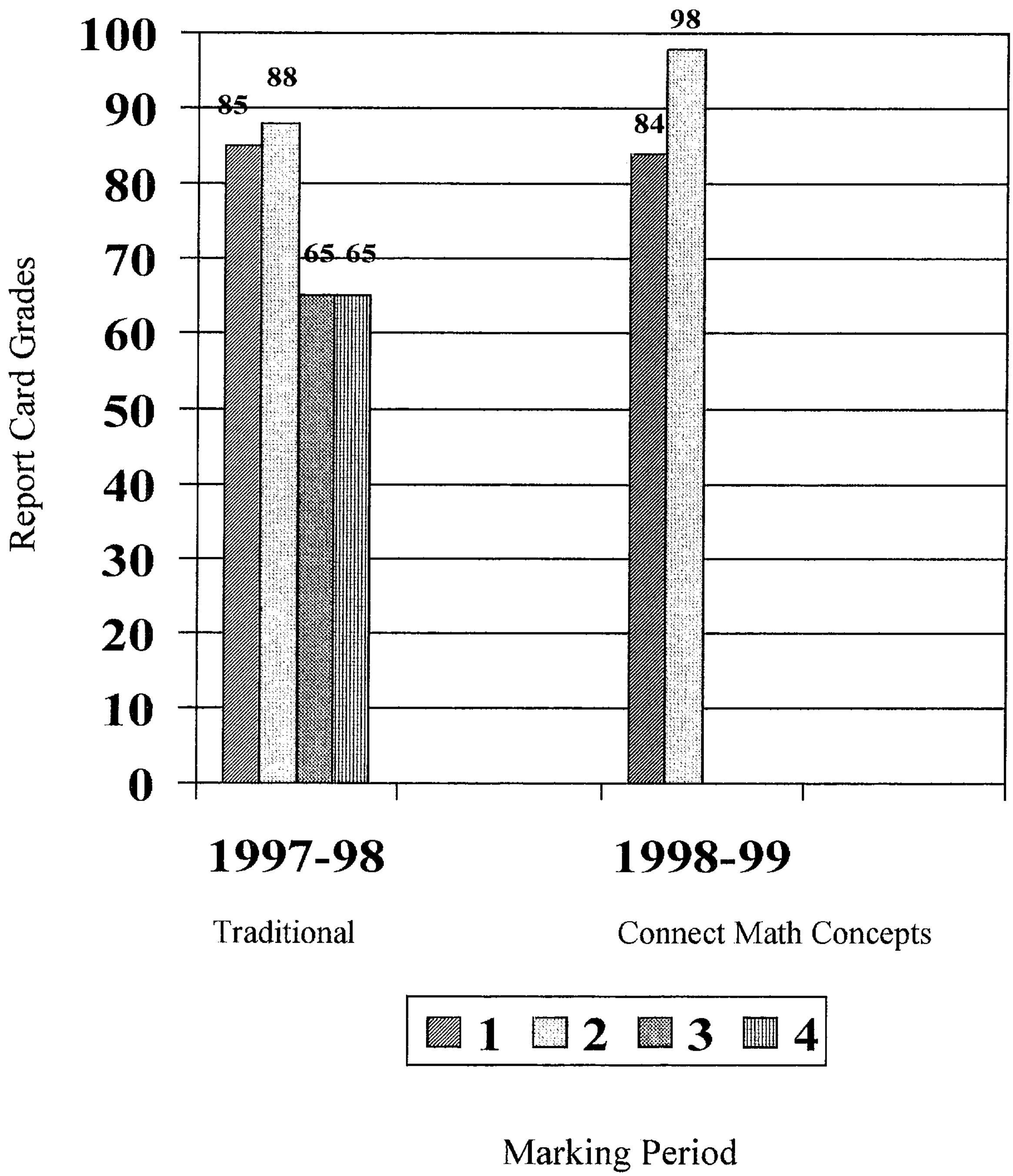


Table 6

Mathematics Academic Achievement

Student 2

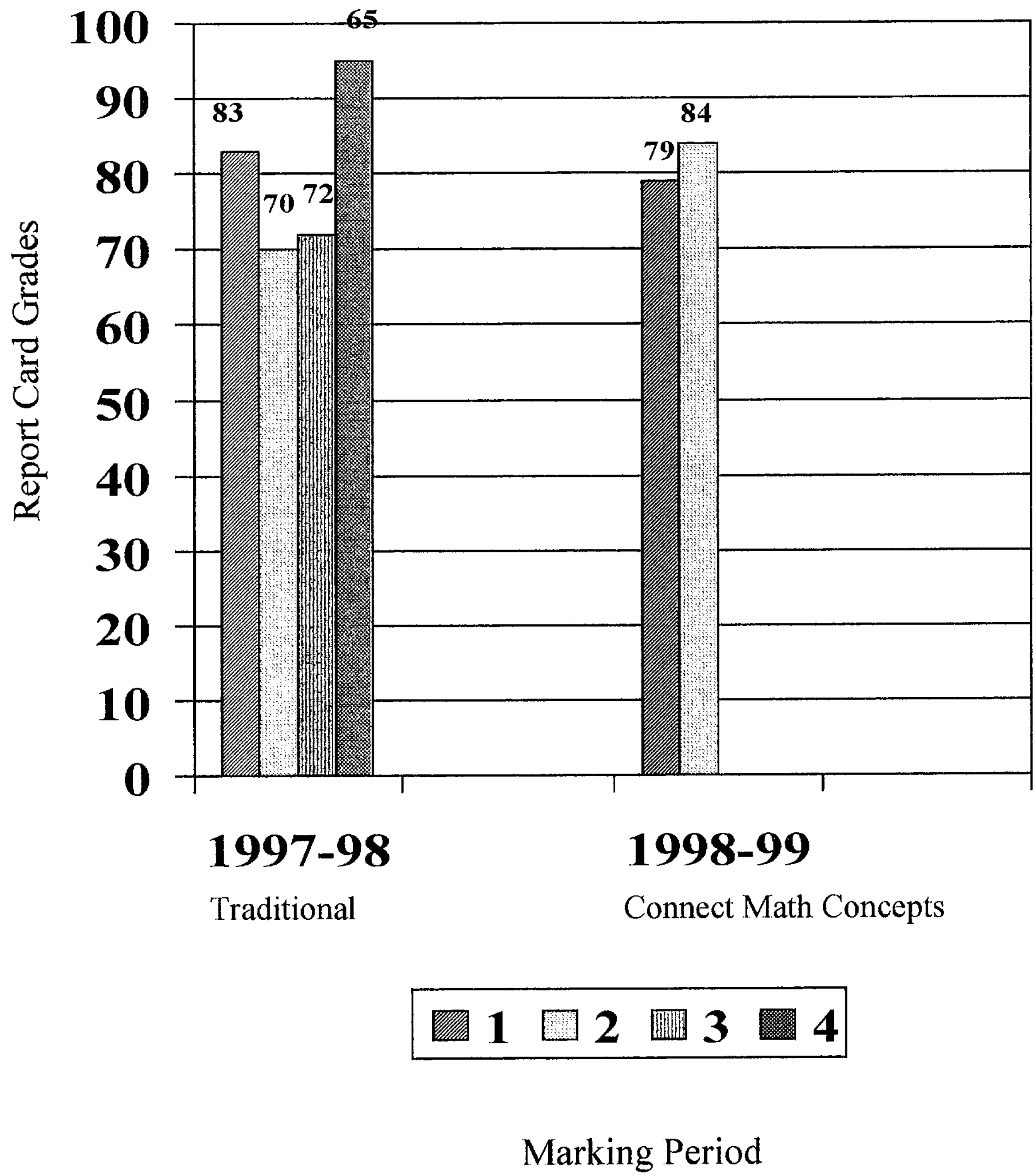


Table 7

Mathematics Academic Achievement

Student 3

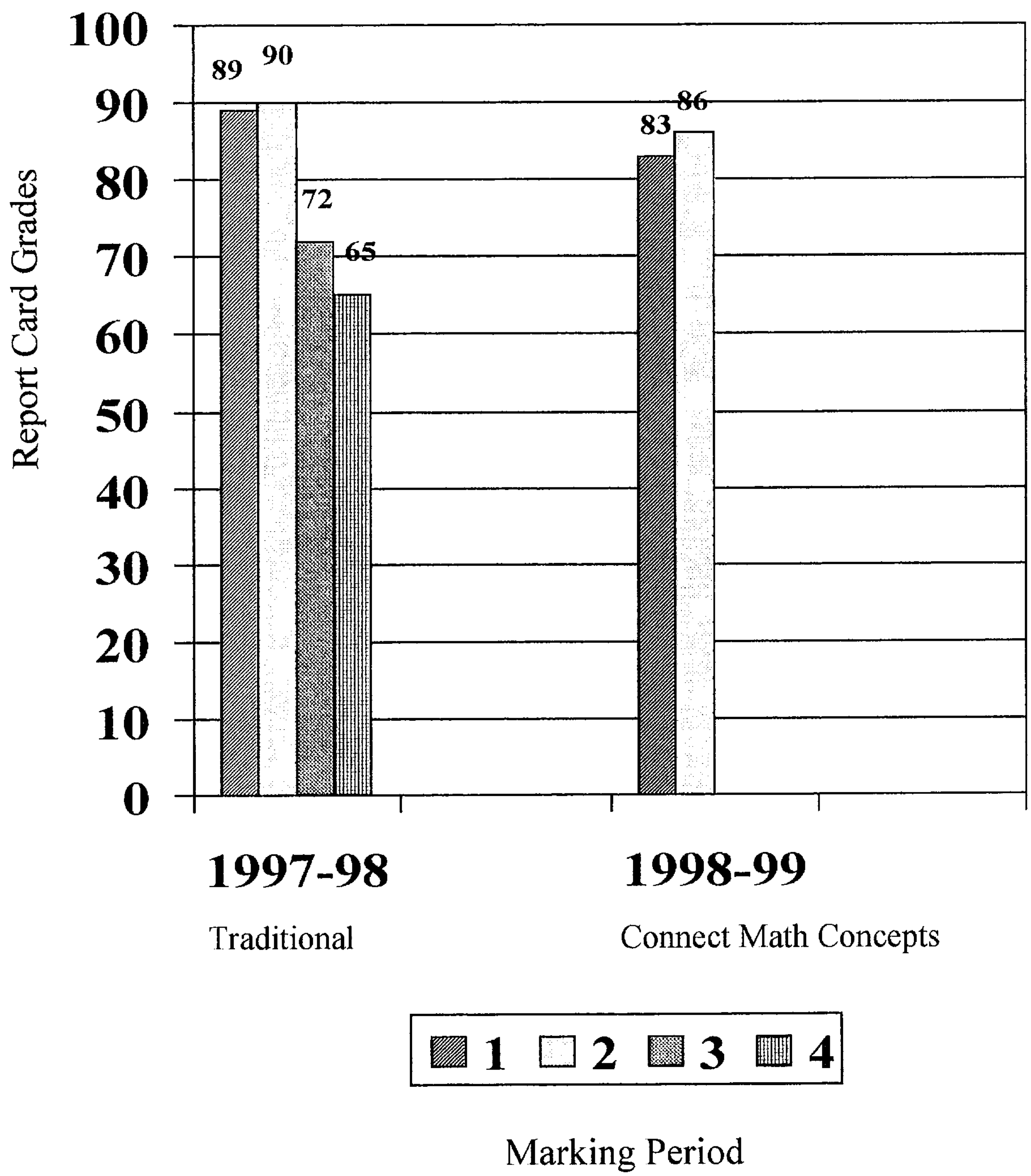


Table 8

Mathematics Academic Achievement

Student 4

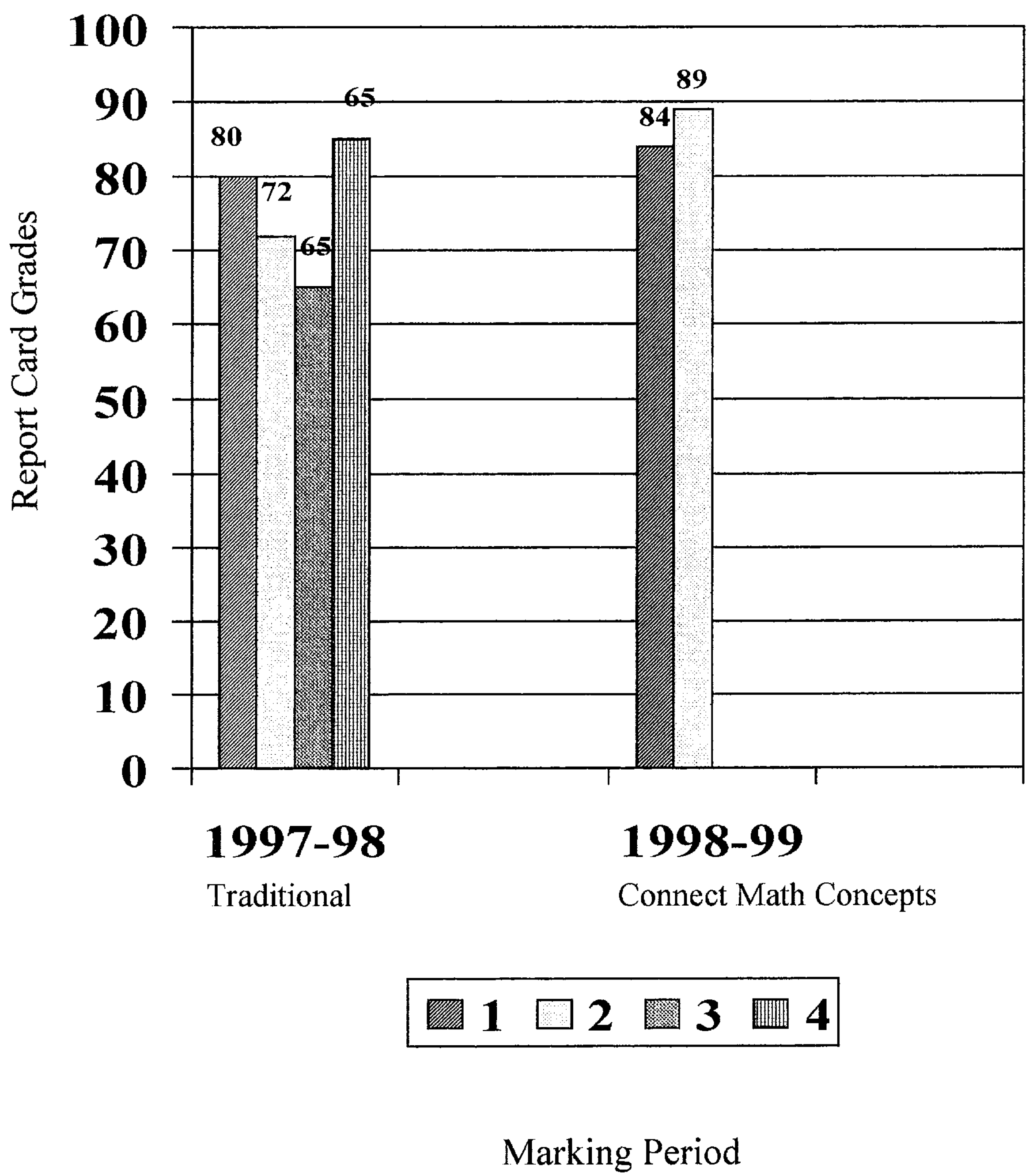
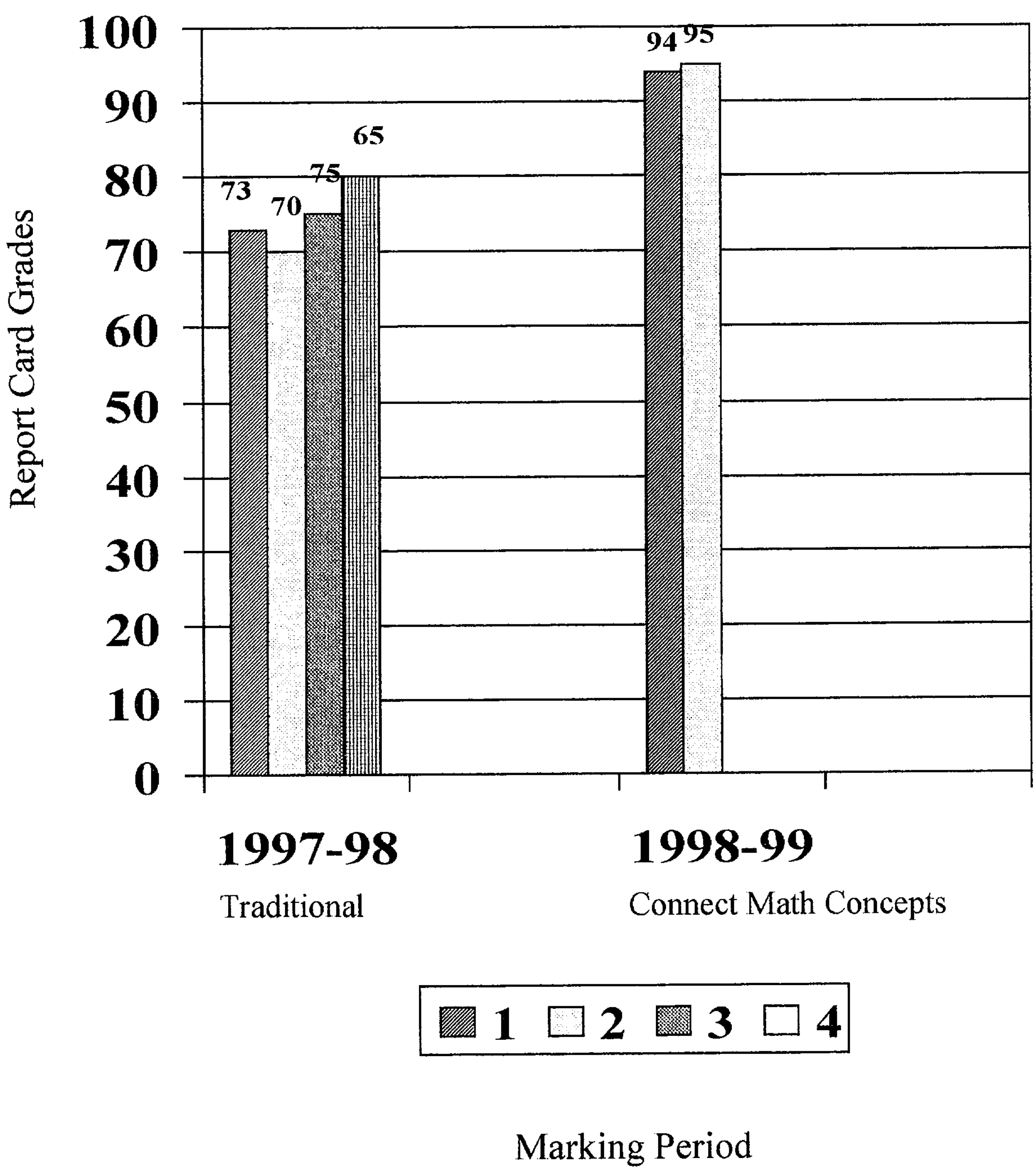


Table 9

Mathematics Academic Achievement

Student 5



Chapter 5

Summary/Conclusions

Introduction

The purpose of this study was to determine if a group of eleven year old learning disabled students would make greater progress acquiring mathematical skills in direct instruction as implemented in *Connecting Math Concepts* than a traditional basal mathematics curriculum.

The subjects for this study were five participants who were identified learning disabled. All five fifth graders receive mathematics instruction in a pullout resource center at the fourth grade achievement level. All students attend the same elementary school in a rural township in southern New Jersey.

Findings

The results of this study indicate that, when utilizing formal and functional measures, students make greater progress acquiring facts and problem-solving skills in a direct instruction program as implemented in *Connecting Math Concepts* than in a traditional basal mathematics curriculum.

Conclusions

The data generated by the formal and functional measure in this study seem to substantiate the conclusion that students make greater progress acquiring skills in direct instruction as implemented in *Connecting Math Concepts* than a traditional basal mathematics curriculum. All five students displayed growth in mathematics based upon report card grades, basic skills test, two-step word problems assessment and comparing/contrasting grade equivalency on the Key Math-R.

Recommendations for Further Research

The results of this study seem to support previous research findings that children participating in a direct instruction mathematics curriculum will show growth in acquiring mathematical skills than in a traditional basal curriculum. Based on this study, further research could include:

1. What level of achievement will students attain utilizing *Connecting Math Concepts* for more than one grade level?

2. What is the rate of success for non-classified and classified pupils in a specific grade?

3. How does the teacher's attitude towards mathematics effect achievement?

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APPENDIX A

Skills Placement Test

NAME: ____________________

1. $34 + 23$

2. $498 + 246$

3. $57 - 18$

4. $900 - 563$

5. 678×4

6. 684×597

7. $8\overline{)35}$

8. $867\overline{)45,157}$

9. Rewrite this fraction in simplest terms.

$\frac{25}{10} =$

10. Rewrite these fractions, using the lowest common denominator (LCD).

$\frac{2}{3} =$

$\frac{1}{9} =$

$\frac{5}{6} =$

11. $\frac{1}{6} + \frac{2}{5}$

12. $5\frac{6}{7} + 9\frac{3}{4}$

13. $3\frac{6}{7} - \frac{1}{2}$

14. $9\frac{1}{6} - 3\frac{3}{4} =$

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15. $\frac{6}{7} \times \frac{9}{4} =$

16. $7\frac{4}{9} \times 4\frac{2}{7} =$

17. $\frac{13}{15} \div 6 =$

18. $8\frac{3}{4} \div 3\frac{4}{5} =$

19. $\begin{array}{r} .68 \\ +.29 \\ \hline \end{array}$

20. $8.79 + 5.57 =$

21. $\begin{array}{r} 7.3 \\ -\ \ .8 \\ \hline \end{array}$

22. $\begin{array}{r} 5.43 \\ -2.87 \\ \hline \end{array}$

23. $\begin{array}{r} .96 \\ \times .7 \\ \hline \end{array}$

24. $\begin{array}{r} 3.94 \\ \times 6.58 \\ \hline \end{array}$

25. $9\overline{)25.83}$

26. $5.2\overline{)126.672}$

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1. $8 - 5$	2. $6 - 6$	3. $5 - 0$	4. $15 - 9$	5. $77 - 5$
6. $86 - 34$	7. $76 - 8$	8. $52 - 35$	9. $675 - 443$	10. $753 - 236$
11. $539 - 172$	12. $846 - 379$	13. $590 - 246$	14. $806 - 472$	15. $600 - 357$

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1. $\begin{array}{r} 4 \\ +5 \\ \hline \end{array}$	2. $\begin{array}{r} 6 \\ +7 \\ \hline \end{array}$	3. $\begin{array}{r} 1 \\ 6 \\ +1 \\ \hline \end{array}$	4. $\begin{array}{r} 74 \\ +\ \ 5 \\ \hline \end{array}$
5. $\begin{array}{r} 57 \\ +\ \ 5 \\ \hline \end{array}$	6. $\begin{array}{r} 65 \\ +22 \\ \hline \end{array}$	7. $\begin{array}{r} 37 \\ +59 \\ \hline \end{array}$	8. $\begin{array}{r} 68 \\ +74 \\ \hline \end{array}$
9. $\begin{array}{r} 28 \\ 45 \\ +14 \\ \hline \end{array}$	10. $\begin{array}{r} 35 \\ 56 \\ +64 \\ \hline \end{array}$	11. $\begin{array}{r} 637 \\ +256 \\ \hline \end{array}$	12. $\begin{array}{r} 589 \\ +345 \\ \hline \end{array}$

APPENDIX B

Two Step Word Problem Assessment

Name______________________________
Date______________________________

Two-Step Word Problems

1. Miss Harris, the zookeeper, is feeding 2 lions. Mr. Jones, the zookeeper is feeding 3 lions. Miss Walls, the naturalist is feeding one more gorilla than all the lions? How many gorillas is Miss Walls feeding?

2. Miss Harris, the zookeeper, had 4 lions, but sent 2 of them to another zoo. Mr. Jones, the zookeeper, had 3 lions but sent 1 of them to another zoo. Miss Walls, the naturalist, has two more gorillas than all the lions remaining with the zookeepers. How many gorillas does Miss Walls have?

3. Miss Harris, the zookeeper, is feeding 3 lions in one cage and 3 times as many in another cage. Mr. Jones, the zookeeper is feeding 2 tigers in one cage and 2 times as many in another cage. How many animals are the zookeepers feeding?

4. Miss Harris, the zookeeper, has 6 lions and she is going to put 2 lions in each cage. Mr. Jones, the zookeeper, has 4 tigers and he is going to put 2 tigers in each cage. How many cages do the zookeepers need for all the animals?

5. Miss Harris, the zookeeper, has 2 tigers. Mr. Jones, the zookeeper, has 3 lions. Miss Walls, the naturalist, has 1 less gorilla than all the animals had by the zookeepers. How many gorillas does Miss Walls have?

6. Miss Harris, the zookeeper was feeding 4 tigers and 1 tiger walked away. Mr. Jones, the zookeeper, was feeding 3 lions and 2 of them walked away. How many fewer lions than tigers did Mr. Jones finish feeding?

7. Miss Harris, the zookeeper, was feeding 2 lions in each of 2 cages. Mr. Jones, the zookeeper was feeding 3 tigers in each of four cages. How many fewer lions than tigers were being fed by the zookeepers?

8. Miss Harris, the zookeeper, has 6 lions and she puts 3 lions in each cage. Mr. Jones, the zookeeper, has 6 tigers and he puts 2 tigers in each cage. How many more cages does one zookeeper have than the other?

9. Miss Harris, the zookeeper, has 3 tigers and 2 lions to feed. Mr. Jones, the zookeeper, has 3 times as many animals to feed as Miss Harris. How many animals does Mr. Jones have to feed?

10. Miss Harris has 5 animals to feed. Of these 2 are tigers and the rest are lions. Miss Walls has 2 times as many gorillas to feed as there are lions. How many gorillas does Miss Walls have to feed?

11. Miss Harris has 3 tigers to feed. Mr. Jones has 2 times as many lions to feed as Mr. Jones has lions. How many gorillas will Miss Walls feed?

12. Miss Harris has 8 tigers and she plans to put 2 in each cage. Miss Walls has 3 times as many cages for her animals as does Miss Harris. How many cages does Miss Walls have?

13. The lady zookeeper has 4 tigers to feed. The man zookeeper has 6 lions to feed. How many would each feed if they fed the same number?

14. The lady zookeeper is responsible for 8 tigers. The lady naturalist is responsible for 6 fewer gorillas. If each fed the same number of animals, how many would each feed?

15. The lady naturalist put 3 tigers in one cage. The lazy zookeeper had 4 times as many lions to put in cages. If the lady zookeeper, placed the same number of lions in each of her 6 cages, how many lions would be in each cage?

16. The lady zookeeper had 8 tigers. She put 2 tigers in each of her cages. The lady naturalist had 4 gorillas. She wanted to put the same number of gorillas in the same number of cages as the lady zookeeper. How many gorillas can the lady naturalist put in each cage if she has the same number of cages as the lady zookeeper?