National Institute for Direct Instruction

Selected Studies of the Efficacy of Direct Instruction Mathematics Programs

Timothy W. Wood and Jean Stockard

December 11, 2014

Arthur, C. & Stockard, J. (2014). *An Analysis of Achievement Scores of Arthur Academy Schools, 2007 to 2013, NFDI Technical Report 2014-2*. Eugene, OR: NIFDI.

Affiliation: Arthur Reading Workshop, National Institute for Direct Instruction and University of Oregon

Design: Pretest-Posttest Norm Comparison Design

Participants: Students enrolled in Arthur Academies, a system of six charter schools in the greater Portland, Oregon metropolitan area. Over 4000 students, ranging from kindergarten to fifth grade were included.

Description of Study: This study examined the impact of the Direct Instruction program, *Connecting Math Concepts*, on mathematics achievement over six consecutive school years, 2007-2008 through 2012-2013. Math skills were measured with the Stanford Achievement Test for students in grades kindergarten and higher and the Oregon Assessment of Knowledge and Skills for students in grades three to five.

Results: At the start of kindergarten, Arthur students had achievement scores that were similar to or slightly lower than students in the nation as a whole. However, by the end of their kindergarten year, the average Arthur student scored much higher than the national average for their grade. In all years, the changes over time, relative to the national norms, were statistically significant. This high level of achievement persisted, and even increased, through later grades. In all years and grades, the percentage of students scoring at high levels was substantially greater than would be expected given national norms.

Tables 1 and 2 and figures 1 and 2 below display the data from kindergarten. Figure 3 shows data from the higher grades.

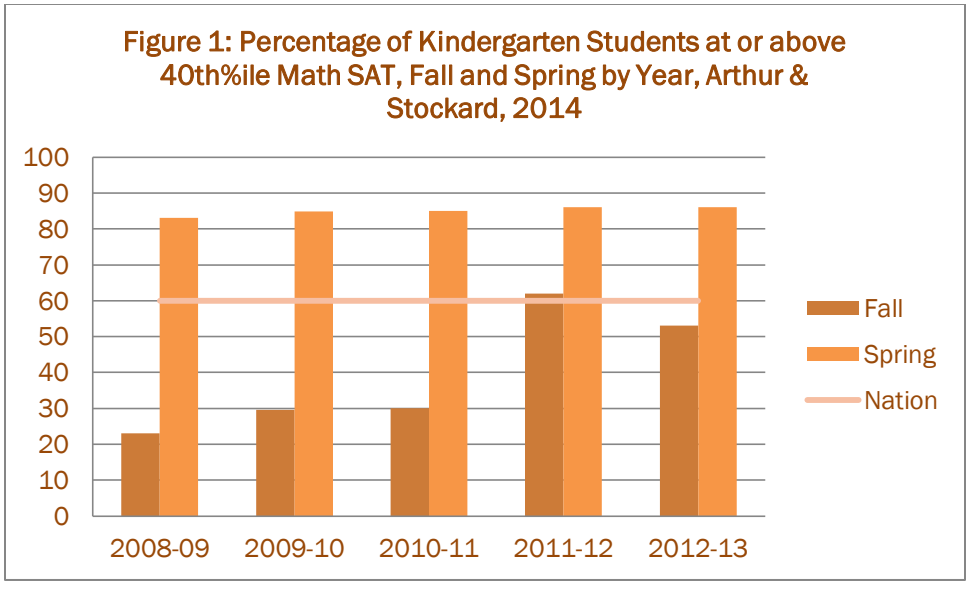
Table 1
Percentage of Kindergarten Students at or Above the 40th Percentile, Math SAT, Fall and Spring by Year, Arthur & Stockard, 2014

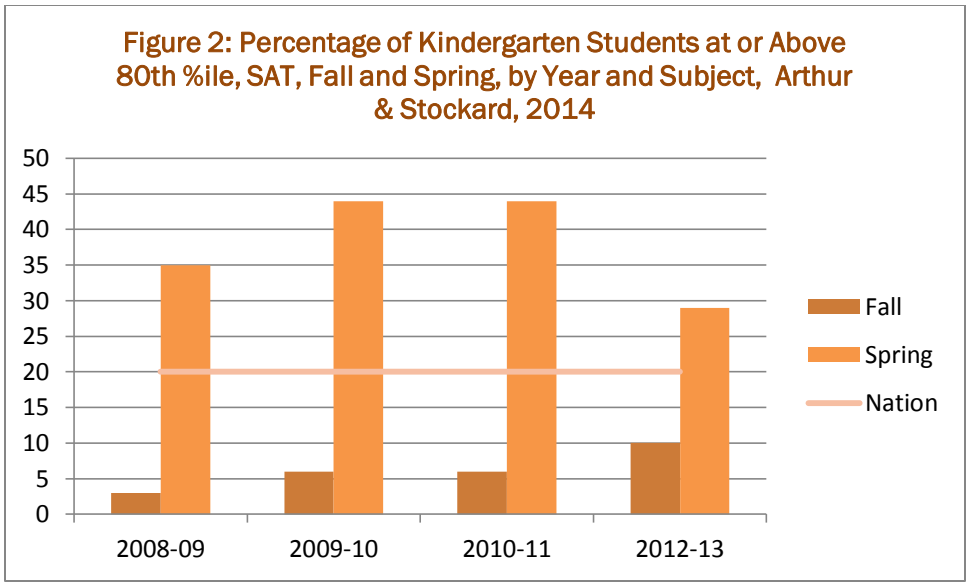
	Fall	Spring	Nation
2008-09	23	83	60
2009-10	30	85	60
2010-11	30	85	60
2011-12	62	86	60
2012-13	53	86	60

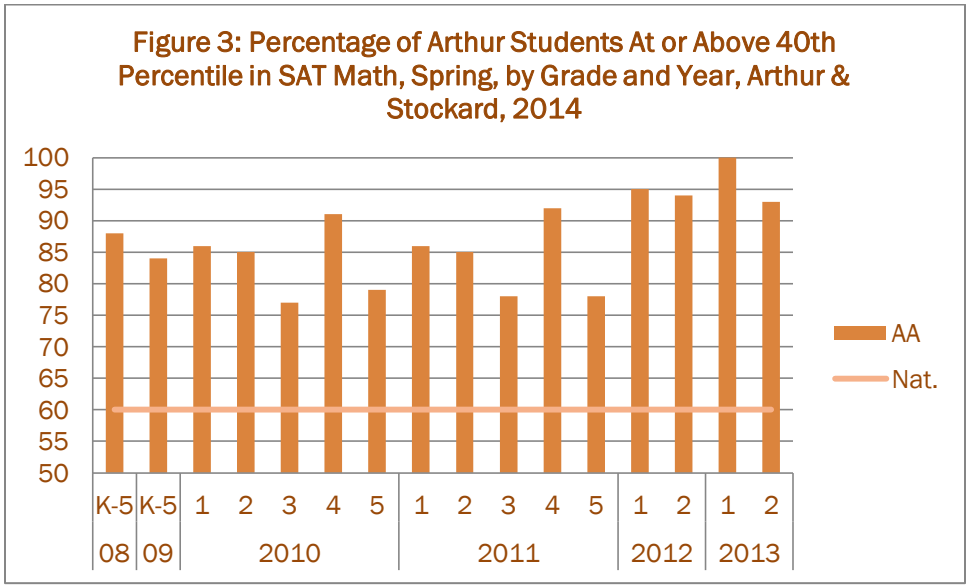
Table 2
Percentage of Kindergarten Students at or above 80th percentile SAT, Fall and Spring, by Year and Subject, Arthur & Stockard, 2014

	Fall	Spring	Nation
2008-09	3	35	20
2009-10	6	44	20
2010-11	6	44	20
2012-13	10	29	20

Note: Data were not available for 2011-12 for this measure







Coughlin, C. (2011). *Research on the effectiveness of Direct Instruction programs: An updated meta-analysis*. Presented at the Annual Meetings of the Association for Behavior Analysis International.

Affiliation: National Institute for Direct Instruction and University of Oregon

Design: Meta-Analysis of Pretest-Posttest Control Group Designs with Random Assignment

Description of Study: A comprehensive literature review was conducted to identify published and unpublished studies of the effectiveness of Direct Instruction programs. The analysis was limited to studies in which students were randomly assigned to receive a Direct Instruction program or an alternative program and that included enough statistical information to calculate effect sizes. Five studies of mathematics met these criteria. Effect sizes were estimated with Hedges' g, using a correction for small sample sizes as appropriate.

Results: The average effect size for the studies of mathematics was 1.03, indicating that the students who received Direct Instruction had average scores at pretest that were more than one standard deviation greater than the comparison group. This value is more than four times greater than the level typically used to denote educational significance (.25).

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, University of Wisconsin--Eau Claire

Design: Year 1: Pretest-posttest control group design with randomized assignment; Year 2: Cohort Control Group Design

Participants: Fourth grade students in one school in a small Wisconsin community over a two year period. Forty six students were in the study in year one and 38 in year two. Classes were heterogeneous, including students with learning disabilities as well as gifted students.

Description of Study: In year one fourth graders were randomly assigned to a classroom using the Direct Instruction program, *Connecting Math Concepts,* or to a classroom using a basal mathematics text, *Invitation to Mathematics* (Scott Foresman). In year 2 the teacher who had been using *Invitation to Mathematics* used *Connecting Math Concepts*. The scores of the teacher's students in year two were compared to the scores of his students in year one, thus controlling for teacher effects. At the start and end of both school years students were administered the National Achievement Test (NAT), a group administered normed achievement test with two sub-tests and a total score; two curriculum-based measures based on the content of the two programs; and a multiplication facts fluency test.

Results: Results with the pretest-posttest control group design (year one) indicated no differences between the groups in pretest scores. However, at posttest, the CMC students had significantly higher scores on five of the six measures and the differences were statistically significant in four of the comparisons. Results with the cohort control group design indicated that the CMC group had larger gains over the school year in five of the six measures. These differences were statistically significant in three of the comparisons.

Table 3 has data from the year one results and Table 4 has results from the cohort comparisons.

Table 3
Results from Crawford and Snider Randomized Control Trial (year 1)

	Pretest		Posttest	
Test	M	SD	M	SD
NAT computation				
CMC	26	8	36	4
SF	26	8	29	7
NAT Concepts and problem-solving				
CMC	31	12	37	13
SF	32	9	39	12
NAT Total				
CMC	56	19	72	16
SF	58	15	69	18
CMC Concepts test				
CMC	6	6	41	8
SF	7	3	15	8
Scott Foresman Test				
CMC	12	3	19	2
SF	13	4	16	4
Multiplication facts				
CMC	15	7	66	7
SF	22	11	48	12

N = 23 in each group

Table 4
Results from Crawford and Snider Cohort Comparison Design

Test	M	SD	M	SD	Gain
NAT computation					
Before (no CMC cohort)	26	9	39	12	13
After (CMC cohort)	26	8	33	7	7
NAT Concepts and problem-solving					
Before (no CMC cohort)	32	9	39	12	7
After (CMC cohort)	30	11	41	13	11
NAT Total					
Before (no CMC cohort)	58	15	69	18	11
After (CMC cohort)	56	17	74	19	18
CMC Concepts test					
Before (no CMC cohort)	7	3	15	8	8
After (CMC cohort)	4	3	33	14	29
Scott Foresman Test					

Before (no CMC cohort)	13	4	16	4	3
After (CMC cohort)	10	4	18	3	8
Multiplication facts					
Before (no CMC cohort)	22	11	48	12	26
After (CMC cohort)	17	10	54	12	37

N=23 for the no CMC cohort and n=19 for the CMC cohort

Cross, R. W., Rebarber, T., & Wilson, S. F. (2002). Student gains in a privately managed network of charter schools using Direct Instruction. *Journal of Direct Instruction, 2*(1), 3-21.

Affiliation: Advantage Schools

Design: Pretest-Posttest Norm Comparison Design

Participants: Over 5000 students in from kindergarten to seventh grade enrolled in 14 charter schools in 11 different states. Over 70 percent qualified for free or reduced lunch.

Description of Study: This study examined the effect of Direct Instruction programs on the academic achievement of students in Advantage Schools, a privately managed network of charter schools. For mathematics instruction both *DISTAR Arithmetic* and *Connecting Math Concepts* were used with students placed in these programs according to their skill levels. Data came from the 1999-2000 school year. Students were tested twice a year, once in the fall and once in the spring with the mathematics subtest of the Stanford Achievement Test-Ninth Edition (SAT-9).

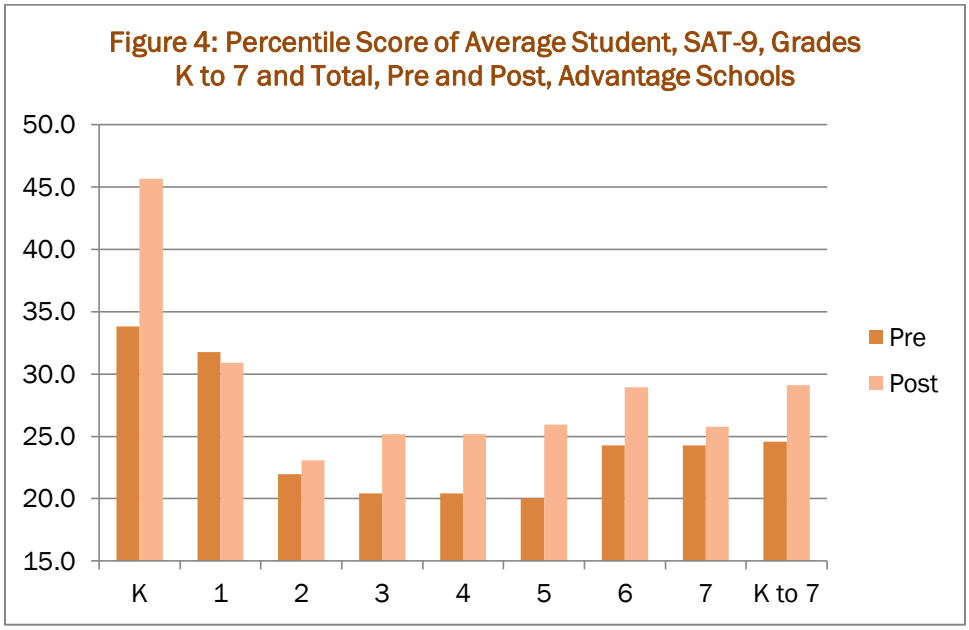
Results: On average, students in the Advantage Schools learned at an accelerated rate in comparison to national norms. Across all grades the average student moved from the 25th percentile at the beginning of the year to the 29th percentile in the spring. The greatest gains were seen among kindergarten students, where the average student moved from the 34th to 46th percentile. All changes, except for those in grades one and seven, were statistically significant.

Table 5
Percentile of Average Student on the SAT-9 Mathematics Subtest, Pre and Post, by Grade, Advantage Schools

	Pre	Post
K	33.8	45.7
1	31.7	30.9
2	21.9	23.1
3	20.4	25.2
4	20.4	25.2
5	20.0	25.9
6	24.3	28.9
7	24.3	25.8

K to 7	24.6	29.1

Note - the percentiles were calculated from the NCE scores given in the article.



Flores, M., & Kaylor, M. (2007). The effects of a Direct Instruction program on the fraction performance of middle school students at-risk for failure in mathematics. *Journal of Instructional Psychology, 34*(2), 84-94.

Affiliation: University of Texas at San Antonio

Design: Pretest-Posttest design

Participants: Thirty seventh grade students at-risk for failure in mathematics from a culturally and linguistically diverse school in a rural district outside of a large southwestern city. Student ages ranged from 12 to 14 years. There were eleven females and nineteen males. Eighteen of the students were Hispanic, six African American, and six white. None were identified as having a learning disability, but all had failed the annual state-designated assessment in mathematics two or more times and had demonstrated deficits in basic fractions.

Description of Study: This study was designed to examine the effects of the Direct Instruction program, *Corrective Mathematics, Basic Fractions*. Students were divided into 3 classes, each with 10-12 students. Instruction lasted seven weeks and covered 14 lessons. The course was an elective, taken in addition to the students' regular seventh grade math course. Each class period lasted 50 minutes, with the first 20 minutes devoted to review, and the remaining time spent on either instruction with the Direct Instruction program or the

traditional program. Students were divided into two groups and would alternate the form of instruction based on the day of the week. Fidelity was monitored and the authors reported procedural fidelity at 90%. Students' knowledge of fractions was tested before starting the program (pretest) and after finishing the program (posttest) with a curriculum based assessment.

Results: Results indicated the intervention had a strong positive effect, with statistically significant differences between pre-test and post-test scores on both the total measure and the measures of individual skills. The mean performance on the pre-test was 20%, with scores ranging from 0-57%. The mean performance on post-test was 77% with scores ranging from 36-100%. Only three students scored below 75% correct on the post-test. The authors did not formally test student behaviors during this study, but noted that students appeared to be more engaged in the Direct Instruction teaching procedures than in the traditional approach.

Table 6
Comparison of Pretest and Posttest Percentage Correct by Item Type, Flores and Ganz

	Pretest	Posttest
Total	20	77
translating whole number into a fraction	4	80
translating a fraction into a whole number	22	90
multiplication of fractions with like denominators	30	93
addition/subtraction of fractions with like denominators	14	84
addition/subtraction of mixed numbers with like denominators	3	57
multiplication of whole numbers and fractions	0.02	67
Range of total scores	0 to 57	36 to 100

Jitendra, A. K., Kameenui, E. J., & Carnine, D. W. (1994). An exploratory evaluation of dynamic assessment and the role of basals on comprehension of mathematical operations. *Education and Treatment of Children, 17,* 139-162.

Affiliation: Lehigh University, University of Oregon

Design: Posttest only control group design

Participants: Twenty-four students, twelve from a school using *Connecting Math Concepts (CMC)* and twelve from a school using the Open Court mathematics series were randomly selected for participation. Both schools were public elementary schools from the same area of the county. Equal numbers of students designated by their teachers as being high, medium or low functioning were chosen. Students in both groups were predominantly Caucasian. One student in the comparison group and two students in the *CMC* group were

identified as having learning disabilities. Groups were almost evenly divided between males and females.

Description of Study: The study was designed to evaluate the relationship of the curricular programs to students' comprehension of mathematical concepts and procedures. Dynamic assessments were used in which students were given specific directions for working math problems and were then observed in doing the work and asked questions about their process and thinking. Three areas were examined: 1) conceptual understanding of borrowing; 2) the procedural connections between different mathematical concepts, such as addition and subtraction or multiplication and division; and 3) solving a two-step word problem. The latter two assessment problems were unfamiliar material to the students.

Results: The *CMC* group outperformed the other group in the all three areas. The scores of the two groups were similar in only two of the twelve sub-areas examined. In some areas the differences were so large that the students in the *CMC* group who were termed low performing had higher scores than students in the Open Court group who were termed high performing.

Table 7
Percentage Correct by Dimension and Group, Jitendra, et al., 1994

	CMC	OC
Conceptual Understanding	70.8	62.5
Connections	57	34
Word Problem Solving	37.5	20.5

McKenzie, M. A., Marchand-Martella, N. E., Moors, M. E., & Martella, R. C. (2004). Teaching basic math skills to preschoolers using Connecting Math Concepts Level K. *Journal of Direct Instruction*, *4*(1), 85-94.

Affiliation: Eastern Washington University

Design: Pretest-posttest norm comparison design

Participants: Sixteen children (6 boys and 10 girls) with ages ranging from three to five. All children attended an integrated university preschool five days a week. Eleven of the students were identified as Caucasian, four as Hispanic, and one Asian American. Five students had developmental delays.

Description of Study: This study examined the effectiveness of the *Connecting Math Concepts – Level K* program in teaching basic math skills to preschool children with and without developmental delays. Children in each session were placed in small groups based on instructional level. All students received 10-20 minutes of math instruction per instructional day for a total period of 6.5 weeks. Each day's instruction focused on

completing one lesson, and all students completed 30 lessons. Children were assessed before and after the introduction of the intervention using the curriculum-based placement test for the first grade program of *Connecting Math Concepts* and the Battelle Developmental Inventory (BDI), a measure of cognitive skills.

Results: The authors presented results separately for the typically developing children and the children with developmental delays. Both groups of students had substantial gains over the study period relative to national norms of the BDI. Scores on the grade one placement test at the end of the study indicated that all of the students were ready to begin the first grade level of the program or higher.

Table 8
Results from McKenzie, et al., Battelle Developmental Inventory, Percentile of Average Student, Gain, and Effect Sizes

	Perceptual Discrimination	Memory	Reasoning and Academic Skills	Conceptual Development	Total Cognitive Domain
Typically developing					
Pretest	49	55	58	41	55
Posttest	50	77	69	67	76
Increase	1	22	10	27	21
Children with Developmental Delays					
Pretest	16	34	3	14	12
Posttest	50	50	35	23	32
Increase	34	16	32	9	20
Total group					
Pretest	37	48	33	31	39
Posttest	50	69	58	53	63
Increase	13	21	25	22	24

Note: The percentiles were calculated by the authors from NCE scores given in the article.

Parsons, J., Marchand-Martella, N., Waldron-Soler, K., Martella, R., & Lignugaris/Kraft, B. (2004). Effects of a high school-based peer-delivered Corrective Mathematics program. *Journal of Direct Instruction*, *4*(1), 95-103.

Affiliation: Eastern Washington University, Utah State University

Design: One-group pretest-posttest norm comparison design

Participants: Students in grades 10 to 12 from a suburban high school in the Pacific Northwest. Ten students, termed “learners,” had failed Integrated Algebra, the lowest level mathematics course at the high school. Nine students, all of whom had completed Algebra II with a B grade or higher, were assigned as peer tutors. The majority of the students were

Caucasian. None of the learners received special education services for mathematics, and this was the only mathematics course in which they were enrolled.

Description of Study: This study was designed to investigate the effects of the *Corrective Mathematics* program on high school students with low mathematics performance when the instruction was provided by their peers. Peer tutors instructed the learners as individuals or in groups of two five day a week for 80 minutes each day over a period of 10 weeks. Both the learners and the peer tutors were tested before and after implementation with the Woodcock-Johnson—Revised Tests of Achievement (WJ-R ACH) Calculation and Applied Problems subtests.

Results: Results indicated that the learners and the peer tutors had higher scores on both subtests of the WJ-R ACH after 10 weeks. The associated effect sizes ranged from .59 to 1.30; substantially greater than the .25 level used to denote educationally significant effects. Even though the sample size was relatively small, three of the four changes were statistically significant. The exception was the test of calculation for peer tutors.

Table 9
Results from Parsons, et al., 2004

	Calculation		Applied Problems	
	Pretest	Posttest	Pretest	Posttest
Learners	85.5	97.1	92.9	98.7
Peer tutors	112.6	120	104.78	117.78

Przychodzin, A. M., Marchand-Martella, N.E., Martella, R.C., & Azim, D. (2004). Direct Instruction mathematics programs: An overview and research summary. *Journal of Direct Instruction*, *4*(1), 53-84.

Affiliation: Eastern Washington University

Design: Narrative Literature Review

Description of Study: This article provides a comprehensive overview of Direct Instruction mathematics programs. It compares the programs to a constructivist approach and shows how the DI programs meet the principles for improving mathematics instruction developed by the National Council of Teachers of Mathematics (NCTM). Results of studies of the efficacy of the DI mathematics programs are summarized, focusing on a meta-analysis of studies published before the early 1990s and 12 individual studies published from the 1990s to the date of the article.

Results: The meta-analysis of 37 studies published before the mid-1990s found an average effect size of 1.11 in favor of the DI programs, more than four times the level traditionally seen as educationally significant. Of the 12 individual studies reviewed, eleven found the DI

programs to be effective. The results appeared in a variety of settings with a range of students. The only exception involved a study of five students that employed a slight modification of a DI mathematics program and assessed achievement with a test designed by the teachers in the study.

Skarr, A. (2013). *Effects of using a scientifically and evidence-based mathematics curriculum to teach fifth grade math skills to a heterogeneous group of fifth graders in a parochial, Catholic school*. Masters of Education Capstone Paper, University of Portland, Portland, Oregon

Affiliation: University of Portland

Design: Pretest-posttest norm comparison design

Participants: Twenty-five fifth grade students from a private Catholic school in the Pacific Northwest. All were from one academically diverse classroom (14 males and 11 females). Iowa Test of Basic Skills (ITBS) scores before implementation indicated that three students had high-level math skills in math, 17 were at grade level, and the remaining five were below grade level. Two of the students were diagnosed with Attention Deficit Hyperactivity Disorder (ADHD), two with Fetal Alcohol Syndrome (FAS), one qualified as an English Language Learner (ELL), and two were placed on Individualized Education Plans (IEP); one for behavior, and the other for a reading learning disability.

Description of Study: This study examined the effects of implementing *Connecting Math Concepts Level E* (*CMC-E*) for a 5 month period (January to June of 2012). Pre-assessment and post-assessment was conducted with the curriculum-based EasyCBM, including a total score as well as sub-test scores related to number and operations thinking; number, operations and algebra thinking; and geometry, measurement, and algebra thinking. Data on a national sample were available for the total score.

Results: Students had significantly higher scores on all measures at the end of the study than they had at the beginning. At the start of the study the *CMC-E* students' total Easy CBM scores were markedly lower than the national sample. But, by the end of the study their scores were equivalent to those in the nation. The increases over time for the study sample were significantly greater than gains found in the nation as a whole, and the associated effect size was educationally significant. In addition, the students reported enjoying the program and becoming more confident with mathematics.

Table 10
Results from Skarr, et al., Average Scores on Easy CBM Mathematics Test

	Pretest	Posttest
Study Students	33.16	39.64
Nation	37.14	39.64

Stockard, J. (2010). Improving elementary level mathematics achievement in a large urban district: The effects of Direct Instruction. *Journal of Direct Instruction*, *10*(Winter), 1-16.

Affiliation: National Institute for Direct Instruction and University of Oregon

Designs: Post-test only control group design (Study A) and a longitudinal panel design (Study B); both with statistical controls

Participants: Two analyses were reported. The first (Study A) looked at 45,000 first grade students enrolled from 1997-98 to 2002-03 in the Baltimore County Public School System (BCPSS). The second (Study B) looked at 4800 students who were in first grade in 1997-98 or 1998-99 and were in the same schools five years later, in fifth grade. BCPSS is a very diverse school system, with high proportions of students receiving free or reduced-price lunch and from minority groups.

Description of Study: This study examined changes in mathematics achievement over time in the BCPSS by comparing achievement of students in schools that used Direct Instruction programs with those that did not. Two DI programs were used, depending on students' level and needs: *DISTAR Arithmetic* and *Connecting Math Concepts*. Mathematics achievement was assessed with the nationally normed Comprehensive Test of Basic Skills (CTBS) in the spring of each year, with sub-tests regarding 1) computations and 2) concepts and applications. Study A examined changes in the average achievement of first grade students over time. Study B looked at changes in individuals' scores from first grade to fifth grade. Statistical models assessed the extent to which changes could be attributed to exposure to the DI programs, adjusting for differences in the average socio-economic level of the students' schools. Results for the panel study were reported for both the full set of schools and for a smaller sample in which schools were matched on socio-economic characteristics.

Results: The average achievement of first grade students increased throughout the BCPSS in the study period. However, the increases were substantially larger for students in the DI schools than in the control schools. These differences were both statistically and educationally significant. The largest differences appeared in the later years of the study as Direct Instruction became fully implemented and incorporated within the schools. On average, the computational scores of first graders were 54 percentile points higher at the end of the study for the DI students and 41 percentile points higher for the control students. For the concepts and applications subtest the average scores of the DI students were 46 points higher, and the average scores of the control students were 20 points higher than at the start of the study.

Results with Study B found that students in all groups had similar gains in computational skills from first to fifth grade. With the measure of concepts and applications, scores of students in the full set of control schools declined, over average, over time; while scores of the DI students and those in the reduced sample of comparison schools increased.

However, the increase was significantly larger for the DI students. The effect size for the DI students was twice as large as that for the reduced sample of control students (.61 compared to .32). Similar results appeared with and without statistical controls.

Table 11

Percentile Scores of Average First Grader, by Year, Group, and CTBS subtest, from Stockard, 2010

Results Unadjusted for SES of School

	Computations		Concepts and Applications	
Year	DI	Control	DI	Control
1998	12	21	16	29
1999	17	20	20	27
2000	41	42	32	33
2001	56	50	42	41
2002	63	54	56	44
2003	66	56	60	46
Change	54	35	44	17

Adjusted for School Level SES

	Computations		Concepts and Applications	
Year	DI	Control	DI	Control
1998	23.8	19.6	21.3	26.5
2003	78.3	60.7	66.8	44.6
Change	54.5	41.1	41.1	20.1

Table 12

Study B: Percentile Score of Average Student, First Grade and Fifth Grade, DI, Full Control Sample, and Reduced Control Sample (Not Statistically Adjusted), from Stockard, 2010

Percentiles:	Grade	DI	Control - full sample	Control reduced sample
Computations	1st	21	32	18
	5th	50	56	52
Concepts and Applications	1st	26	42	30
	5th	45	46	41
Change				
Computations		29	24	34
Concepts and Applications		19	4	11

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, Edison school, and Galesburg-Augusta Public Schools

Design: Pretest-Posttest Control Group Design, and Posttest Only Control Group Design

Participants: Students in Michigan elementary schools. Students in two third grade classrooms and one fifth grade classroom in a high poverty school (87 percent free lunch rate) used *Connecting Math Concepts (CMC*). Students in in the comparison group were from the high poverty school and a comparison low poverty school (less than ten percent free lunch rate). There were three comparison third grade classrooms (one at the high poverty school) and two comparison fifth grade classrooms (one at the high poverty school).

Description of Study: This study compared the mathematics achievement of students who used *Connecting Math Concepts* (CMC) with those in the comparison classrooms, all of whom used the Addison-Wesley mathematics program. The third graders in the low poverty school were in their first year with the Addison-Wesley program. In the first and second grade their mathematics instruction involved extensive work with "hands on," manipulative-type activities. Three measures were examined: 1) a problem solving test based on items covered in the two curricula administered in the spring, as a post-test; 2) the norm-referenced Iowa Test of Basic Skills (ITBS) every year, which yields a total score and scores on three subtests – Computation, Concepts, and Problem-Solving – and was given in the spring of each year; and 3) the Kaufman Test of Educational Achievement-Comprehensive Form, with a group administered Computations test given to all *CMC* students in the fall and spring and an individually administered Applications subtest, given to six students of varying ability in each *CMC* classroom in the fall and spring.

Results: Results indicated that third grade students instructed with *CMC* outperformed students in the control group from the same schools on the problem solving test and had scores that were similar to or higher than students from the low poverty school. Results from the ITBS revealed that students instructed with *CMC* maintained their achievement status from the previous year while the comparison students, in both the high poverty and low poverty schools had declining scores. On average the *CMC* students gained more than one year in grade equivalent scores on both the calculation and applications subtests of the KTEA-C. Students deemed academically talented had, on average, gains of over two years.

Results with fifth graders also showed clear advantages for the *CMC* students. On the problem-solving test, the *CMC* students in the high poverty school had much higher scores than the Addison Wesley students in the same school and slightly higher scores than the Addison Wesley students in the low poverty school. Results on the KTEA indicated the more

than a year's growth in grade equivalent scores on the calculation subtest for students in all ability categories. For the applications subtest, growth was substantially stronger for the academically talented. These high poverty students were performing at an eighth grade level by the conclusion of the fifth grade. The slower rate of growth for the lower ability students was attributed to scheduling issues within the school and the inability to place students at their appropriate level. The strong performance of the *CMC* students continued into the next academic year, with differences between the *CMC* students and the Addison Wesley students becoming larger. Additionally, all of the *CMC* teachers reported very positive experiences teaching with *CMC*, specifically mentioning the high student success rate, increased on-task behavior, sophisticated problem-solving skills, and improved student confidence.

Table 13
Results from Vreeland, et al, 1994

Problem Solving Test - Third Grade - Perecent Accurate		
	% correct	% Free lunch
CMC, High Poverty School, Classroom 1	64	87
CMC, High Poverty School, Classroom 2	75	87
Addison Wesley, High Poverty School	33	87
Addison Wesley, Low Poverty School, Classroom 1	69	3
Addison Wesley, Low Poverty School, Classroom 2	46	8

ITBS, Math Percentile Rank, Third Graders, 2nd and 3rd grade			
	2nd Grade (Pre)	3rd Grade (post)	Change in %ile rank
CMC, High Poverty School, Classroom 1	52	49	-3
CMC, High Poverty School, Classroom 2	60	64	1
Addison Wesley, High Poverty School	65	50	-15
Addison Wesley, Low Poverty School, Classroom 1	26	22	-4
Addison Wesley, Low Poverty School, Classroom 2	34	22	-12

KTEA-C, Third Graders, Fall and Spring, Grade Equivalent			
	Fall	Spring	Gain
CMC, High Poverty School, Classroom 1			
Math Calculations	3	4.5	1.5 years
Math Applications	2.9	4.1	1.2 years
CMC, High Poverty School, Classroom 2			
Math Calculations	3.1	5.1	2.0 years
Math Applications	3.1	4.5	1.4 years
CMC, Academically Talented Students (n=4)			
Math Calculations	3.5	5.7	2.2 years
Math Applications	4.1	6.1	2.0 years

Fifth Grade Problem Solving Test, Percent Accurate

	% Accurate	% Free Lunch
CMC High Poverty	82	87
Addison Wesley High Poverty	36	87
Addison Wesley Low Poverty	79	8

ITBS, Math Percentile Rank, Third Graders, 2nd and 3rd grade

	4th Grade	5th Grade	Change
CMC High Poverty	46	46	None

KTEA-C Performance by Ability Level, Grade Level

	Pretest	Posttest	Gain
Academically Talented			
Math Calculations	6.0	8.0	2
Math Applications	6.3	8.5	2.2
Average and Above Average			
Math Calculations	5.1	6.7	1.6
Math Applications	4.9	5.6	0.7
Low			
Math Calculations	3.9	5.3	1.4
Math Applications	4.5	4.7	0.2

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

Affiliation: Upper Darby School District, Pennsylvania

Design: Pretest-Posttest Control Group Design

Participants: Students in first and fourth grade in eight elementary schools in a suburban Pennsylvania school district. Slightly more than 300 first graders and 350 fourth graders were included, with slightly more students in the control group.

Description of Study: One teacher from the first and fourth grade in each school volunteered to implement *Connecting Math Concepts* (*CMC*) in their classrooms. The remaining classrooms in this district were instructed with a traditional basal program and served as the control group. Students received pretesting from the *CMC* program. Posttests were designed by the teachers involved in the study. Teachers were instructed to include concepts that were common to both groups and to present them in a neutral format. The authors noted a number of problems with fidelity, especially with the first grade teachers

Results: For first graders pretest results revealed no significant differences between the means of comparable classes, although the *CMC* students had slightly lower scores. Posttest results revealed a small, but insignificant, advantage for the *CMC* students. Results for fourth graders, where teachers exhibited much better fidelity to the program, were different. The *CMC* students had significantly lower pretest scores than those in the control

group, but significantly higher posttest scores. Strong increases occurred in all but two of the eight schools. In these two schools, the CMC groups began the year significantly below the control groups, but were reported to be making substantial progress in closing the gap.

[Here is a table that could be used to summarize the results. Note that this is the study that we feel shaky about, primarily because of the low fidelity and also because the assessment was developed by the teachers.]

Table 14

Results of Wellington, 1994 - District Means Pretest and Posttest by Grade

	First Grade		Fourth Grade	
	Pretest	Posttest	Pretest	Posttest
CMC	9.7	28.2	27.0	49.6
Control	9.7	27.8	28.5	43.0