

Long-Term Effects of Full-day Kindergarten in Third and Fourth Grade (FEDS ~ L4)

Supplementary Study to Full/Extended Day Kindergarten Longitudinal Study
Effects of Full-Day Kindergarten in Subsequent Years: Third Grade (FEDS-L3)

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Recent research on the benefits of full-day kindergarten indicates that students who attend full-day kindergarten experience stronger positive academic outcomes when compared to students in half-day classrooms. Similar national research suggests that the positive academic effects of full-day kindergarten are long lasting, and remain at least through the third grade year.

The *Long-Term Effects of Full-day Kindergarten in Third Grade and Fourth Grade (FEDS-L4)* is a supplementary study to the *Full/Extended Day Kindergarten Longitudinal Study Effects of Full-Day Kindergarten in Subsequent Years: Third Grade*. For *FEDS-L4*, the kindergarten student cohort examined is students who were enrolled in 12 Clark County School District (CCSD) schools that had both full-day kindergarten classrooms and half-day kindergarten classrooms in 2005-2006. At each school, parents had the option to enroll their student in traditional half-day kindergarten, or to enroll them in fee-based full-day kindergarten. Both reading and mathematics achievement outcomes for third grade (2008-2009) and fourth grade (2009-2010) were included as the outcome measure in the analyses. ***The results of the FEDS-L4 indicate that the positive effects of attending full-day kindergarten remain through third and fourth grade. When they are in third and fourth grade, students who attended full-day kindergarten continue to outperform students who attended half-day in both reading and mathematics.***

FEDS-L4 STUDENT SAMPLE

The student sample chosen for the FEDS-L4 study was selected to maximize the likelihood that estimates of full-day kindergarten effects were as accurate as possible. The sample consists of students who attended tuition-based full-day kindergarten (treatment group) with students who attended half-day kindergarten (comparison group) in the same 12 elementary schools.

Table One shows the numbers of kindergarten students who were enrolled in kindergarten at the 12 schools in 2005-2006. The number of half-day kindergartners consists of both morning only and afternoon only session only students.

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| School Name | Number of Full-day Students | Number of Half-day Students |
|--------------------------------|-----------------------------|-----------------------------|
| BILBRAY Elementary School | 128 | 25 |
| CONNERS Elementary School | 101 | 24 |
| GIVENS Elementary School | 55 | 26 |
| HUMMEL Elementary School | 89 | 29 |
| LAMPING Elementary School | 82 | 105 |
| LUMMIS Elementary School | 54 | 29 |
| MACK Elementary School | 50 | 29 |
| NEAL Elementary School | 67 | 55 |
| SCHERKENBACH Elementary School | 111 | 53 |
| TANAKA Elementary School | 166 | 26 |
| TAYLOR GLEN Elementary School | 65 | 55 |
| WIENER Elementary School | 178 | 27 |
| Total | 1146 | 483 |

Tables Two and Three show the demographic profile of the FEDS-L4 student sample. While there are minimal differences between the full and Half-day groups, these are controlled for in the analyses below.

| Attend Type | American Indian/ Alaskan Native | Asian/Pacific Islander | Black | Hispanic | White |
|-------------|------------------------------------|---------------------------|-------|----------|-------|
| Half-day | 1.22 | 13.44 | 12.48 | 19.98 | 52.88 |
| Full-day | 0.41 | 11.39 | 5.80 | 13.66 | 68.74 |

| Attend Type | Gender | | Various Subgroups | | |
|-------------|--------|--------|-------------------|------|-------|
| | Male | Female | FRL | IEP | ELL |
| Half-day | 50.35 | 49.65 | 23.80 | 8.03 | 13.35 |
| Full-day | 51.97 | 48.03 | 7.93 | 8.70 | 5.80 |

FEDS-L4 STUDENT ACHIEVEMENT MEASURES

For the FEDS-L4 study, both mathematics and reading Criterion Reference Test (CRT) scores were used as measures of academic achievement. CRTs are administered to all third and fourth grade students attending CCSD. The scale scores on both reading and mathematics CRTs range from 100 to 500 points. Based on this test, students are considered proficient if their scale score is 300 or more and not proficient if their scale score is 299 or less.

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In addition, CRT proficiency benchmarks are used to explore if there are differences in proficiency rates between the full-day and half-day study cohort. Emergent, approaches standards, meets standards, and exceeds standards are the 4 benchmark categories. Students who are in the emergent and approaches categories are considered not proficient, while students in the meets and exceeds standards categories are considered proficient.

Data Compilation

The FEDS-L4 student CRT scores were matched to the primary student database (Platinum Report Facility – PRF) housed at CCSD. The PRF database was used to determine student level demographics, including:

- Free and Reduced Lunch status;
- English Language Proficiency status;
- Ethnicity
- Gender
- Special Education designations
- CRT scale score and proficiency level

Student locations by grade and school were tracked using this database.

METHODS

This study hopes to approximate the benefits of a quasi-experimental design by examining a closely matched treatment and comparison group and examining students within the same school to account for school level effects. Comparing groups within the same school allows for more precise estimates of the relationship between full-day students and achievement outcomes. The major advantage of using a quasi-experimental design is that it can suggest causal effects. For FED-L4, whether full-day kindergarten is causally related to higher student test scores in later years.

Several methods were used to examine if there were statistically significant differences between full-day and half-day students when in third and fourth grade.

T-test – CRT Mean Reading and Mathematics Scores

Inferential statistics were used to examine if there were differences in mean CRT reading and mathematics scores for full-day and half-day kindergarten groups. The t-test statistic was used to determine if these differences were statistically significant.

Ordinary Least Squares Multivariate Regression

There are minimal differences in demographics between full-day and half-day kindergarten cohorts. In order to control for these differences statistically, Ordinary Least Squares (OLS) Multivariate Regression was used to analyze the relationship between participation in full-day kindergarten and CRT scale scores, controlling for important student characteristics.

Control Variables

Several control variables that also have been known to have a relationship to student academic outcomes are used to isolate and estimate the effects of full-day kindergarten. Controlling for other variables helps to ensure that the relationship between full-day kindergarten and CRT score is not actually caused by other these factors. When controlling for these things, there is more confidence that the key variable of interest, full-day kindergarten, is associated with changes in CRT scores.

Model

In OLS regression analysis is a linear equation is used to predict the value of the dependent variable, CRT score, using information regarding a number of independent variables. The following equation specifies the OLS (Ordinary Least Squares) regression model used for this analysis.

$$Y = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \epsilon$$

where:

Y = CRT reading or math scale score OR Y = CRT Benchmark category

X1 = Full or Half time status in kindergarten (0 = half-day; 1 = full-day)

X2= Free and Reduced Lunch Status (0 = FRL eligible; 1 = FRL not eligible)

X3= English Language Learner Status (0 = not English proficient; 1 = English proficient)

X4= Special Education Status (0 = Special Education designated; 1 = non-Special Education)

X5= Ethnicity (0 = White; 1 = Black; 2 = Asian/Pacific Islander; 3 = Hispanic 4 = American Indian

X6= Gender (0 = Female; 1 = Male)

This equation specifies the variability in the dependent variable (Y = CRT score) is due to six independent variables; X₁ (full-day or half-day status), X₂ (FRL status), X₃ (ELL status) and X₄ (special education status), X₅ (Ethnicity), X₆ (Gender). These independent variables are assumed to have a linear and additive effect on Y (CRT score). This effect size is represented by the unstandardized partial regression coefficients $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5,$ and β_6 . Each β represents the amount of change in Y produced by a (unit) or difference in an X (with the other Xs held constant). For this analysis, the dependent variable Y (CRT score) was measured in two ways. First, the scale score from the CRT reading and mathematics is used as the dependent variable. Second, CRT proficiency benchmark category is used.

RESULTS – CRT READING AND MATHEMATICS MEAN SCALE SCORES

The following findings are based on an analysis of the mean CRT scores of full-day treatment and half-day control group of kindergarten students. CRT scores are taken from their third grade year (2008-2009) and fourth grade year (2009-2010).

| Table 4. Full and Half-day Kindergarten Cohort 2005-2006 Reading and Math CRT Mean Scores, 2009 and 2010 | | | |
|---|-----------------|-----------------|--|
| Test Type and Year | Half-day | Full-day | Full-day difference over Half-day |
| CRT Reading Mean Scale Score - 2009 (3rd Grade) | 332.04 | 351.80 | 19.76* |
| CRT Math Scale Mean Score - 2009 (3rd Grade) | 331.99 | 360.02 | 28.03* |
| CRT Reading Mean Scale Score - 2010 (4th Grade) | 337.61 | 366.91 | 29.30* |
| CRT Math Mean Scale Score - 2010 (4th Grade) | 325.58 | 347.68 | 22.10* |

*Significant at $p < .000$

Table four shows that on all tests, students who attended full-day kindergarten outperform students who attended half-day kindergarten. The differences between student’s scores are simply the subtraction of the half-day student mean CRT score from the full-day student CRT mean score. The range of differences runs from 19.76 to 29.30 points higher. T-tests were used to check if each result was statistically significant. For the CRT mean scale score analyses:

- Full-day kindergarten student’s scores were statistically significantly higher (+19.76) in CRT reading in 2009.
- Full-day kindergarten student’s scores were statistically significantly higher (+28.03) in CRT mathematics in 2009.
- Full-day kindergarten student’s scores were statistically significantly higher (+29.30) in CRT reading in 2010.
- Full-day kindergarten student’s scores were statistically significantly higher (+22.10) in CRT mathematics in 2010.

| Table 5. T-test of Significance for CRT Reading and Mathematics, 2009 and 2010 | | | | | | | |
|---|----------|-------------|----------|-----------|--------------------------------|------------------------|------------------------------|
| | F | Sig. | t | df | Significance (2-tailed) | Mean Difference | Std. Error Difference |
| CRT Reading Scale Score 2009 | 2.763 | 0.097 | 5.275 | 1292 | 0 | 19.758 | 3.746 |
| CRT Math Scale Score 2009 | 0.887 | 0.346 | 6.616 | 1292 | 0 | 28.038 | 4.238 |
| CRT Reading Scale Score 2010 | 8.046 | 0.005 | 6.571 | 1264 | 0 | 29.302 | 4.459 |
| CRT Math Scale Score 2010 | 4.751 | 0.029 | 7.659 | 1263 | 0 | 22.107 | 2.886 |

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To better understand the strength of the effect of full-day kindergarten on CRT reading and mathematics scores, an OLS multiple regression analysis was conducted. The results of this analysis are depicted in Tables six through nine. The results indicate that even when controlling for important demographic characteristics of students (FRL status, ELL status, Special Education status, ethnicity, and gender) *if a student attended full-time kindergarten it was statistically significant and positively related to higher CRT reading and mathematics scores.*

| Table 6. Regression Output, CRT Reading Mean Score 2009 | | | | | | |
|---|-----------------------|-----------------------------|------------|---------------------------|---------|--------------|
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Significance |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 351.140 | 3.102 | | 113.204 | 0.000 |
| | Full-day Kindergarten | 13.822 | 3.705 | 0.102 | 3.731 | 0.000 |
| | Ethnicity | -2.321 | 1.211 | -0.056 | -1.917 | 0.055 |
| | FRL | -28.853 | 4.500 | -0.177 | -6.412 | 0.000 |
| | IEP | -29.750 | 6.541 | -0.122 | -4.548 | 0.000 |
| | GENDER | -11.424 | 3.410 | -0.090 | -3.350 | 0.001 |
| | ELL | -10.610 | 5.675 | -0.054 | -1.870 | 0.062 |

a. Dependent Variable: CRT Reading Scale Score 2009

| Table 7. Regression Output, CRT Mathematics Mean Score 2009 | | | | | | |
|---|-----------------------|-----------------------------|------------|---------------------------|--------|--------------|
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Significance |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 340.096 | 3.558 | | 95.584 | 0.000 |
| | Full-day Kindergarten | 23.119 | 4.250 | 0.149 | 5.440 | 0.000 |
| | Ethnicity | -3.252 | 1.389 | -0.069 | -2.342 | 0.019 |
| | FRL | -28.516 | 5.162 | -0.154 | -5.525 | 0.000 |
| | IEP | -32.381 | 7.503 | -0.117 | -4.316 | 0.000 |
| | GENDER | 8.003 | 3.911 | 0.055 | 2.046 | 0.041 |
| | ELL | 6.446 | 6.509 | 0.029 | 0.990 | 0.322 |

a. Dependent Variable: CRT Math Scale Score 2009

Table 8. Regression Output, CRT Reading Mean Score 2010

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Significance |
|-------|-----------------------|-----------------------------|------------|---------------------------|--------|--------------|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 360.550 | 3.754 | | 96.041 | 0.000 |
| | Full-day Kindergarten | 21.249 | 4.478 | 0.134 | 4.745 | 0.000 |
| | Ethnicity | -1.568 | 1.473 | -0.032 | -1.065 | 0.287 |
| | FRL | -31.198 | 5.525 | -0.162 | -5.646 | 0.000 |
| | IEP | -33.529 | 7.962 | -0.117 | -4.211 | 0.000 |
| | GENDER | -13.105 | 4.122 | -0.088 | -3.180 | 0.002 |
| | ELL | -13.995 | 6.894 | -0.061 | -2.030 | 0.043 |

a. Dependent Variable: CRT Reading Scale Score 2010

Table 9. Regression Output, CRT Mathematics Mean Score 2010

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Significance |
|-------|-----------------------|-----------------------------|------------|---------------------------|---------|--------------|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 336.317 | 2.450 | | 137.246 | 0.000 |
| | Full-day Kindergarten | 17.248 | 2.920 | 0.169 | 5.907 | 0.000 |
| | Ethnicity | -2.055 | 0.960 | -0.065 | -2.140 | 0.033 |
| | FRL | -17.802 | 3.602 | -0.143 | -4.942 | 0.000 |
| | IEP | -18.305 | 5.190 | -0.099 | -3.527 | 0.000 |
| | GENDER | -1.835 | 2.688 | -0.019 | -0.683 | 0.495 |
| | ELL | 0.737 | 4.494 | 0.005 | 0.164 | 0.870 |

a. Dependent Variable: CRT Math Scale Score 2010

Controlling for other characteristics shows that the relationship between full-day kindergarten and CRT reading and mathematics score is not due to other factors. The relationship between full-day kindergarten and CRT scores was statistically significant at the $p < .001$ level and in the hypothesized direction. The standardized regression coefficient (full-day or half-day status) in Tables Five through Eight indicates that full-day kindergarten can approximate the importance of FRL status in some CRT tests. Taken together, these analyses provide evidence that *full-day kindergarten is positively related to higher literacy scores in the third and fourth grade, regardless of student background.*

RESULTS – CRT READING AND MATHEMATICS PROFICIENCY LEVELS

The following findings are based on an analysis of CRT proficiency levels of the full-day treatment and half-day control group of kindergarten students. CRT proficiency levels are taken from their third grade year (2008-2009) and fourth grade year (2009-2010).

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| Table 10. Full and Half-day Kindergarten Cohort (2005-2006) CRT Reading Proficiency Status 2009 (3rd Grade) | | | | | | | | | |
|---|----------|------|------------|-------|-------|-------|---------|-------|-------------------------------------|
| | Emergent | | Approaches | | Meets | | Exceeds | | % Students at Proficiency and Above |
| | Count | % | Count | % | Count | % | Count | % | |
| Half-day | 17 | 1.94 | 235 | 26.80 | 346 | 39.45 | 279 | 31.81 | 71.27 |
| Full-day | 3 | 0.72 | 63 | 15.14 | 164 | 39.42 | 186 | 44.71 | 84.13 |

| Table 11. Full and Half-day Kindergarten Cohort (2005-2006) CRT Math Proficiency Status 2009 (3rd Grade) | | | | | | | | | |
|--|----------|------|------------|-------|-------|-------|---------|-------|-------------------------------------|
| | Emergent | | Approaches | | Meets | | Exceeds | | % Students at Proficiency and Above |
| | Count | % | Count | % | Count | % | Count | % | |
| Half-day | 34 | 3.88 | 240 | 27.40 | 267 | 30.48 | 335 | 38.24 | 68.72 |
| Full-day | 2 | 0.48 | 64 | 15.38 | 139 | 33.41 | 211 | 50.72 | 84.13 |

| Table 12. Full and Half-day Kindergarten Cohort (2005-2006) CRT Reading Proficiency Status 2010 (4th Grade) | | | | | | | | | |
|---|----------|------|------------|-------|-------|-------|---------|-------|-------------------------------------|
| | Emergent | | Approaches | | Meets | | Exceeds | | % Students at Proficiency and Above |
| | Count | % | Count | % | Count | % | Count | % | |
| Half-day | 42 | 4.88 | 189 | 21.95 | 360 | 41.81 | 270 | 31.36 | 73.17 |
| Full-day | 6 | 1.49 | 52 | 12.87 | 173 | 42.82 | 173 | 42.82 | 85.64 |

| Table 13. Full and Half-day Kindergarten Cohort (2005-2006) CRT Math Proficiency Status 2010 (4th Grade) | | | | | | | | | |
|--|----------|------|------------|-------|-------|-------|---------|-------|-------------------------------------|
| | Emergent | | Approaches | | Meets | | Exceeds | | % Students at Proficiency and Above |
| | Count | % | Count | % | Count | % | Count | % | |
| Half-day | 53 | 6.19 | 198 | 23.13 | 500 | 58.41 | 105 | 12.27 | 70.68 |
| Full-day | 4 | 1.00 | 37 | 9.27 | 275 | 68.92 | 83 | 20.80 | 89.72 |

Tables 10 through 13 show that on all CRT tests, students who attended full-day kindergarten on average are more proficient than students who attended half-day kindergarten. For the CRT mean scale score analyses:

- In CRT reading for 2009, 12.86% more students who attended full-day kindergarten were proficient or above compared to students who attended half-day.

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- In CRT mathematics for 2009, 15.71% more students who attended full-day kindergarten were proficient or above compared to students who attended half-day.
- In CRT reading for 2010, 12.47% more student who attended full-day kindergarten were proficient or above compared to students who attended half-day.
- In CRT mathematics for 2010, 19.04% more students who attended full-day kindergarten were proficient or above compared to students who attended half-day.

Likewise, analysis using the second dependent variable of CRT proficiency category also indicates that *full-day kindergarten is a predictor of higher proficiency scores.*

To better understand the strength of the effect of full-day kindergarten on CRT reading and mathematics proficiency levels, an OLS multiple regression analysis was conducted. The results of this analysis are depicted in Tables 14 through 17. The results indicate that even when controlling for important demographic characteristics of students (FRL status, ELL status, Special Education status, ethnicity, and gender) ***if a student attended full-time kindergarten it was statistically significant and positively related to higher CRT reading and mathematics proficiency levels.***

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Significance |
|-------|-----------------------|-----------------------------|------------|---------------------------|--------|--------------|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 3.235 | 0.039 | | 82.704 | 0.000 |
| | Full-day Kindergarten | 0.194 | 0.047 | 0.113 | 4.146 | 0.000 |
| | Ethnicity | -0.032 | 0.015 | -0.061 | -2.092 | 0.037 |
| | FRL | -0.382 | 0.057 | -0.186 | -6.724 | 0.000 |
| | IEP | -0.366 | 0.083 | -0.119 | -4.421 | 0.000 |
| | GENDER | -0.105 | 0.043 | -0.065 | -2.440 | 0.015 |
| | ELL | -0.106 | 0.072 | -0.043 | -1.484 | 0.138 |

a. Dependent Variable: CRT Reading Scale Score 2009

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Significance |
|-------|-----------------------|-----------------------------|------------|---------------------------|--------|--------------|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 3.136 | 0.043 | | 73.195 | 0.000 |
| | Full-day Kindergarten | 0.250 | 0.051 | 0.134 | 4.877 | 0.000 |
| | Ethnicity | -0.027 | 0.017 | -0.047 | -1.585 | 0.113 |
| | FRL | -0.365 | 0.062 | -0.164 | -5.858 | 0.000 |
| | IEP | -0.342 | 0.091 | -0.102 | -3.750 | 0.000 |
| | GENDER | 0.072 | 0.047 | 0.042 | 1.529 | 0.127 |
| | ELL | 0.005 | 0.078 | 0.002 | 0.068 | 0.946 |

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a. Dependent Variable: CRT Math Scale Score 2009

| Table 16 - Regression Output, CRT Reading Proficiency 2010 | | | | | | |
|--|-----------------------|-----------------------------|------------|---------------------------|--------|--------------|
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Significance |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 3.244 | 0.042 | | 77.402 | 0.000 |
| | Full-day Kindergarten | 0.186 | 0.050 | 0.107 | 3.724 | 0.000 |
| | Ethnicity | -0.020 | 0.016 | -0.038 | -1.248 | 0.212 |
| | FRL | -0.299 | 0.062 | -0.141 | -4.860 | 0.000 |
| | IEP | -0.287 | 0.089 | -0.091 | -3.228 | 0.001 |
| | GENDER | -0.150 | 0.046 | -0.092 | -3.271 | 0.001 |
| | ELL | -0.165 | 0.077 | -0.065 | -2.142 | 0.032 |

a. Dependent Variable: CRT Reading Scale Score 2010

| Table 17 - Regression Output, CRT Mathematics Proficiency 2010 | | | | | | |
|--|-----------------------|-----------------------------|------------|---------------------------|--------|--------------|
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Significance |
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.903 | 0.035 | | 82.229 | 0.000 |
| | Full-day Kindergarten | 0.259 | 0.042 | 0.177 | 6.156 | 0.000 |
| | Ethnicity | -0.021 | 0.014 | -0.048 | -1.549 | 0.122 |
| | FRL | -0.249 | 0.052 | -0.140 | -4.804 | 0.000 |
| | IEP | -0.236 | 0.074 | -0.090 | -3.177 | 0.002 |
| | GENDER | -0.020 | 0.039 | -0.014 | -0.513 | 0.608 |
| | ELL | 0.008 | 0.065 | 0.004 | 0.130 | 0.896 |

a. Dependent Variable: CRT Math Scale Score 2010

Controlling for other characteristics shows that the relationship between full-day kindergarten and CRT reading and mathematics score is not due to other factors. The relationship between full-day kindergarten and CRT scores was statistically significant at the $p < .001$ level and in the hypothesized direction. The standardized regression coefficient (full-day or half-day status) in Tables 13 through 16 indicates that full-day kindergarten can approximate the importance of FRL status in some CRT tests. Taken together, these analyses provide evidence that *full-day kindergarten is positively related to higher proficiency levels in the third and fourth grade, regardless of student background.*

DISCUSSION

The results of FEDS-L4 are similar to other research on the effects of full-day kindergarten.

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In FEDS 2004-2005, the result was a strong positive relationship between students who attended full-day kindergarten and literacy scores. In the current FEDS-L4, we found that **there still exists a positive relationship between CRT scores and previous attendance in full-day kindergarten. Not only does full-day kindergarten increase student scores when in kindergarten, but it also has long-term positive effects on achievement over time.**

This program has the potential to save districts financially over time. Cost/Benefit studies have shown that having full-day kindergartens relieve districts of financial costs over time in remediation and less incidence of grade repeating. In a study of third and fourth graders conducted in Philadelphia, researchers found that former full-day kindergartners were 26% more likely than former half-day kindergartners to have reached those grades without repeating a grade, leading to “savings of \$2 million for every 1,000 kindergartners in improved retention rates.” (Gilliam & Zigler, 2001).

The findings of this study align closely with the results of earlier studies in this report comparing the learning and growth effects. Full-day kindergarten leads to markedly higher academic performance than does half-day kindergarten.