

Reading Achievement in a Direct Instruction School  
and a “Three Tier” Curriculum School

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# Reading Achievement in a Direct Instruction School and a “Three Tier” Curriculum School

## Executive Summary

This report examines data from two schools within the same Oregon school district. One school adopted the *Reading Mastery* Direct Instruction program as the core reading curriculum for all primary children, while the other used a “three tiered” model, occasionally employing DI for students that teachers felt would benefit from the instruction.

Data were available for 2 cohorts of students who were in the schools from kindergarten through third grade. There were almost equal numbers of students from each school and there were no significant differences between the schools in the students’ eligibility for free or reduced lunch, their racial-ethnic characteristics, or their special education designation. A slightly modified version of DIBELS was used to assess achievement gains over the time span of the study.

Key findings include:

- Students in the Direct Instruction School had statistically significant higher gains in Oral Reading Fluency (ORF) from first through third grade than students in the Control School. These differences were especially marked for students in special education.
- Almost all of the effect sizes comparing ORF of the two groups surpassed the usual criterion of educationally significant (.25). By the end of third grade, the effect size for ORF for the total group of students was .42, while the effect size for special education students was .73.
- The odds of a child in the DI school having levels of oral reading fluency that would indicate a possibility of academic failure were less than half that of a child in the control school.
- Similar results occurred with the measures of onset recognition fluency, phonemic segmentation fluency, and nonsense word fluency, consistently favoring the Direct Instruction students.
- There were no differences between the groups in letter naming fluency between the two groups in kindergarten. This result was expected because the DI curriculum does not emphasize learning of letter names at that level.

Results add to the literature that documents the higher levels of achievement and stronger achievement gains of students receiving Direct Instruction. They also indicate the extent to which having Direct Instruction as a core curriculum enhances achievement of all students, both those receiving special education and those only in general education programs.

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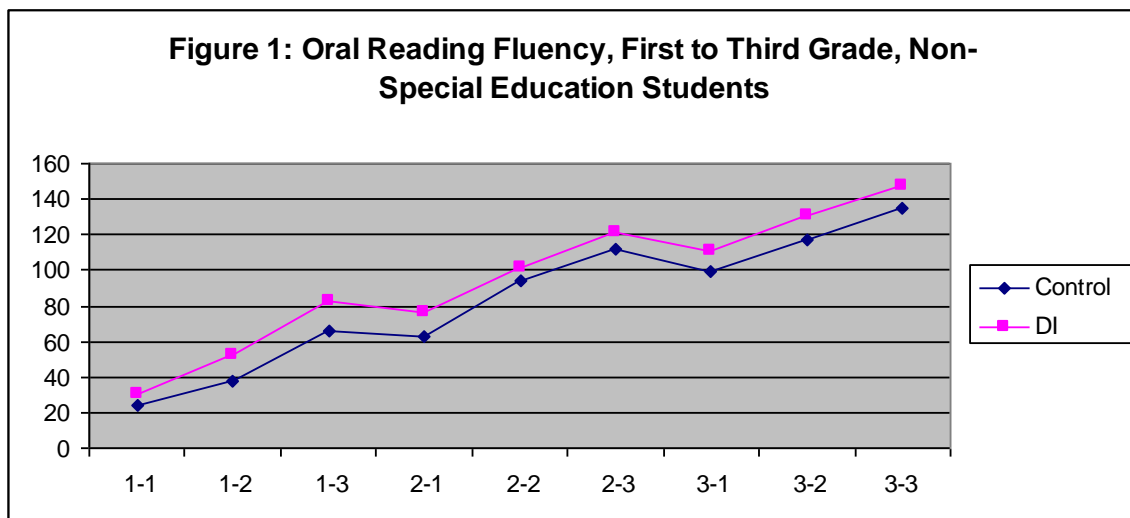
## Reading Achievement in a Direct Instruction School and a “Three Tier” Curriculum School

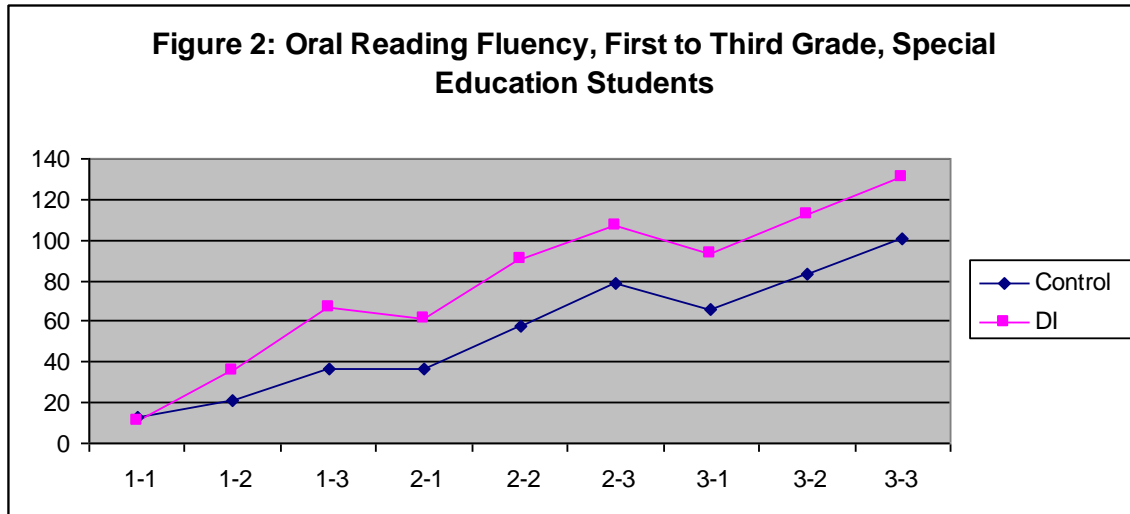
This report examines data from two elementary schools in the Bethel, Oregon, school district. One school adopted the Direct Instruction program, *Reading Mastery*, as the core reading curriculum for the primary grades. The other, termed the Control School, used a traditional curriculum, employing a “three tiered” model and occasionally using Direct Instruction for students that teachers felt would benefit from the program. This report examines the growth in reading achievement of two cohorts of students from kindergarten through third grade in each of these schools. Full details on the methodology and the statistical results are included in a technical appendix.

The analysis focuses on 169 students who were enrolled in their respective schools from Kindergarten through third grade. There were no differences between the students in the two schools in their race-ethnicity, receipt of free or reduced lunch, or proportion receiving special education services. The Dynamic Indicators of Basic Early Literacy Skills (DIBELS) scores were routinely gathered to monitor students’ progress. The DIBELS measures have high statistical reliability and can be compared against established benchmarks that indicate the level at which students should achieve to reach generally accepted literacy goals.

### Oral Reading Fluency

The most important DIBELS measure is Oral Reading Fluency (ORF), which taps students’ ability to accurately and fluently read short passages. Figures 1 and 2 illustrate the Oral Reading Fluency scores of students in the Control and Direct Instruction schools from the beginning of first grade through the end of third grade. Figure 1 gives data for the students in general education, and Figure 2 gives data for students in Special Education. In early first grade the students in the two schools had similar average scores,





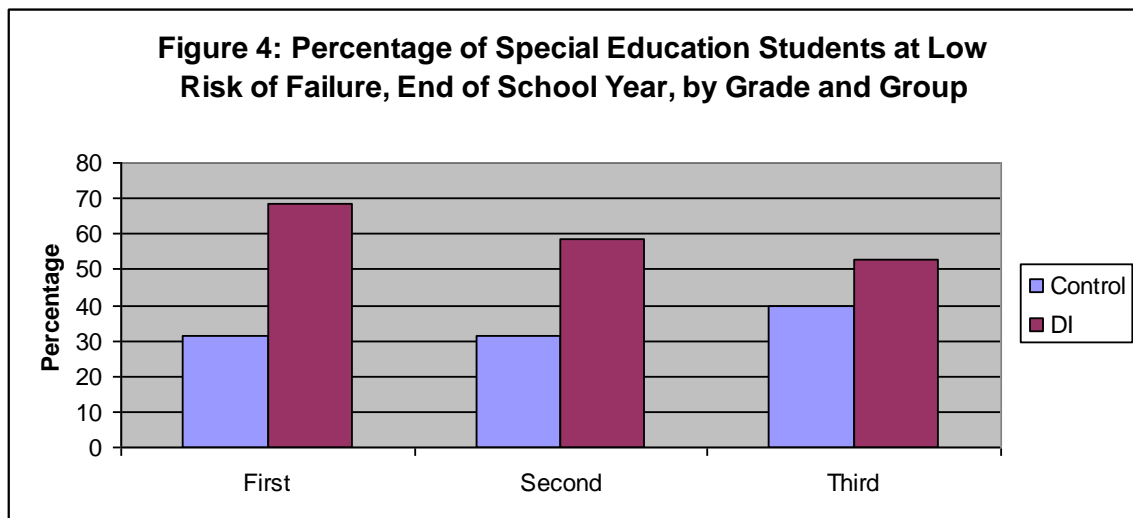
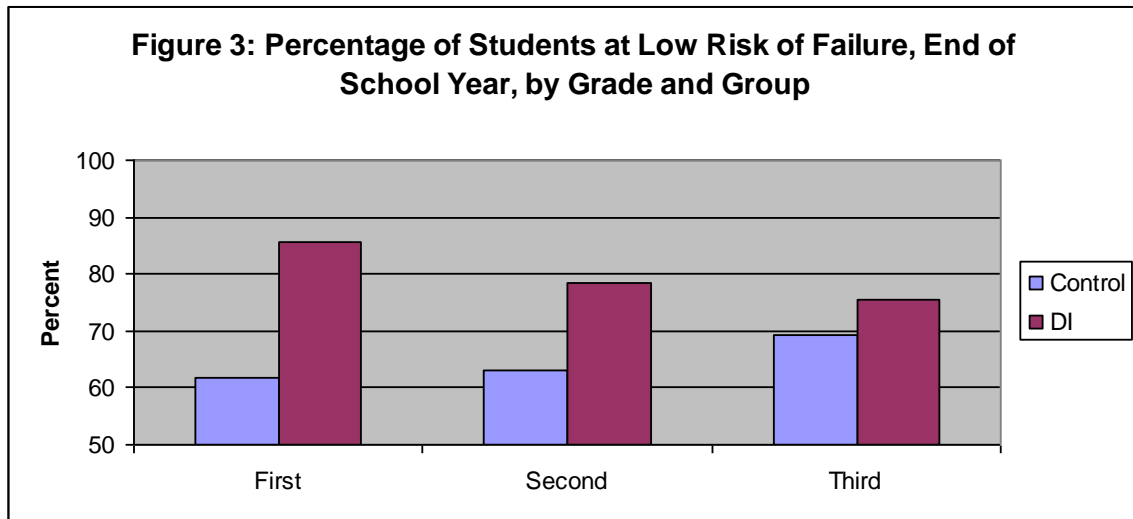
but over time the students in the Direct Instruction School had significantly stronger gains, on average, than those in the control schools. The difference in these gains occurred for both the general education and special education students, but was significantly stronger among the special education students. All of the differences were both statistically significant and substantively strong.

Effect sizes are a commonly used metric to summarize differences between two groups. As explained more fully in the Appendix, effect sizes of .25 or larger have traditionally been considered “educationally significant.” At the beginning of first grade the effect sizes summarizing the difference between the two groups were quite small. This would be expected given the groups’ general equivalence at the start of their schooling experience. But, after that time with greater exposure to the chosen curricula, the effect sizes became quite large, ranging up to .94 for special education students. Only one of the 24 effect sizes calculated for data after the beginning of first grade failed to meet the .25 criterion of educational significance.

Another way of examining the differences between the groups is to compare students’ Oral Reading Fluency scores to standard benchmarks for adequate progress. Figures 3 and 4 summarize this information for the total group of students and for special education students. The data in these figures indicate the percentage of students whose ORF scores at the end of each grade indicated that they were at “low risk” for failure in the future. In other words, the data tell the percentage of students who were “on track” for success, as compared to other students in their grade throughout the nation.

The results are clear. For both the entire group of students and for those in special education, the students in the Direct Instruction school were much more likely at each grade to be on track for future success. In the DI school over three-fourths of all the students and well over half of the special education students were meeting benchmarks at the end of each grade that would predict future success. Corresponding figures in the Control School were much lower, especially among the special education students. Calculations included in the appendix indicate that the odds that a child in a DI school

would be at risk of future academic failure were less than half, and often far less than half, that of a child in the Control school.



### Other Measures

Several other DIBELS measures were administered to students in kindergarten and first grade, and the results with these measures support the findings summarized above. Two measures were administered from mid-year in kindergarten through the end of first grade: Phonemic Segmentation Fluency (PSF), which measures the ability to separate words into phonemes, and Nonsense Word Fluency (NWF), which measures the ability to read phonetic nonsense words. Students in the Direct Instruction school had significantly greater gains from kindergarten through the end of first grade than students in the Control School in their scores on both of these measures. The gains in phonemic segmentation were especially large for special education students in the DI school.



One measure was administered only at the beginning and middle of the kindergarten year: Onset Recognition Fluency (OnRF), which taps the ability to recognize the initial sound of words. Students in the DI school had slightly higher scores on this measure, but the differences were not statistically significant. Finally, a measure of Letter Naming Fluency (LNF) was administered during kindergarten and at the beginning of first grade. The Direct Instruction curriculum does not emphasize learning letter names during those years, for research indicates that instruction in letter names at an early age is largely unrelated to later reading achievement. As expected, students in the Control school had significantly higher scores on the LNF measure.

### Summary

This report analyses the achievement of students enrolled from kindergarten through third grade in two schools in the same Oregon district. One of the schools instituted Direct Instruction as a core primary reading curriculum, while the other occasionally used DI as a supplementary program for students deemed in need of additional help. There were no significant differences between the students in the two schools in race ethnicity, eligibility for free or reduced lunch, or special education status.

Data from regularly administered DIBELS tests were available on all students in two cohorts from first through third grade. Statistical analyses indicated strong and statistically significant results in favor of the DI curriculum. Numerous calculations indicate that the differences were substantively strong and educationally meaningful. Students in the DI school had significantly greater gains in oral reading fluency, nonsense word fluency, and phonemic segmentation fluency, the skills most closely related to continued success in reading. The changes in onset recognition fluency also favored DI, but were not statistically significant. Changes in letter naming fluency, a skill not shown by the literature to be related to later success in reading and not included in the Direct Instruction curriculum in the first months of instruction, were greater in the control school. This result was expected. Changes in favor of direct instruction were stronger among special education students for both oral reading fluency and phonemic segmentation fluency.

The presence of numerous data points provides additional strength for these conclusions. The superior achievement of students in the Direct Instruction program was found with different measures and at virtually all testing periods. The effect sizes were consistently strong and educationally important, resulting in students in the DI school being at substantially lower risk for educational failure in future years.

These results appear to provide additional evidence in support of the efficacy of Direct Instruction as a core curriculum for all students. The school that employed the Direct Instruction program *Reading Mastery* as the core curriculum had significantly greater student gains over time and fewer students at risk for problems in the future. These results appeared with all students, both those in general education and those in special education.

In addition, for some of the measures the gains in achievement were especially strong for students in special education. As such, the results indicate that special education students may be better served in schools that employ Direct Instruction as a core curriculum rather than by simply use it as one of a variety of possible interventions in a “three tiered” model. That is, the systematic implementation of Direct Instruction within the entire school appears to be better for both the general population and the special education population of students.

## Technical Appendix

### Methodology

The discussion below describes the sample as well as the measures and analysis that were employed.

#### *The Sample*

Characteristics of the two schools, as of 2001-02, the year before the first year of data availability, are given in Table 1. The DI school included a broader span of grades (K through 8) than the control school (K through 5), and had slightly more students at each grade level (mean = 78) than the control school (mean = 68). In addition, the DI school had a slightly higher percentage of students on free and reduced lunch and lower scores on the statewide reading assessments (from students in grades 3 and 5). All of these factors could indicate that the DI school had a student body that was slightly more at risk. In contrast, however, the attendance rates of the two schools were almost identical, and the DI school had a lower percentage of minority students enrolled.

Table 1: Characteristics of the DI and Control School, 2001-02

	DI	Control
Grade Range	K-8	K-5
Enrollment, 2001-2	704	407
Free and reduced Lunch (%)	34.1	26.8
Minority enrollment (%)	9.8	17.9
Oregon State Assessment Reading Score, 2002	94.3	107.1
Attendance Rate, 2001-02 (%)	93.8	94.9

As noted in the text, the Direct Instruction School used *Reading Mastery* as the core curriculum in grades K-3. In fourth grade DI was used occasionally, but was not the core curriculum. In addition, in kindergarten, students in the Title I program received additional instruction with another phonics program (Optimize, now called Scott Foresman Reading). The control school did not implement Direct Instruction except for a few children who were judged as needing additional instruction. This was part of a “three tiered” plan where different levels of intervention were used depending upon the perceived needs of the students. Our analysis should be seen as an examination of the extent to which adopting DI as the core curriculum within a school can produce changes in the average levels of achievement and achievement gain over time.

In our analysis we were not able to ascertain which students received the supplemental instruction in Direct Instruction within the control school. Thus, the analysis should be seen as a conservative test of Direct Instruction, for some of the students within the control school, most likely those who were receiving special

education, may have had Direct Instruction. Any bias that would result from the few students in the control school that received DI would act against the possibility of significantly higher achievement in the DI schools. In addition, it would be difficult to argue that the bias that could be introduced by additional phonics instruction for a few students in the DI schools in kindergarten would persist through third grade, the end of our data collection period.

Data were available from 2 cohorts of students who were in the schools from kindergarten through third grade: 72 children who began kindergarten in 2002-03 and 97 who began kindergarten in 2003-04. Students were almost evenly split between the two schools with 85 in the control school and 84 in the DI school. Analyses with data within each school indicated no significant differences between the two cohorts on demographic characteristics, achievement measures or achievement growth. Thus the two cohorts are considered jointly.

Eighty-nine percent of the students were non-Hispanic whites, 29 percent received free or reduced lunch, and 20 percent were in special education. Differences between the students in the two schools were not statistically significant on any of these measures. That is, the students in the analysis from the two schools were very similar in race-ethnicity, poverty status, and probability of assignment to special education.

### *Measures*

In both schools data were routinely gathered using a slightly modified version of the Dynamic Indicators of Basic Early Literacy Skills (DIBELS). The DIBELS measures are a set of standardized, individually administered indicators of early literacy development that take only about one minute to administer, can be used to regularly monitor the development of both pre-reading and early reading skills, and have very high reliability. All measures result in numeric scores that indicate the number of correct responses given in one minute. Benchmarks have been established to indicate where students should be at the beginning, middle, and end of a school year to be “at risk,” at “some risk,” or at “low risk” of not achieving established literacy goals.

Table 2 lists the measures that were used and the times of administration. A measure of letter naming fluency (LNF) was given three times in kindergarten and once in first grade. Because fluency in letter naming is not a necessary precursor to reading, it is not a core element of the DI curriculum in kindergarten. Thus, we did not expect to find any differences between the control and treatment school on this measure.

The other measures are more directly related to reading. Students exposed more consistently to the DI curriculum, as in the treatment school, would be expected to have higher scores and greater gains on these measures. The lowest level of these skills, recognizing the beginning sound of words, is measured by the onset recognition fluency (OnRF) measure, which was administered two times in the kindergarten year. Two measures were administered twice in kindergarten and three times in first grade: phonemic segmentation fluency (PSF), which measures the ability to separate words into

phonemes; and nonsense word fluency (NWF), which measures the ability to read phonetic nonsense words.

The most important measure is oral reading frequency (ORF), a measure of how fluently a child reads correctly. This measure was administered three times a year beginning in first grade. The ORF was the major focus of our analysis, although results are also presented for the other measures.

Table 2: DIBELS Measures Used in Analysis and Year of Administration

	Kindergarten	First Grade	Second Grade	Third Grade	Total
Letter naming fluency	3	1			4
Onset recognition fluency	2				2
Phonemic segmentation fluency	2	3			5
Nonsense word fluency	2	3			5
Oral reading fluency		3	3	3	9
Total number of measures	9	10	3	3	25

Note: Numbers in the table refer to the number of administrations that occurred for a given test in a given year.

### *Analysis*

Students' scores on the first administration of each test were compared between those with and without free and reduced lunch, special education status, and minority status. The only characteristic consistently related to differences in the initial scores was special education status, with special education students always having lower scores. Thus, in the following analyses, students' special education status is included as a control variable. If DI is an effective treatment, it would be expected that it would impact both regular and special education students.

Two different techniques were used to analyze the data. The first is a repeated measures analysis of variance with the test scores as repeated measures and the school, or treatment group, as well as special education status as factors. We would expect a significant linear effect of treatment, with children gaining proficiency over time. If having DI as a core curriculum is more effective than the three tier model, we would also expect a significant two-way interaction between these over time changes and school, with greater gains for the treatment school. If school wide implementation of DI is more effective with special education students than the three tier model we would expect a significant three way interaction (school by special education by DIBELS measure). Mean scores and Cohen's d, as a measure of effect size, are included to provide descriptive understandings of the trends.

For the measure of oral reading fluency (ORF), arguably the most important indicator and the one for which we have the most data, we also calculated whether children’s scores placed them “at risk” and whether they were “at low risk” for not meeting literacy goals. We compared the percentage of students in each category across the two schools using simple chi-square tests and also calculated the odds of children falling into these categories.

## Results

The results with oral reading fluency (ORF) are presented first, followed by the results with the other measures.

### *Oral Reading Fluency*

Table 3 gives the means and standard deviations for the ORF scores for each school and each administration for both the total sample and by special education status. Table 4 gives the results of the analysis of variance. The three-way interaction (ORF by school by special ed status) is statistically significant ( $p < .001$ ), indicating that the changes over time in ORF differ both by school and by special education status.

Examining the means, one can see that this interaction results from the very strong gains of special education students in the DI school. The total group of students in the DI school had stronger gains, on average, than those in the control school, but these gains were even stronger among the special education students. On average, students in the control school gained 106 words per minute on the ORF from the beginning of first grade to the end of third grade, while those in the DI school gained 116 words (Panel A). Among special education students, those in the control school only gained 88 words, while those in the treatment school gained 119 words (Panel B). Similar results appeared with the non-special education students, although the differences weren’t quite as dramatic: those in the control school gained an average of 111 words while those in the treatment school gained, on average, 117 words (Panel C).

Table 3: Means and Standard Deviations, Oral Reading Fluency Measures, by School and Grade, Total Sample and by Special Education Status

A. Total Sample	Control School			DI School			Cohen's D
	Mean	S.D.	N	Mean	S.D.	N	
1st grade, first of year	23	29	60	28	31	56	0.17
1st grade, mid year	34	31	84	49	34	83	0.46
1st grade, end of year	60	37	84	80	38	83	0.52
2nd grade, first of year	58	34	85	73	35	83	0.44
2nd grade, mid year	87	37	84	99	37	83	0.33
2nd grade, end of year	105	33	84	118	35	83	0.38
3rd grade, first of year	93	34	81	107	38	79	0.39
3rd grade, mid year	111	34	80	127	39	79	0.43
3rd grade, end of year	129	34	78	144	38	78	0.42
Difference 1-1 to 3-3	106			116			

<b>B. Special Education Students</b>	<b>Control School</b>			<b>DI School</b>			<b>Cohen's D</b>
	<b>Mean</b>	<b>S.D.</b>	<b>N</b>	<b>Mean</b>	<b>S.D.</b>	<b>N</b>	
1st grade, first of year	13	12	8	11	9	7	-0.13
1st grade, mid year	21	23	16	36	27	16	0.59
1st grade, end of year	37	26	16	67	39	16	0.94
2nd grade, first of year	37	25	16	61	32	16	0.85
2nd grade, mid year	58	31	16	91	48	16	0.84
2nd grade, end of year	79	29	16	107	42	17	0.81
3rd grade, first of year	66	29	15	93	42	17	0.77
3rd grade, mid year	84	32	15	113	42	17	0.79
3rd grade, end of year	101	37	15	130	45	17	0.73
Difference 1-1 to 3-3	88			119			

<b>C. Non-Special Education Students</b>	<b>Control School</b>			<b>DI School</b>			<b>Cohen's D</b>
	<b>Mean</b>	<b>S.D.</b>	<b>N</b>	<b>Mean</b>	<b>S.D.</b>	<b>N</b>	
1st grade, first of year	24	30	52	30	32	49	0.19
1st grade, mid year	37	32	68	52	34	67	0.45
1st grade, end of year	66	37	68	83	37	67	0.45
2nd grade, first of year	63	34	69	76	35	67	0.38
2nd grade, mid year	94	35	68	101	34	67	0.21
2nd grade, end of year	112	31	68	121	33	66	0.30
3rd grade, first of year	99	32	66	111	37	62	0.34
3rd grade, mid year	117	32	65	131	37	62	0.38
3rd grade, end of year	135	31	63	147	36	61	0.37
Difference 1-1 to 3-3	111			117			

The final column in Table 3 gives Cohen's *d*, a standard measure of effect size, calculated by dividing the difference between the means by the common standard deviation. Traditionally, *d* values of .25 or larger are considered educationally significant. The effect sizes are small at the first administration of the ORF in Grade 1, which would be expected given the general equivalence of the two groups. After that time, and through the end of third grade, the *d* values become quite large, ranging up to .94 for special education students at the end of first grade. Only one of the 24 effect sizes from the comparisons after the beginning of first grade fails to meet the .25 criterion (.21 for non-special education students at the middle of second grade).

Table 4: Analysis of Variance, ORF by School and Special Education Status

<u>Within Subjects Effects</u>	F	df	prob.
ORF	336.11	8	<.001
ORF by School	5.56	8	<.001
ORF by Special Ed Status	0.34	4	0.85
ORF by School by Special Ed	4.16	8	<.001
<u>Between Subjects Effects</u>			
School	5.82	1	0.02
Special Education Status	2.01	1	0.16
School by Special Ed	0.99	1	0.32
Error df		98	

Table 5 reports the percentage of students in each school who, based on the ORF scores, were “at risk” of not meeting literacy goals and the percentage at “low risk” of not meeting these goals. Values are given for each administration beginning with the middle of first grade. The students in the DI school outperform those in the control school in all of the comparisons. While not all of the individual comparisons are statistically significant, the chance of having all of the differences favor the treatment school is extremely small.

Examination of the magnitude of the percentages is telling. With most assessment points within the treatment school, fewer than five percent of the students are deemed at risk of not reaching the goals and students in the control school are at least twice as likely as those in the treatment school to be at risk. Similarly, students in the treatment school are much more likely to be deemed at low risk of not meeting literacy goals. The differences are even more striking with the special education students. In fact, over half of the special education students in the DI school are at low risk of failure.

The final column of Table 5 reports the odds ratios, another type of effect size. The “odds” simply refer to the relative chance of a child falling in one group or another. For instance, for students in the control school at the mid-year of first grade (the first row of data in panel B), 56% were deemed at low risk of not meeting achievement goals, while 44% did not fall in this category. Thus, the odds that a child in the control school would be at low risk were  $56/44 = 1.27$ , close to even. In the treatment school, 82% of the students at the mid-year point of first grade were deemed at low risk of not meeting achievement goals. Thus, the odds that a child in the treatment school would be at low risk were  $82/18 = 4.52$ , much better than even. The odds ratio is calculated by simply dividing these two values ( $4.52/1.27 = 3.56$ , the value in the last column of the first row of Panel B). This tells us that the odds that a treatment school child will be at low risk is over 3.5 times as great as the odds that a control school child will be at low risk.



Table 5: Percentage of Students "At Risk" and "At Low Risk" of Not Meeting Literacy Goals by School and Administration

*A. Percent of Students At Risk by School*

	Control	DI	Chi-square	prob.	n	Odds ratio
1st grade, mid year	5	2	0.67	0.41	167	0.49
1st grade, end of year	6	1	2.72	0.10	167	0.19
2nd grade, first of year	14	2	7.54	0.01	168	0.15
2nd grade, mid year	17	7	3.53	0.06	167	0.39
2nd grade, end of year	8	4	1.65	0.20	167	0.41
3rd grade, first of year	12	5	2.66	0.10	160	0.38
3rd grade, mid year	5	3	0.67	0.41	159	0.49
3rd grade, end of year	6	3	1.35	0.25	156	0.39

*B. Percent of Students at Low Risk by School*

	Control	DI	Chi-square	prob.	n	Odds Ratio
1st grade, mid year	56	82	13.14	<.001	167	3.56
1st grade, end of year	62	86	12.02	0.001	167	3.63
2nd grade, first of year	54	76	8.75	0.003	168	2.67
2nd grade, mid year	70	83	3.88	0.05	167	2.09
2nd grade, end of year	63	78	4.66	0.03	167	2.11
3rd grade, first of year	68	76	1.28	0.26	160	1.49
3rd grade, mid year	69	81	3.18	0.08	159	1.93
3rd grade, end of year	69	76	0.80	0.37	156	1.38

*C. Percent of Special Education Students at Low Risk by School*

	Control	DI	Chi-square	prob.	n	Odds Ratio
1st grade, mid year	31	63	3.14	0.08	32	3.68
1st grade, end of year	31	69	4.50	0.03	32	4.82
2nd grade, first of year	31	56	2.03	0.15	32	2.83
2nd grade, mid year	44	56	0.50	0.48	32	1.65
2nd grade, end of year	31	59	2.53	0.11	33	3.15
3rd grade, first of year	27	65	4.63	0.03	32	5.03
3rd grade, mid year	40	59	1.13	0.29	32	2.14
3rd grade, end of year	40	53	0.54	0.46	32	1.68

Note: Benchmarks are not available for the first administration in first grade. Special education students are included in the values in panels A and B. For Panel A the odds ratio describes the relative odds of a student in the DI school versus a student in the control school being at high risk of failure. For panels B and C the odds ratio describe the relative odds of being at low risk of failure.

In general, the odds ratios are striking. For all administrations, the odds of a treatment school child being at risk of failure are less than half – often far less than half – that of a child in the control school. (These are the values in Panel A of Table 5.) Similar results appear at the other end of the scale. The students in the treatment school have much higher odds of being at a low risk of academic failure, and these results appear for both the total group of students (Panel B) and for special education students (Panel C).

#### *Other Indicators*

Table 6 gives the analysis of variance results for the other DIBELS measures (Panel A) and the associated descriptive statistics for both the total group (Panel B) and special education students (Panel C). These other measures were only given through the end of first grade and thus should be seen as providing only supplementary information to that provided by the longer-term data on the ORF.

The first two columns have results for letter naming fluency (LNF), which was assessed three times in kindergarten and at the beginning of first grade. It should be recalled that we did not expect that students in the treatment school would have greater gains in letter naming fluency (LNF) because that skill is not explicitly taught until a later point in the DI curriculum. The data support this expectation. The results of the analysis of variance (Panel A) indicate significant changes over time ( $p < .001$ ) as well as significant main effects of school ( $p = .04$ ) and special education status ( $p < .001$ ). Comparisons of the means (Table 7) indicate that students in the control school had higher scores than students in the treatment school and special education students had lower scores than non special education students at all administrations of the test.

Onset Recognition Fluency was tested at only the first and middle of the kindergarten year. The analysis of variance results indicate a significant effect only for the over time changes ( $p < .001$ ), with a trend for the main effect of school ( $p = .09$ ). Examination of the means indicates higher values for the treatment school for both administrations. The increase in scores is slightly higher for the treatment school, but the interaction effect does not reach traditional levels of significance ( $p = .12$ ).

Results for Phonemic Segmentation Fluency, which was assessed from the middle of kindergarten through the end of first grade, show a significant three-way interaction effect ( $p = .005$ ), as well as significant two-way interactions between gains and school ( $p < .001$ ) and gains and special education status ( $p = .04$ ). Examination of the means indicates that, as expected, the gains were stronger in the treatment school than the control school and that this was especially so with the special education students. The students in the DI school had scores at the first testing that were substantially lower than those of students in the control school, but had virtually identical scores by the last administration.

Finally, results with Nonsense Word Fluency, which was assessed from mid kindergarten through first grade, indicate significant two-way interactions of gains by school ( $p = .002$ ) and gains by special education status ( $p < .001$ ), but not a significant three-way interaction ( $p = .38$ ). Examination of the means indicates that, as expected,

Table 6: Analysis of Variance Results for Letter Naming Fluency, Onset Recognition Fluency, Phonemic Segmentation Fluency, and Nonsense Word Fluency with Schools and Special Education Status as Factors

*A: Analysis of Variance Results*

	Letter Naming Fluency		Onset Recognition Fluency		Phonemic Segmentation Fluency		Nonsense Word Fluency	
	F	prob.	F	prob.	F	prob.	F	prob.
Within Subjects Effects								
Change over time	160.92	<.001	97.32	<.001	42.44	<.001	166.72	<.001
Change by School	1.57	0.20	2.43	0.12	7.53	<.001	4.35	0.002
Change by Special Ed Status	2.27	0.08	0.38	0.54	2.56	0.04	5.40	<.001
Change by School by Sp. Ed.	0.30	0.82	2.13	0.15	3.81	0.005	1.05	0.38
Between Subjects Effects								
School	4.12	0.04	2.93	0.09	2.88	0.09	0.07	0.79
Special Education Status	14.94	<.001	1.03	0.31	17.20	<.001	13.75	<.001
School by Special Education	0.14	0.71	0.06	0.81	0.00	0.99	0.02	0.89

*B: Mean Values of LNF, OnRF, PSF, and NWF by Time of Administration and School, Total Group*

Time of Administration	LNF		OnRF		PSF		NWF	
	Control	DI	Control	DI	Control	DI	Control	DI
K, first of year	18	16	15	17	----	----	----	----
K, mid year	32	26	29	34	45	37	30	26
K, end of year	47	39	----	----	50	50	42	41
1st grade, first of year	41	37	----	----	48	44	40	37
1st grade, mid year	----	----	----	----	53	52	67	69
1st grade, end of year	----	----	----	----	56	55	86	95
Gains	23	21	14	16	11	18	56	69

*C: Mean Values of LNF, OnRF, PSF, and NWF by Time of Administration and School, Special Education Students*

Time of Administration	LNF		OnRF		PSF		NWF	
	Control	DI	Control	DI	Control	DI	Control	DI
K, first of year	14	9	13	14	----	----	----	----
K, mid year	26	16	25	35	40	22	24	17
K, end of year	37	29	----	----	43	48	34	32
1st grade, first of year	31	27	----	----	42	42	29	23
1st grade, mid year	----	----	----	----	47	47	48	55
1st grade, end of year	----	----	----	----	51	50	56	76
Gains	18	18	12	21	12	29	33	60

Note: Degrees of freedom for within subject effects are 3, 156 for LNF, 1, 162 for OnRF, and 4, 154 for PSF and NWF. Degrees of freedom for between subject effects are 1, 156 for LNF, 1, 162 for OnRF, and 1,154 for PSF and NWF. "Gains" reported in Panels B and C are simply the difference between the last and the first administration of a test.

gains were much stronger in the treatment school than in the control school. The average scores of students in the DI school were lower than those of students in the control school at the first administration, but were substantially higher by the last administration.