The Research Base for

Direct Instruction Mathematics Programs

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INTRODUCTION

The following is a description of the research base for Direct Instruction mathematics programs, specifically *DISTAR Arithmetic I* and *II*, *Corrective Mathematics*, and *Connecting Math Concepts*. Direct Instruction mathematics programs have been used successfully to guide students' learning of everything from basic operations, strategies, and applications to more complex operations throughout their various levels. Evidence of this can be seen in over 30 years of published research in a wide variety of settings (Adams & Engelmann, 1996). Studies included in this review were selected using the First Search, ERIC, Psych INFO, Education ABS, and ProQuest databases. Descriptors included the following: Direct Instruction, *DISTAR Arithmetic*, *DISTAR Arithmetic I*, *DISTAR Arithmetic II*, direct instruction, direct teaching, direct verbal instruction, explicit instruction, mathematics instruction, *Corrective Mathematics*, and *Connecting Math Concepts*. Ancestral searches of reference lists were used to identify other possible research articles. Also, hand searches were done in the following peer-reviewed journals: *Effective School Practices*, *Journal of Direct Instruction*, and *Education and Treatment of Children*.

A 25-Year Direct Instruction Math Retrospective

Basic Information

Reference. Adams, G., & Engelmann, S. (1996). *Research on Direct Instruction*: *25 years beyond DISTAR*. Seattle, WA: Educational Achievement Systems.

Affiliation. University of Oregon, Eugene.

Evaluation. Meta-analysis.

Studies

Thirty-seven studies; 173 individual comparisons (general education, special education, and Follow Through combined with the general education group).

Description of Study

Studies included in the meta-analysis examined the effectiveness of a variety of Direct Instruction (DI) programs, including *DISTAR Arithmetic I* and *II*, *Corrective Math*, and *Connecting Math Concepts*. These studies were required to have the following elements: means and standard deviation of groups, the use of a suitable comparison group, and random selection of participants in groups. Thirty-four out of 37 studies involved the active intervention of DI programs. Three follow-up studies were not included in the statistical analysis but were reviewed in a separate chapter. Studies were examined along the following 10 variables (Adams & Engelmann, 1996):

(1) Type of student (i.e., general education, Project Follow Through, special education, follow-up study)

(2) Year of publication

(3) Age/grade of the student (i.e., elementary, secondary school)

(4) Subject (i.e., reading, math, language)

(5) Type of test (i.e., standardized, criterion-referenced)

(6) Type of research design (i.e., experimental with random assignment, causal-comparative)

(7) Duration of intervention

(8) Type of teacher (i.e., special teachers who presented lessons, students' general education teachers)

(9) Fidelity of implementation data

(10) Country in which the study was conducted

Results

In a sample polling of means, approximately 87% of the studies favored DI programs and approximately 12% favored non-DI programs. Slightly less than 1% found scores to be the same. In a sample polling of statistically significant outcomes, 64% of the studies found statistically significant ($p = .001$) outcomes. An effect size of 1.11 in favor of DI math programs was found in 33 of the 37 comparisons that included a math component. Effect size of .75 and above are rare in educational research, confirming that the overall effect is substantial.

Maintenance Effects of Direct Instruction Follow Through

Basic Information

Reference. Becker, W., & Gersten, R. (1982). Follow-up of Follow Through: The later effects of the Direct Instruction model on children in fifth- and sixth grades. *American Educational Research Journal*, *19*(1), 75–92.

Affiliation. University of Oregon, Eugene, Oregon.

Design. Quasi-experimental.

Participants

One thousand one hundred ninety-one fifth graders: experimental group (624 Follow Through graduates); control group (567 non-Follow Through graduates). Eight hundred seventy-six sixth graders: experimental group (473 Follow Through graduates); control group (403 non-Follow Through graduates).

Description of Study

Project Follow Through (1968–1976) has been called the largest, most expensive educational experiment ever conducted (Adams & Engelmann, 1996). According to Adams and Engelmann, over 10,000 economically disadvantaged students in 180 different communities participated in this $500 million project designed to evaluate nine different approaches to educating low-income students in kindergarten through third grade. One of these approaches was the Direct Instruction approach known as *DISTAR*. The results of Project Follow Through have been well documented. This study examined what, if any, maintenance effects existed with students who had participated in the Direct Instruction Follow Through program.

The following five sites participated: Dayton, Ohio; East St. Louis, Illinois; Tupelo, Mississippi; Smithville, Tennessee; and Uvalde, Texas.

The dependent measures in math included the Computation, Concepts, and Problem Solving subtests of the Metropolitan Achievement Test (MAT); the Total Math score across subtests was also provided. While this study examined outcomes in reading, math, science, language, and spelling, only math results are included in this summary.

Results

Results were positive. Math scores at the end of fifth grade showed the following average effect sizes: Computation, .09; Concepts, .18; Problem Solving, .27; and Total Math, .18. MAT math scores at the end of sixth grade showed the following average effect sizes: Computation, .13; Concepts, .24; Problem Solving, .18; and Total Math, .26. While the results of this study showed that Follow Through graduates outperformed the control groups in math, the authors noted that their overall scores in math dropped after leaving *DISTAR Arithmetic*. Specifically, in comparison with the MAT norm sample, Follow Through graduates lost significant ground in math by the end of sixth grade.

As a result of this study, the authors reached two conclusions. First, problem solving strategies are more likely to be maintained when they are learned well (i.e., Follow Through graduates often outperform their non-Follow Through peers in math problem solving). Second, in order for students to build on previously learned strategies, effective instruction must continue throughout the intermediate grades.

Direct Instruction Follow Through: The Long Term Impact

Basic Information

Reference. Meyer, L.A. (1984). Long-term academic effects of the Direct Instruction Project Follow Through. *The Elementary School Journal*, *84*(4), 380–394.

Affiliation. University of Illinois at Urbana-Champaign.

Design. Quasi-experimental.

Participants

One hundred fifty-four ninth grade students: experimental group (61 Follow Through graduates); control group (93 non-Follow Through graduates). Four hundred fifty post-high school participants: experimental group (237 Follow Through graduates); control group (213 non-Follow Through graduates).

Description of experimental group: Ethnicity (African-American – approximately 85%, Puerto Rican – approximately 11%, Other – 4%); SES (approximately 77% of families receiving Aid for Dependent Children); and other unique characteristics (reading achievement levels approximately 4–6 months below grade level as determined by the Metropolitan Achievement Test [MAT]). No further descriptive information (i.e., gender) was provided.

Description of control group: Ethnicity (African-American – approximately 82%, Puerto Rican – approximately 17%, Other – 1%); SES (approximately 78% of families receiving Aid for Dependent Children); and other unique characteristics (reading achievement levels approximately 4–6 months below grade level as determined by the MAT). No further descriptive information (i.e., gender) was provided.

Description of Study

This study compared the long-term academic effects of Direct Instruction on Follow Through graduates from PS 137, Bainbridge School, in Brooklyn, New York's Ocean Hill-Brownsville community, with a non-Follow Through control group in the same community. Specifically, the author attempted to answer the following two research questions: (1) How do Follow Through graduates compare with the control group in high school, and (2) How do the Follow Through students' third grade performance correlate with their ninth grade performance in reading and math?

The following outcome measures were examined: graduation rates, retention rates, drop-out rates, college application rates, and corresponding college acceptance rates. High school graduation rates and college acceptance rates are included in this summary. Additionally, while the study examined both reading and math achievement, only math results are included in this summary. Dependent measures in math included the following: the California Achievement Test (CAT) Total Math score; the Wide Range Achievement Test (WRAT) math score; the Metropolitan Achievement Test (MAT) math score; and the Slossen IQ test.

Results

Regarding post-school outcomes, the author found that Follow Through graduates fared better than the control group in all areas. Specifically, approximately 63% of Follow Through graduates successfully finished high school, compared to approximately 38% of the control group. In addition, approximately 37% of Follow Through graduates applied to college (34% were accepted), while 22% of the control group applied to college (17% were accepted).

Results of ninth grade math measures were also positive for Follow Through graduates. On the CAT, Follow Through graduates received an average grade equivalent of 8.59, while non-Follow Through students received an average grade equivalent of 7.95. The author also found positive correlations (Pearson product moment) between end-of-third-grade WRAT, Slossen, and MAT scores in math. Specifically, an average correlation of .42 was found for end-of-third-grade WRAT math scores and ninth grade WRAT math scores for Follow Through graduates (comparison scores were not available for the control group). Additionally, an average correlation of .20 was found for ninth grade WRAT math scores and Slossen IQ scores (comparison scores were not available for the control group).

DISTAR Arithmetic and Moderate Intellectual Disabilities

Basic Information

Reference. Young, M., Baker, J., & Martin, M. (1990). Teaching basic number skills to students with a moderate intellectual disability. *Education and Training in Mental Retardation*, 25, 83–93.

Affiliation. Macquarie University, School of Education, N.S.W., Australia.

Design. Pretest-posttest with no comparison group.

Participants

Five students (3 males, 8 years old; 1 female and 1 male, 10 years old) with intellectual impairment (all scored between 35 and 54 on the Wechsler Intelligence Scale for Children-Revised [WISC-R]) and impaired articulation (2–3 word utterances). No further descriptive information (i.e., SES or ethnicity) was provided.

Description of Study

This study compared *DISTAR Arithmetic I* to a teacher-developed discrimination learning theory (DLT) program based on the first 60 lessons of *DISTAR Arithmetic I*. Specifically, academic engaged time and mastery of basic math skills were examined. During the baseline phase, *DISTAR Arithmetic I* was implemented according to the program script.

During the DLT phase, discrimination learning theory was used to adapt *DISTAR Arithmetic I* to meet these students' unique needs (i.e., impaired articulation). All DLT instructional materials were teacher-made. The response cards that were used consisted of both correct response cards and distracter cards. Specifically, students matched correct response cards to concepts presented in the match-to-sample format of the DLT phase.

Dependent measures included the following: *DISTAR Arithmetic* placement test, teacher-designed pretest-posttest based on material covered in the first 60 lessons of *DISTAR Arithmetic I*, and academic engagement data based on interval recording.

Results

During baseline, average performance on mastery tests ranged from 18% to 73%, while average academic engaged time ranged from 18% to 31%. During the DLT phase, average performance on mastery tests ranged from 69% to 96%, while academic engaged time ranged from 56% to 84%. It was further determined, over the course of 5 days at a 5-week maintenance probe, that both mastery scores and academic engaged time remained higher than in baseline. As a result, the authors concluded that the match-to-sample format of the DLT phase was an effective adaptation of *DISTAR Arithmetic I* in teaching math skills to students with articulation problems.

Corrective Mathematics for Children Struggling in Math

Basic Information

Reference. Parsons, J., Marchand-Martella, N., Waldron-Soler, K., Martella, R., & Lignugaris/Kraft, B. (in press). Effects of a high school-based peer-delivered Corrective Mathematics program. *Journal of Direct Instruction*.

Affiliation. Eastern Washington University, Department of Counseling, Educational, and Developmental Psychology, Cheney, Washington.

Design. Pretest-posttest with no comparison group.

Participants

Nineteen secondary students consisting of 10 learners (6 tenth graders, 2 eleventh graders, 2 twelfth graders; 2 females, 8 males; 1 African-American, 9 Caucasians); and 9 peer tutors (6 eleventh graders, 3 twelfth graders; 7 females, 2 males; all Caucasian). No further descriptive information (i.e., SES) was provided.

Description of Study

This study examined the use of a peer-delivered *Corrective Mathematics* program in an urban secondary general education classroom for students struggling in math. Learners received 60 days of instruction and completed an average of 4.36 lessons per day.

Dependent measures included the following: Calculation and Applied Problems subtests of the Woodcock Johnson-Revised Test of Achievement (WJ-R) and the *Corrective Mathematics* placement test. Specifically, students assigned to the learner group were pre- and posttested using the aforementioned measures. Peer tutors were pre- and posttested using the Calculation and Applied Problems subtests of the WJ-R.

Results

Posttest results indicated that both learners and peer tutors experienced gains in one or both areas of the WJ-R. Specifically, learners made average standard score gains of 11.60 (effect size = 2.11) on the Calculation subtest and 5.80 (effect size = .86) on the Applied Problems subtest of the WJ-R. Average gains on the Calculation subtest were statistically significant at the .01 level, and average gains on the Applied Problems subtest were statistically significant at the .05 level. Additionally, learners made program level gains ranging from two levels to six levels (average = 3.2 levels) as indicated on the *Corrective Mathematics* placement posttest.

Posttest results for peer tutors showed average standard score gains of 7.40 (effect size = .54) on the Calculation subtest and 13.00 (effect size = 1.32) on the WJ-R. While the average gains on the Calculation subtest did not reach statistical significance ($p < .20$), average gains on the Applied Problems subtest did reach statistical significance at the .001 level.

DI Math/Reading Programs and Brain-Injured Students

Basic Information

Reference. Glang, A., Singer, G., Cooley, E., & Tish, N. (1991). Using Direct Instruction with brain-injured students. *Direct Instruction News*, *11*(1), 23–28.

Affiliation. Oregon Research Institute, Eugene, Oregon.

Design. Single-subject pretest-posttest: multiple baseline across content areas.

Participant

Eight-year-old male with traumatic brain injury (Full Scale WISC-R IQ score of 81). No further descriptive information (i.e., SES, ethnicity) was provided.

Description of Study

The study examined the effects of using *Corrective Mathematics* and *Corrective Reading Comprehension A* to target deductive reasoning, math story problems, and addition and subtraction math facts. Instruction took place twice a week over a 6-week period.

Baseline data were taken using three probes in each instructional area. Authors included sample items from each probe, but the sources of the probes were not identified.

Results

Posttest results were positive after approximately 12 hours of instruction. Specifically, average percentage scores on deductive reasoning probes increased from 6.7% to over 90% correct; average story problem accuracy increased from 11.4% correct to 91.25% correct; and basic math fact recall increased from 6 correct facts per minute to 11.5 correct facts per minute.

Direct Instruction and At-Risk Students

Basic Information

Reference. Sommers, J. (1991). Direct Instruction programs produce significant gains with at-risk middle school students. *Direct Instruction News*, *11*(1), 7–14.

Affiliation. Big Piney, Wyoming.

Design. Pretest-posttest with no comparison group.

Participants

One hundred twelve sixth, seventh, and eighth grade students at risk for academic failure. No further descriptive information (i.e., gender, SES, ethnicity) was provided.

Description of Study

This study took place over a 7-year period (1985–1992) in a rural farming community of approximately 500 people. At the time of this study, there was a significant number of transient families. Because a large number of students from these families were found to be at-risk, a basic skills program was developed. Students considered to be "at-risk" scored below the 50th percentile on two standardized tests (i.e., Gates-MacGinitie Reading Test, Stanford Mathematics Test) but did not qualify for special education services. The math program consisted of the *Corrective Mathematics* Multiplication, Division, Basic Fractions, Fractions-Decimals-Percents, and Ratios and Equations modules and Heath Mathematics (their grade level textbook). The dependent measure used was the Key Math Diagnostic test.

Results

Posttest results on the Key Math Diagnostic test showed average gains of 1.2 months per month of instruction. Results were only reported as grade level gains. No additional data (i.e., standard scores, percentile ranks) were provided.

Connecting Math Concepts vs. Invitation to Mathematics

Basic Information

Reference. Snider, V.E., & Crawford, D.B. (1996). Action research: Implementing Connecting Math Concepts. *Effective School Practices*, *15*(2), 17–26.

Affiliation. University of Wisconsin-Eau Claire, Wisconsin.

Design. Correlated with statistical controls: pretest-posttest control group.

Participants

Forty-six fourth graders. No further descriptive information (i.e., gender, SES, ethnicity) was provided.

Description of Study

This study compared *Connecting Math Concepts* to *Invitation to Mathematics* by Scott Foresman (SF). Participants included 46 fourth graders in a small rural school district in northern Wisconsin. Students were randomly assigned to two general education classrooms. One teacher used *Connecting Math Concepts*, Level D, the other teacher used SF. The *Connecting Math Concepts* group completed 90 out of 120 lessons, while the SF group completed 10 out of 12 chapters.

Dependent measures included the following: Computation, Concepts and Problem Solving, and Total Math subtests of the National Achievement Test (NAT); two curriculum-based assessments (one based on *Connecting Math Concepts*, one based on SF), and an experimenter-designed multiplication facts test. No significant pretest differences between groups were noted.

Results

Statistically significant differences in favor of the *Connecting Math Concepts* group were noted on the multiplication facts test ($p = .0001$), both curriculum-based assessments (*Connecting Math Concepts*, $p = .0001$; *SF*, $p = .002$), and on the NAT Computation subtest ($p = .006$). No statistically significant differences were noted on the NAT Concepts and Problem Solving subtest or on the Total NAT score.

A Connecting Math Concepts Efficacy Follow-up Study

Basic Information

Reference. Crawford, D.B., & Snider, V.E. (2000). Effective mathematics instruction: The importance of curriculum. *Education and Treatment of Children*, *23*(2), 122–142.

Affiliation. Western Washington University, Bellingham, Washington; University of Wisconsin-Eau Claire, Eau Claire, Wisconsin.

Design. Correlated with statistical controls: pretest-posttest control group.

Participants

Thirty-eight fourth graders. No further descriptive information (i.e., gender, SES, ethnicity) was provided.

Description of Study

This study was a follow-up to an earlier study (Snider & Crawford, 1996) where both teachers used *Connecting Math Concepts*.

Dependent measures included the following: Computation, Concepts and Problem Solving, and Total Math subtests of the National Achievement Test (NAT), two curriculum-based assessments (one based on *Connecting Math Concepts*, one based on *Invitation to Mathematics* by Scott Foresman), and an experimenter-designed multiplication facts test.

Results

After 1 year of using *Connecting Math Concepts*, the teacher who had previously used Scott Foresman had students who made greater gains than the previous year on both the multiplication facts tests and on both curriculum-based assessments. However, no significant posttest differences were noted on the NAT subtests or total test scores.

Possible reasons for the lack of pre- to posttest gains were noted by the authors: (a) less-than-optimal implementation of *Connecting Math Concepts*; (b) lack of alignment between the NAT Concepts and Problems Solving subtests and either curriculum; and (c) the fact that performance on norm-referenced tests is more highly correlated with reading comprehension scores than with computation scores.

The positive results found in their earlier study (Snider & Crawford, 1996) and the positive results on the curriculum-based assessments and multiplication facts tests in this study prompted the district-wide adoption of *Connecting Math Concepts*.

Connecting Math Concepts vs. Discovery Learning

Basic Information

Reference. Tarver, S. & Jung, J. (1995). A comparison of mathematics achievement and mathematics attitudes of first and second graders instructed with either a discovery-learning mathematics curriculum or a Direct Instruction curriculum. *Effective School Practices*, *14*(1), 49–57.

Affiliation. Department of Rehabilitation Psychology and Special Education, University of Wisconsin-Madison.

Design. Quasi-experimental: nonequivalent control group.

Participants

One hundred nineteen students entering the first grade in a Midwestern suburban elementary school. No further description (i.e., gender, SES, ethnicity) was provided.

Description of Study

This study took place over 2 years. Students were randomly assigned to five classrooms. One experimental classroom used *Connecting Math Concepts*, while four control classrooms used *Math Their Way* and Cognitively Guided Instruction (*MTW*/CGI).

Dependent measures included the following: Computation and Concepts and Applications subtests of the Comprehensive Test of Basic Skills-Mathematics (CTBS-M). The CTBS-M was administered as a pretest (Level 10, Form A), as a first grade posttest (Level 11, Form A), and as a second grade posttest (Level 12, Form A). Students also responded to an experimenter-designed math attitudes survey that corresponded to the following NCTM standards: (a) students should learn to value mathematics; (b) students should become confident in their ability to do math; and (c) students should learn to communicate mathematically.

Results

At the end of first grade, CTBS-M posttest results showed that *Connecting Math Concepts* students scored significantly higher than the *MTW*/CGI group on Computation ($p = .0001$) and Total Math ($p = .0173$) but not on the Concepts and Applications subtest. At the end of second grade, *Connecting Math Concepts* students scored significantly higher than the *MTW*/CGI group on all posttest measures (i.e., Concepts and Applications, $p = .0089$; Computation, $p = .0001$; and Total Math, $p = .0003$). Second graders in the *Connecting Math Concepts* group exhibited significantly higher math attitude scores ($p = .0119$) than the *MTW*/CGI group; differences in math attitude for first graders did not reach statistical significance.

Direct Instruction: Effects on Stable & Mobile Urban Children

Basic Information

Reference. Brent, G., & DiObilda, N. (1993, July/August). Curriculum alignment versus Direct Instruction: Effects on stable and mobile urban children. *The Journal of Educational Research*, *86*(6), 333–338.

Affiliation. Rowan College, Camden, New Jersey.

Design. Quasi-experimental: non-equivalent control group.

Participants

One hundred eighty-nine first graders: experimental group (99 students: 23 stable, 76 mobile) and control group (90 students: 27 stable, 63 mobile). Ethnicity of groups: African-American – approximately 45%; Hispanic – approximately 45%; Asian – approximately 7%; and Caucasian – approximately 3%. SES of groups: approximately 60% of students participating in Head Start or a similar preschool program. Other unique characteristics of groups: overall annual mobility rate was approximately 45%, compared to approximately 20% nationwide. No further descriptive information (i.e., gender) was provided.

Description of Study

This study compared the effects of Direct Instruction (DI) curricula to those of the traditional basal curricula in Camden, New Jersey over a 2-year period. At that time, Camden was considered to have the highest percentage of children who lived in poverty (approximately 60%) in the country. The mobility rate in Camden was also higher than the national average. For that reason, this study also examined the effects of each curriculum on both stable and mobile urban children. In an attempt to improve standardized test scores, school district officials had aligned their schools' traditional basal programs with the Comprehensive Test of Basic Skills-Form U, Level D (CTBS), the district's standardized assessment. This study compared students using *Connecting Math Concepts* with the control groups using *Holt Math Series*.

All participants were pre- and posttested using the CTBS. The Metropolitan Achievement Test Survey Battery (MAT) was also administered to stable students to measure performance on a curriculum-neutral test and to allow for comparisons with national norms. Authors examined the effects that program, mobility, and interaction had on both groups.

Results

CTBS Total Math scores were similar among stable and mobile *Connecting Math Concepts* groups as well as stable control groups (average percentile scores fell between 87 and 88 for all three groups). In contrast, the average mobile control group percentile score on Total Math was 81. Both stable and mobile *Connecting Math Concepts* groups scored higher than the control groups on the CTBS Computation subtest, yielding a significant program main effect of 5.22. On the other hand, the stable control group scored higher than either *Connecting Math Concepts* group on the Concepts subtest.

On the MAT, the *Connecting Math Concepts* group scored higher than the control group on all math subtests. Differences on three of the four subtests reached statistical significance at the $p < .01$ level (i.e., Total Math, $F = 7.30$; Computation, $F = 8.61$; and Mathematics Concepts, $F = 10.13$). Overall, mobility was found to have a negative impact on student achievement in both the *Connecting Math Concepts* and the control groups. However, scores on the CTBS indicated that mobility was more detrimental to the control groups.

Connecting Math Concepts vs. Addison-Wesley Mathematics

Basic Information

Reference. Vreeland, M., Vail, J., Bradley, L., Buetow, C., Cipriano, K., Green, C., Henshaw, P., & Huth, E. (1994). Accelerating cognitive growth: The Edison school math project. *Effective School Practices*, *13*(2), 64–69.

Affiliation. Kalamazoo Public Schools; Portage Public Schools; Galesburg-Augusta Public Schools; and Edison Elementary School, Kalamazoo, Michigan.

Design. Quasi-experimental: nonequivalent control group.

Participants

Five third grade classrooms (2 experimental classrooms, 3 control classrooms) and 4 fifth grade classrooms (2 experimental classrooms, 2 control classrooms). SES of third grade groups: 2 low-SES experimental classrooms, 1 low-SES control classroom, and 2 high-SES control classrooms. SES of fifth grade groups: 2 low-SES experimental classrooms, 1 low-SES control classroom, and 1 high-SES control classroom. No further descriptive information (i.e., gender, ethnicity) was provided.

Description of Study

This study compared *Connecting Math Concepts* to *Addison-Wesley Mathematics (A-W)* as part of a 1-year pilot program to assess the efficacy of using *Connecting Math Concepts*. Teachers at Edison Elementary School in Kalamazoo, Michigan had expressed concerns with their school's basal math program. Many of Edison's teachers didn't feel that the students were mastering skills in computation, story problems, and fractions. Other criticisms of their existing program included the superficial coverage of important topics and a lack of systematic review. Additionally, due to the primarily low-SES composition of Edison (87% of Edison's 600 students were eligible for lunch assistance programs), *Connecting Math Concepts* posttest scores were compared with *A-W* posttest scores both in Edison and at a higher-SES school using *A-W*. The efficacy of using *Connecting Math Concepts* with academically talented students was also examined.

Dependent measures included the Iowa Test of Basic Skills (ITBS) Total Math (consisting of three subtests: Computation, Concepts, and Problem-Solving); the Kaufman Test of Educational Achievement-Comprehensive Form (KTEA-C) Calculation and Applications subtests; and a curriculum-based measurement (CBM) based on *Connecting Math Concepts* and *A-W*.

Results

Posttest results were largely positive for *Connecting Math Concepts (CMC)* students. CBM posttest scores were higher for *Connecting Math Concepts* third graders (*CMC* average = 70% accuracy; Edison *A-W* average = 33% accuracy; high-SES *A-W* average = 57%). *Connecting Math Concepts* fifth graders in Edison had higher CBM posttest averages than *A-W* fifth graders (*CMC* average = 82% accuracy; Edison *A-W* average = 36%; high-SES *A-W* average = 79%).

ITBS posttest scores indicated that *A-W* third graders experienced a decline in their average percentile rank (pretest = 65; posttest = 50). One *Connecting Math Concepts* third grade classroom experienced a smaller decline in average percentile rank (pretest = 52; posttest = 49), while the other *Connecting Math Concepts* third grade classroom showed a slight increase in average percentile rank (pretest = 60; posttest = 61). ITBS results for *Connecting Math Concepts* fifth graders remained the same from pre- to posttest. No ITBS comparison data for fifth graders were included in the study.

KTEA-C posttest scores indicated that *Connecting Math Concepts* third graders experienced grade level gains of more than 1 year (average = +1.5). No KTEA-C posttest scores for *A-W* groups were included in the study. Additionally, four academically talented *Connecting Math Concepts* third graders and four academically talented *Connecting Math Concepts* fifth graders were pre- and posttested using the KTEA-C. Posttest results indicated average grade level gains of approximately 2 years for both groups.

Connecting Math Concepts: An Elementary School Adoption Evaluation

Basic Information

Reference. Wellington, J. (1994). Evaluating a mathematics program for adoption: Connecting Math Concepts. *Effective School Practices 13*(2), 70–75.

Affiliation. Upper Darby School District, Upper Darby, Pennsylvania.

Design. Quasi-experimental: nonequivalent control group.

Participants

Sixteen first grade classrooms and 16 fourth grade classrooms. Ethnologically and socio-economically diverse school district (i.e., full-time ESL teachers serving over 35 nationalities, 3 elementary teachers, 2 middle school teachers, and 1 high school teacher). Stability of students completing elementary through high school between 30% and 40%. No further descriptive information (i.e., gender) was provided.

Description of Study

This study compared the effectiveness of *Connecting Math Concepts* with the district's basal math series for a period of one year. All eight of the district's elementary schools participated in the study. One first grade classroom and one fourth grade classroom per school used *Connecting Math Concepts*. First and fourth grade comparison groups were also chosen from each school.

Dependent measures included the following: a pretest consisting of the *Connecting Math Concepts* placement test; a teacher-designed, curriculum-based posttest based on both *Connecting Math Concepts* and the traditional basal being used by the comparison groups; and a district-designed mastery test. No significant pretest differences were noted.

Results

An end-of-the-year, district-designed mastery test was given to all students in first through fifth grades. Results indicated that the rate of mastery (defined as 70%) declined at the higher grade levels. Specifically, percentages of students performing at or above the mastery level in each grade were as follows: 95.9% of first graders, 77.7% of second graders, 56.7% of third graders, 56.6% of fourth graders, and 20.5% of fifth graders. Curriculum-based measurement (CBM) posttest results showed statistically significant ($p = .05$) differences for two out of the eight first grade classrooms: one in favor of the *Connecting Math Concepts* group and one in favor of the traditional basal group. Fourth grade CBM posttest results showed statistically significant differences ($p = .05$) in favor of six out of the eight *Connecting Math Concepts* groups. The author cited varied levels of acceptance by *Connecting Math Concepts* teachers as one possible reason for the lack of significant pre- to posttest gains for *Connecting Math Concepts* first graders.

Connecting Math Concepts and Students with Mental Retardation

Basic Information

Reference. Tai-Hwa, E.L. (1992). Effects of Direct Instruction math on achievement of the mentally retarded in Taiwan, ROC. *Direct Instruction News 11*(2), 5–8.

Affiliation. University of Oregon, Eugene, Oregon.

Design. Pretest-posttest with no comparison group.

Note. This article was composed of two studies, both summarized below.

Study 1: A 2-year pilot study of middle school students with mild mental retardation.

Participants

Year 1: 6 middle school students with mild mental retardation (3 students' IQ scores ranged from 43 to 70; 3 students' IQ scores below 50). Year 2: 35 middle school students with mental retardation (IQ range: 43–70). No further descriptive information (i.e., gender, SES) was provided.

Description of Study

This 2-year pilot study examined the effects of using *Connection Math Concepts* with middle school students in Taiwan. In the first year of the pilot study, six middle school students with mild mental retardation were taught using *Connecting Math Concepts*. In the second year, thirty-five middle school students with mental retardation were taught using *Connecting Math Concepts*. All materials were translated into Chinese by the researcher.

Dependent measures included the following: Key Math Diagnostic Arithmetic Test and the *Connecting Math Concepts* placement test. However, *Connecting Math Concepts* placement test data were not included in the published investigation.

Study 2: A two-year study of elementary students with severe to profound mental retardation.

Participants

Seven students (age range: 5-9 to 7-7); intellectually impaired (IQ range: 17–34); all had language impairments. No further descriptive information (i.e., gender, SES) was provided.

Description of Study

Seven elementary students with severe to profound mental retardation were taught using *Connecting Math Concepts* over a 2-year period. Five students received services under a variety of disability categories (i.e., Down Syndrome, ADHD, autism), while two had undisclosed disabilities. All seven students were identified as having language impairments (i.e., three had articulation problems, two were nonverbal, one student spoke a different dialect than the majority of the group, and one student had receptive language deficits). All instructional materials were translated into Chinese by the researcher. Dialectical considerations were not discussed. Accommodations for nonverbal students included clapping and pointing to correct responses. Students were taught using small group and individual instruction as determined by the individual needs of the students.

Dependent measures included the following: Stanford-Binet Intelligence Scale, Preschool Language Scale, Columbia Mental Maturity Scale, Draw-a-Man Test, Adaptive Behavior Scale, and the *Connecting Math Concepts* placement test.

Study 1 Results

Results of the first year implementation were found to be positive in developing the following mathematical skills: counting, symbol identification, mental computation, addition, subtraction, multiplication, division, fractions, time, money, measurement, and story problems. No specific posttest data were included.

Results of the second year implementation were also found to be positive. The author stated that all 35 students "exceeded their mental age by at least two years." No specific posttest data were included.

Study 2 Results

Results were positive. After 2 years, *Connecting Math Concepts* placement test results showed that four of the seven students were performing at grade level. According to the author, the students' mean IQ score increased approximately 10 points. No further posttest data were provided.

Connecting Math Concepts and Special-Ed Students

Basic Information

Reference. Helmke, L. (1992). Brief report: Connecting Math Concepts in special education. *Direct Instruction News 11*(3), 14.

Affiliation. Dubuque Community School District, Dubuque, Iowa.

Design. Pretest-posttest with no comparison group.

Participants

Two students receiving special education services (both fifth graders, both Caucasian males). No further descriptive information (i.e., SES) was provided.

Description of Study

This study examined the use of *Connecting Math Concepts* Level C with two students who received special education services. Instruction took place from November 1991 to March 1992. Two students were pre- and posttested using the Stanford Diagnostic Math Test (SDMT), Form G. No other dependent measures were included.

Results

Results were positive for both students. One student made the following grade level gains on the SDMT: Numeration, from 2.9 to 5.5; Computation, from 2.9 to 4.3; and Applications, from 1.8 to 6.0. A total grade level gain from 2.3 to 5.0 was reported for this student. The second student made the following grade level gains on the SDMT: Numeration, from 2.9 to 6.0; Computation, from 3.5 to 5.2; and Applications, from 1.6 to 2.7. A total grade level gain from 2.5 to 4.6 was reported for this student. No further posttest data were provided.

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