Impact of Reading Roadmap Afterschool Programs on the Reading Achievement of 2nd and 3rd Grade Students

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Abstract

Early literacy disparities can result in negative long-term outcomes and supplemental programs provided afterschool can assist to help reduce the achievement gap. This report presents the Reading Roadmap early literacy afterschool program, an innovative approach developed by Andrew J. Hysell in partnership with local Kansas school districts, the Kansas Department for Children and Families (DCF) and the Kansas State Department of Education (KSDE). The Reading Roadmap program was commissioned in 2014 to develop a scalable, systemic approach for afterschool literacy that could be replicated by schools and nonprofits to increase the impact of supplemental reading programs. Over its five years of implementation, the Reading Roadmap model scaled from twenty to fifty schools across the state of Kansas, targeting nonproficient early readers from socio-economically disadvantaged populations. This study specifically focuses on the Garden City School District's K-3 students attending the of the Garden City School District, five of which operated Reading Roadmap afterschool programs during the 2018-19 SY school year. The study employs a quasi-experimental design using five different matching models comparing the literacy achievement of program participants based on school-administered assessments versus those students that did not participate. The analysis shows a statistically significant impact that attending Reading Roadmap afterschool programs increased student assessment scores by up to 16% as compared to non-participating peers. While recognizing that rigorous, science-based school instruction is the core of a successful literacy effort, the results of the Reading Roadmap suggest that aligning afterschool literacy more closely with school efforts can help close the achievement gap among striving readers, including among English Language Learners.

Introduction

Upon completion of third grade, students transition from learning to read to reading to learn. At this point, students not reading proficiently are less likely to graduate from high school on time (Fiester, 2010; Lesnick, George, Smithgall & Gwynne, 2010; Hernandez, 2011). Therefore, policymakers have prioritized early literacy and focused resources on programs that aim to accelerate reading progress.

Among these investments are afterschool programs. The 21st Century Community Learning Centers (21st CCLC) has provided for two decades more than a billion dollars annually to local afterschool programs ("21st Century Learning Centers", n.d.) to support students to "meet state and local student standards in core academic subjects, such as reading and math." Despite this expressed goal, there is ambiguity surrounding the 21st CCLC afterschool program's measurable impact on student's reading proficiency (Dynarski, et al., 2003; Mahoney & Zigler, 2003; James-Burdumy, et al., 2005; Dynarski, 2015; Paluta, et al., 2016).

One reason for this may be that traditional afterschool literacy programs frequently focus on providing enrichment as opposed to structured reading intervention. While there is no formal definition of what constitutes enrichment, it has been described as adding value or strength to core academics and sometimes as offering opportunities beyond regular instruction. The programming provided by one well-regarded afterschool literacy

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enrichment program is described as increasing the “enjoyment of reading, building vocabulary, deepening thinking...” (“What is AfterSchool KidzLit?”, n.d.).

While enrichment programs clearly offer value to participants, they are not designed to deliver the kind of targeted, intensive and skill-focused intervention necessary to accelerate reading improvement. Studies suggest that nonproficient readers lack discrete phonemic and phonics skills and therefore benefit from targeted lessons addressing those needs in structured, small-group settings (What Works Clearinghouse, 2009; Jones, Condradi, & Amendum, 2016). An afterschool enrichment program in contrast provides learning opportunities, but without the specificity or intensity of a reading intervention system. Enrichment programs tend to have high student-to-staff ratios, lessons that are not necessarily matched to individual needs and usually do not include progress monitoring of discrete skill proficiency.

In contrast to enrichment programs, many tutoring programs incorporate the science of reading and are structured to provide the intensive support necessary to aid in the acquisition of phonemic and phonics skills. However, the cost of tutoring programs falls outside of what a 21st CCLC afterschool program budget can support for every participant. Further, even effective tutoring programs, including computer programs, usually operate independently of school instruction with separate assessments—including screening, diagnostics and summative testing—as well as instructional and progress monitoring strategies. This can lead to excessive testing as well as a lack of symmetry between in-school reading help and afterschool support. It can mean the strategy and philosophy underlying literacy support for a striving reader can fluctuate significantly between the school day and afterschool.

Reading Roadmap Afterschool

The goal of the Reading Roadmap is to identify a “roadmap” of practices for use by an elementary school to enhance the academic impact of their afterschool literacy program. To develop an effective afterschool model, the Reading Roadmap partners with schools that use a multi-tiered system of supports (MTSS). The MTSS process empowers schools to collect, organize and utilize student data to ensure every student receives effective, individualized instruction and intervention for reading. A defining characteristic of the MTSS model is a schedule of intervention periods during which at-risk readers receive extra help. Using screening and diagnostic data, schools group students into these periods to match intervention with individual needs. With MTSS in place, the Reading Roadmap can connect the afterschool program with the school’s tiered system to add extra, targeted intervention time to supplement and accelerate outcomes. Specifically, the Roadmap aligns afterschool lessons with MTSS-generated student-level data as well as the partner school’s instructional strategies and progress monitoring system.

While structured and aligned with MTSS, the Reading Roadmap strives to remain true to the intent of a traditional afterschool program by providing enrichment and recreational opportunities for participants. The Reading Roadmap merges structured, science-based reading interventions into engaging activities suitable for an afterschool environment. For example, students sound-out syllables while rolling on the floor, write consonant-vowel-consonant words in shaving cream and hunt for syllables using flashlights in a darkened room. Further, the program offers regular group read-aloud activities as well as physical activity programming.

Garden City, Kansas

Reading Roadmap programs have been implemented in both Kansas and Mississippi, serving over ten thousand children. The purpose of this study is to ascertain the impact of the Reading Roadmap’s MTSS-aligned afterschool program in a rural school district over the course of a school year by reviewing individual student school

assessment data. Garden City public school district (USD 457) is one of over thirty Kansas school districts that have implemented a Reading Roadmap afterschool program. A rural city located in western Kansas, Garden City has a high English-language learner (ELL) population and poverty rate that exceeds the state's average. During the 2018-2019 school year (2018-19 SY), the Reading Roadmap operated afterschool programs at five of the district's twelve elementary schools. The participating schools were selected for the program predicated upon reading support need as well as high levels of relative poverty within the district.

All Garden City elementary schools employed an identical schoolwide MTSS model to assess, support and monitor student reading progress. Each school used a FastBridge universal screener three times a year in September, January and April. According to FastBridge cut scores, students were grouped into three tiers each with its own reading instructional schedule. All children schoolwide received ninety minutes of core reading instruction per day each day. However, students received varying types of support during two additional daily reading periods based upon their tier grouping. Tier 1 students, or those deemed on track for grade level reading, received sixty minutes of reading enrichment support. Tier 2 students flagged as at-risk received one thirty-minute intervention, plus thirty minutes of supplemental support. Tier 3 children deemed significantly behind received two separate thirty-minute reading intervention periods, one in a small group with no more than three children per teacher. Garden City used the Reading Roadmap afterschool program as an additional intervention opportunity for their Tier 3 student population. In the five Reading Roadmap schools, about 19% (201 out of 1,181 K-3 assessed) of students fell into Tier 3. About half of these Tier 3 students were recruited for the afterschool program.

Program Administration

Each Reading Roadmap program involved a grant to schools that provided funds for hourly tutoring staff, materials and transportation. In addition, each grant funded a fulltime program coordinator—a school employee—responsible for student recruitment and retention, program preparation, delivery of intervention and collection of data. The program coordinator also participated with teams of school administrators and teachers to align in-school benchmark, formative and progress monitoring data with afterschool tutoring. For each student afterschool, the program coordinator collected phonemic awareness and phonics screening and attendance data as well as tracked participant progress through individual afterschool lessons.

Each year, the program coordinator received 40 hours of formal in-person training, 40 hours of informal in-person training, 36 hours remote training and over 50 hours of technical assistance, principally from Reading Roadmap program managers. The training included program requirements, program fidelity, budgeting, participant recruitment and retention, staffing, logistics requirements, individual component training, data requirements, child safety, scheduling, in-school communications training, MTSS training and technology/computer program training. The technical assistance provided ongoing coaching and monitoring to enhance success in implementation of the training principles. In addition, Reading Roadmap program managers visited the schools three times a year to conduct fidelity checks of both the afterschool program as well as the Garden City district's implementation of its MTSS model.

Program Design

The Reading Roadmap ran from September 2018 to April 2019 for a total of 100 days. The program met daily, four days a week for 90 minutes per day. Each day's schedule involved two 30-minute reading rotations, a 30-minute physical activity rotation and a short snack period. Tier 3 students participating in the Reading Roadmap program received up to a total of three hundred extra minutes of small group intervention and an equal amount of

vocabulary and comprehension practice. The total program time of the Reading Roadmap was less than 13%* of the time a student spends in school.

***Skills/Fluency Rotation*:** The first rotation of the afterschool program featured a small group intervention with a participant-to-tutor ratio of no greater than eight-to-one. Student reading level, as determined by in-school FastBridge testing, drove student group placement. This rotation was focused on phonemic and phonics skills, or building fluency depending upon participant identified need. To strengthen phonemic awareness and phonics skill accuracy, participants received either the 95% Group or Reading Crossroads Intervention curriculum. To match a lesson with a participant's individual need, a Quick Phonics Screener was given to each participant either by a teacher or in the afterschool program. Students identified for fluency support received the One-Minute Reader program.

***Structured Read-Aloud and Vocabulary*:** The second reading rotation featured a structured read-aloud activity. Using the Reading Crossroads Structured Read-Aloud and Vocabulary curriculum, one tutor worked with a group of up to twenty students. The structured read-aloud activity provided tutors with a choice of over 100 lesson plans based on popular, award-winning children's books. Each lesson plan included vocabulary words with kid-friendly definitions, as well as comprehension strategies and questions that correspond with each level of Norman Webb's Depth of Knowledge Chart. It also included activities and games that allowed readers to practice newly introduced vocabulary words and comprehension activities to encourage a deeper understanding of narrative text.

Data and Methodology

The Reading Roadmap and the Garden City School district shared data through a written agreement and collaborated to collect and analyze student reading progress districtwide for the 2018-19 SY. To assess the potential impact of afterschool on reading achievement, the Reading Roadmap designed a quasi-experimental study. A quasi-experimental design was selected due to the nature of the afterschool program. The Reading Roadmap afterschool program operated only at the district's lowest income schools and specifically targeted Tier 3 students (a.k.a. at-risk readers) for enrollment. Therefore, a random assignment of students to the program for purposes of the study was not possible.

The study's design includes a statistical analysis of the association between students' participation in the afterschool program and their end-of-year reading achievement controlled for educational and socioeconomic characteristics as well as school environment. The treatment group for the study includes all district 2nd and 3rd grade students who attended at least one day of afterschool programming during the 2018-19 school year. The study focused on 2nd and 3rd graders as reading progress for both grades was measured by Garden City using the same FastBridge CBM-Read (CBMR) assessment. The comparison group consisted of all district 2nd and 3rd grade students who never participated in any afterschool programming. Data for the study involved individual-level data, classroom data and schoolwide information. The collection of participant demographic, socioeconomic and cultural information, as well as reading assessment data, was conducted by the school and shared with the Reading Roadmap through the data-sharing agreement. In addition, the Reading Roadmap collected socioeconomic and demographic school-level from data publicly available from KSDE for both the treatment and comparison groups.

* Based on the ratio of 1.5 hours of afterschool programming for 100 days (150 hours afterschool programming) and the state required minimum schooling hours of 1,116 (Reference: https://www.ksde.org/Portals/0/School%20Finance/guidelines_manuals/1116hrs%20statute%20FAQ.pdf).

Table-1: *Distribution of students based on grade level and after-school participation*

	Number/Percentage of Students in the Group
Students in 2nd & 3rd Grades	1,134
Students in 2nd & 3rd Grades who Participated RR Afterschool	185
Percentage of 2nd & 3rd Graders who Participated RR Afterschool	16.3%

As seen in the Table-1, during the 2018-19 SY, 1,134 students attended either 2nd or 3rd grade at the twelve Garden City elementary schools. Of these students, 616 attended one of the five schools with Reading Roadmap afterschool programs. Appendix-A provides details about the demographics and socioeconomics of all district students as well as educational data of their classroom teachers.

The statistical model used to estimate the impact of Reading Roadmap is shown in Equation-1 in Appendix-B. The three components of the model include (1) the outcome, or the student's end-of-year reading assessment score; (2) the intervention, or the student's participation in the afterschool program and (3) control variables, including students' baseline reading assessment scores at the beginning of the school year, socioeconomic and demographic characteristics as well as classroom and school level characteristics.

After multiple rounds of data collection, 1,134 observations were obtained for 2nd and 3rd graders in the district. However, despite best efforts, a small amount of data was missing for some students. For example, some students moved in and out of the district during the school year. As a result, 70 student records lacked Fall assessment data and 97 student records were missing Spring results. An additional 27 students lacked data relating to at least one variable reducing the total number of complete records to 940.

To avoid possible bias in the regression analysis caused by missing data, an imputation process was conducted (Collins, Shafer & Kam, 2001; Shafer & Graham, 2002; Rubin, 2004). Separate regressions models were implemented to estimate missing data with an exception for the outcome variable of Spring assessment scores. C1 in the Appendix-C shows the summary statistics of all variables included in the regression analysis for both before and after data imputation.

Sample Matching

When reviewing the treatment and comparison groups, significant variation in student socioeconomic and cultural backgrounds, as well as variation in environmental factors, was observed. Numerous educational studies have found relationships between student early literacy success and socioeconomic, cultural and environmental characteristics. (White, 1982; Sirin, 2005; Aikens & Barbarin, 2008). Therefore, a statistical analysis of sample matching was employed.

The goal of sample matching methods is to find a group of individuals comparable to individuals in the treatment group. To ensure equivalence between the treatment and comparison groups, a number of different sample matching methods were conducted to observe any potential differences in the statistical model's outcomes. 1-to-1 and 1-to-Many matching based on Nearest Neighborhood method; Radius matching; Kernel matching and matching based on a Local Linear Regression method. Appendix-D shows the results of each matching model.

The PSMATCH2 module of Stata 14 statistical software was used to conduct all five matching processes. As part of these matching methods, each student's Fall CBM-Reading assessment scored was used as a baseline matching measurement between program participants and those that did not attend the afterschool program. In

addition, student demographic and socioeconomic characteristics (all binomial variables) were utilized. The results of matching obtained by using the 1-to-1 Matching of Nearest Neighborhood method are shown in Table 2 below. A PSTEST module was implemented to examine the efficacy of the matching. Table-2 shows the summary table for the test.

Table-2: *Quality of Sample Matching Test for the 1-to-1 Matching Method (with Caliper)*

VARIABLE	Sample Type	Mean		% Bias
		Treated	Control	
Fall Assessment Score	Unmatched	50.475	82.026	-91.2
	Matched	50.874	50.920	-0.1
Gender (Female=1)	Unmatched	0.519	0.491	5.6
	Matched	0.526	0.583	-11.4
Race (White=1)	Unmatched	0.831	0.886	-15.9
	Matched	0.846	0.851	-1.6
Grade Level	Unmatched	2.551	2.542	2.0
	Matched	2.537	2.520	3.4
FoRM	Unmatched	0.852	0.721	32.4
	Matched	0.846	0.886	-9.9
Disability Status	Unmatched	0.153	0.153	0.0
	Matched	0.154	0.154	0.0
Ethnicity (Hispanic=1)	Unmatched	0.776	0.702	16.8
	Matched	0.789	0.783	1.3
AVERAGE			***Unmatched***	***15.9***
			Matched	***1.6***

To measure efficacy of the 1-to-1 Matching model, a standardized percentage bias is calculated as the percentage ratio of the differences of the sample means in the treated and non-treated sub-samples to the square root of the average of the sample variances in the treated and non-treated groups (Harding, 2003; Leuven & Sianesi, 2003). A reasonable sample matching method is expected to have standardized bias at 5% or below (Rosenbaum, 1985). As shown in the table, the standardized percentage bias of the variable set in the matching model was estimated as 1.6% which is significantly less than the percentage bias of 15.9% among the unmatched sample. Similar results were observed among the other four sample matching methods Table-D1 in the Appendix-D contains the details of each matching method.

Results of the Analysis

Once the quality of the sample matching method was determined, the focus shifted next to an implementation of the regression analysis in order to address the main research question of the study: whether participation in the Reading Roadmap Afterschool was associated with increased reading achievement. To answer that question, a step-by-step model progression of the regression analysis with a comparison of data sets before and after the 1-to-1 Matching was conducted. Results of the analysis are summarized in the Table-3.

The null model, Model-0, calculated the average assessment score of students in the Spring semester. A 20% decrease in average Spring assessment score was observed and likely explained by an expected higher percentage of at-risk readers in the matched sample. Model-1 is the univariate model that adds afterschool participation into the equation. In subsequent models—Model-2, Model-3 and Model-4—additional independent variables are added.

(i) *Individual characteristics*: Fall assessment score, gender, race, grade level, free-and-reduced lunch status, English Language Learner (ELL) status, disability status and whether a student was part of an ethnic minority

(ii) *Teacher Information*: Teachers' years of experience and level of education

(iii) *School-level Characteristics:* School's percentage of students eligible for free-or-reduced lunch, percentage of ELL students, percentages of students with a disability code, afterschool participation status and the median fall assessment score of students at the school.

An important finding of four of the five matched data set models was that each multivariate regression model demonstrated a consistent 98% statistically significant positive correlation between the afterschool participation and students' reading achievement. The 1-to-Many matched data set produced a positive correlation that was 94% statistically significant. The consistent statistical significance of the model in context of a variety of matching processes supports the conclusion of a probable impact of afterschool program participation on student reading achievement. Table-3 below shows these results estimated for the complete model (Model-4) by using the samples obtained after the application of all five matching models. A more detailed version of this comparison can be found in Appendix-D.

Afterschool participants demonstrated greater reading growth than their peers districtwide. For the 2018-19 SY, all 1,064 2nd and 3rd grade students achieved growth of an average of 35.64 points between their Fall and Spring assessment scores (see Table C-1 in Appendix-C). Based upon this rate of growth, a 4.27 to 5.53 point equated to a 12% to 16% boost in students' reading development in one school year because of afterschool program participation. Afterschool participants demonstrated reading growth of 76% compared to their peers' 68% growth.

The growth of Reading Roadmap program participants was even more dramatic based on the FastBridge Assessment's own internal guidelines. FastBridge is a research-based third-party assessment that is administered independently by the school district. According to the 2018-19 Benchmarks and Norms manual of the FastBridge Learning (Published by Theodore J. Christ and Colleagues, LLC), a 2nd grader on track for grade-level reading is expected to increase 25 points from Fall to Spring on the FastBridge CBM-R assessment. According to the assessment, a benchmark 3rd grader is expected to grow 19 points from Fall to Spring. Considering the range of benchmark reading growth, the Reading Roadmap improvements equate with 17-22% of the expected reading growth of a 2nd grader and as much as 29% of a 3rd grader.

Considering that the Reading Roadmap afterschool program is supplemental to the school day, the extra increase in reading growth is noteworthy. The total program time of the Reading Roadmap is less than 13%* of the time a student spends in school. Giving early readers a boost of 12% to 29% through attending afterschool can provide schools with another tool to close the achievement gap.

*Based on the ratio of 1.5 hours of afterschool programming for 100 days (150 hours afterschool programming) and the state required minimum schooling hours of 1,116 (Reference: https://www.ksde.org/Portals/0/School%20Finance/guidelines_manuals/1116hrs%20statute%20FAQ.pdf). *** p<0.01, ** p<0.05, * p<0.1

Table-3: *The Regression Analysis Results for Model-4*

VARIABLES	Nearest Neighborhood (1-to-1 Matching)	Nearest Neighborhood (1-to-Many Matching)	Radius Matching	Kernel Matching	Local Linear Regression
	Model-4	Model-4	Model-4	Model-4	Model-4
RR Participation	5.250**	4.270*	4.604**	4.604**	5.525**
	(0.018)	(0.052)	(0.010)	(0.010)	(0.012)
Fall Assessment Score	0.955***	0.979***	1.017***	1.017***	0.975***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Gender (Female=1)	-2.283	-3.840**	-1.106	-1.106	-3.272*
	(0.194)	(0.040)	(0.428)	(0.428)	(0.068)
Race (White=1)	4.893**	3.341	2.368	2.368	6.287***
	(0.029)	(0.164)	(0.293)	(0.293)	(0.007)
Grade Level	-3.463	-4.195**	-4.433***	-4.433***	-3.807*
	(0.108)	(0.047)	(0.004)	(0.004)	(0.079)
FoRM	-3.107	-2.492	-1.182	-1.182	-3.166
	(0.233)	(0.341)	(0.506)	(0.506)	(0.221)
ELL Status	1.900	0.728	-0.827	-0.827	2.328
	(0.297)	(0.708)	(0.575)	(0.575)	(0.209)
Disability Status	-20.317***	-17.586***	-16.270***	-16.270***	-19.863***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Minority Status	9.942***	8.887**	1.320	1.320	9.959***
	(0.004)	(0.011)	(0.540)	(0.540)	(0.004)
Teacher's Years of Experience	0.789**	0.386	0.118	0.118	0.951**
	(0.031)	(0.296)	(0.677)	(0.677)	(0.010)
Teacher Experience Squared	-0.025**	-0.011	-0.006	-0.006	-0.028**
	(0.026)	(0.342)	(0.450)	(0.450)	(0.013)
Teacher's Education Level	0.191	-0.366	-0.152	-0.152	-0.198
	(0.801)	(0.630)	(0.787)	(0.787)	(0.794)
Percentage of Students on FoRM	-23.504	-18.550	-6.187	-6.187	-25.141*
	(0.115)	(0.259)	(0.574)	(0.574)	(0.090)
Percentage of Students as ELL	-19.752	-24.666*	-22.095*	-22.095*	-22.355
	(0.158)	(0.099)	(0.052)	(0.052)	(0.110)
Percentage of Students with Disability	19.089*	11.144	5.677	5.677	22.997**
	(0.085)	(0.438)	(0.433)	(0.433)	(0.043)
School's RR Contract Status	5.182*	6.528*	3.438	3.438	6.649**
	(0.098)	(0.051)	(0.112)	(0.112)	(0.040)
Median Fall Assessment Score of the School	-0.623***	-0.442**	-0.428***	-0.428***	-0.642***
	(0.002)	(0.021)	(0.001)	(0.001)	(0.001)
Median Spring Assessment Score of the School	0.376**	0.227	0.326**	0.326**	0.345**
	(0.030)	(0.219)	(0.016)	(0.016)	(0.046)
Constant	60.842***	68.969***	55.269***	55.269***	64.839***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	350	396	1,035	1,035	356
R-squared	0.813	0.798	0.818	0.818	0.813

p-values in parentheses

Limitations of the Analysis

A limitation of the study is that it did not include a randomized control. An extensive and rigorous matching process was implemented to overcome that limitation. Second, the study only features a single school district with a significant ELL population. The results may or may not be applicable to other school districts. Finally, the study only relates to a single school year. While the program is designed to sustain reading improvement over the course of multiple school years, the data was not available to conduct a longitudinal analysis. The final two limitations of the study could be overcome through future studies.

Conclusion

A rigorous quasi-experimental study was used with a variety of propensity score matching approaches. The findings demonstrate a positive impact of Reading Roadmap afterschool programs on students' reading skill achievement. Moreover, the magnitude of the impact of this participation in the afterschool programs relative to the effect of school attendance on student's reading skills suggests a meaningful boost to participant reading proficiency. These results are encouraging evidence that afterschool reading programs may be structured to help improve reading achievement.

Underlying this study is the reality that no afterschool program by itself can reasonably be expected to close the reading achievement gap. Science-based, systematic school day reading instruction and intervention, like that provided through MTSS, is a foundational component of any successful early reading effort. The Reading Roadmap can be viewed as a supplemental support with measurable, additive benefit towards the overall effort to accelerate reading progress among all students.

Acknowledgement

Thanks to Mark Dynarski who reviewed early drafts of this study and provided much useful feedback. Also, special thanks to all Garden City public school district staff including Dr. Steve Karlin (Superintendent), Crystal Steinmetz (Director of Curriculum & Assessment), Monica Diaz (Language & Literacy Coordinator), Jamie Schweer, Melanie Marcy, Sonia Mendez, Sabrina Espinoza and Shayla Seibert (Program Coordinators). Also, many thanks to all Reading Roadmap staff including Tabitha Brotherton (Director, Programming), Kate Combs (Program Manager) and Kim Trang (Assistant Data Analyst) for their countless effort in making this study to be possible.

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Appendices

Appendix-A: *Data Relating the Demographics and Socioeconomics of Students and Educational Information of their Classroom Teachers.*

Table-A1 : *Demographic and Socioeconomic Distribution of K-3 Students*

	Students at RR Contracted Schools	RR Students at RR Contracted Schools	Students at non-RR Schools
Number of Students	*1,355*	*342*	*982*
Percentage of Female Students	48%	52%	46%
Percentage of Non-Hispanic White Students	14%	11%	27%
Percentage of Hispanic Students	74%	74%	64%
Percentage of Students Eligible to FoRM	77%	85%	68%
Percentage of Students as ELL	46%	54%	37%
Percentage of Students with Disability	13%	16%	19%

Table-A1 provides gender, race and ethnicity demographic information of the students as well as their eligibility for Free and Reduced-Priced Meals (FoRM), English Language Learner (ELL) status and Disability status. The two groups show similar gender characteristics. Differences between the students from schools with Reading Roadmap (RR) programs and those without are found for other variables listed in the table. These differences are the result of the fact that the Reading Roadmap made a conscious decision while implementing its afterschool program to provide extra educational resources to public schools most in need. The contrast is even greater when afterschool participants are compared with students from schools without RR programs. For instance, on average, about 68% of students in schools without RR programs were reported to be eligible to receive FoRM while as many as 85% of RR afterschool participants were in that category. Similarly, a comparison of students who were deemed ELL reveals that 37% in non-RR schools as opposed to 54% RR participants had that status. The differences between students from non-RR schools and students at schools with RR programs are shown in the Table-A1. These differences between the students at RR and non-RR schools not only point to individual differences but also underline a possible school nesting effect. Schools generally reflect their neighborhood and community in terms of key statistics. Another evidence of a nesting effect is shown in Table-A2 below. The table summarizes the average years of experience and educational information relating the classroom teachers of the K-3 students subject to the data collected for this study.

Table-A2: *Classroom Teacher Information for each Student Group*

	Average Years of Teaching Experience	% of Teachers with Education Beyond BS	% of Teachers with Education Beyond MS
Teachers at RR Contracted Schools	8	65%	4%
Teachers of Students in RR Afterschool	7	57%	5%
Teachers at non-RR Schools	12	72%	14%

As seen in the Table-A2, students at non-RR schools had teachers with more years of teaching experience and education. The average years of experience of classroom teachers for RR afterschool participants was 8 years while its was 12 for teachers at non-RR schools. Similarly, the percentage of classroom teachers at non-RR schools with education beyond a bachelor's or master's degree was 72% and 14% respectively, while same percentages for RR participant teachers was 65% and 4%.

Appendix-B: *Impact Estimation Models*

The regression model for estimating impacts is shown below as Equation-1.

$$\hat{Y}_i = \hat{\beta}_0 + \sum_{i=1}^{n} \hat{\beta}_{1i} Z_i + \sum_{i=1}^{n} \sum_{k=2}^{k_1} \hat{\beta}_{ki} X_{ki} + \sum_{i=1}^{n} \sum_{k=k_1+1}^{k_2} \hat{\beta}_{ki} D_{ki} + \hat{\varepsilon}_i \qquad \text{Equation-1}$$

Where Y is the dependent variable for year-end assessment score of students (Spring 2019 CBMR test score), Z is the treatment variable (RR Afterschool participation), X is the vector of all control variables that define the individual characteristics of students (students' demographic and socioeconomics and cultural variables), D is the vector of control variables that represent variables associated with students' achievement (teacher and school variables), i is the index number to identify each observed individuals (or students), is the error term, $\hat{\beta}_0$ is the estimated model constant, k is the index number to identify the covariates where k_1 >2 and $k_2 > k_1 + 1$.

As shown in the Equation-1, the model is a linear multivariate regression model. To test the correlation between students' participation to the RR afterschool program and their reading assessment results, the mathematical estimation model shown in the Equation-1 gradually builds up. The null model, or Model-0, is starred and includes only the constant of the model as shown in the Equation-2.

$$Y_i = \hat{\beta}_0 \qquad \text{Equation-2}$$

This model helps illustrate the average Spring 2019 assessment score of students of the sample to show mean assessment scores of the students. In the next step, the treatment variable, RR afterschool participation, is added to the Model-0 to create Model-1 as shown in the Equation-3.

$$\hat{Y}_i = \hat{\beta}_0 + \sum_{i=1}^{n} \hat{\beta}_{1i} Z_i + \hat{\varepsilon}_i \qquad \text{Equation-3}$$

After testing the average test score of student change based on the variable defining the RR afterschool participation, covariates were added relating individual variables to obtain Model-2 estimates the Equation-4.

$$\hat{Y}_i = \hat{\beta}_0 + \sum_{i=1}^{n} \hat{\beta}_{1i} Z_i + \sum_{i=1}^{n} \sum_{k=2}^{k_1} \hat{\beta}_{ki} X_{ki} + \hat{\varepsilon}_i \qquad \text{Equation-4}$$

Finally, the covariates for environmental variables were added to the model to obtain the estimates for Model-3 shown in the Equation-1.

Appendix-C: *Data Imputation for Observations with Missing Data*

To impute missing data, a multivariate linear regression analysis was implemented and an estimation made by defining Fall assessment data and the teacher information education and experience as dependent variables. After each model was conducted, a predicted value for the dependent variable was estimated. These predicted values were added into the observation where variables had missing data. For other observations, data was kept as observed. Descriptive analysis of variables before and after the data imputation process are shown in the Table-C1 below.

Table-C1: *Summary statistics of variables in the regression model*

VARIABLES	Before the Data Imputation					After the Data Imputation				
	Observ.	Mean	Std. Dev.	Min	Max	Observ.	Mean	Std. Dev.	Min	Max
RR Participation	1,134	0.16	0.370	0	1	1,134	0.16	0.370	0	1
Fall Assessment Score	1,064	77.51	39.314	1	203	1,090	76.70	39.671	1	203
Spring Assessment Score	1,037	113.15	40.038	3	240	1,037	113.15	40.038	3	240
Gender (Female=1)	1,130	0.50	0.500	0	1	1,130	0.50	0.500	0	1
Race (White=1)	1,129	0.88	0.329	0	1	1,129	0.88	0.329	0	1
Grade Level	1,134	2.54	0.498	2	3	1,134	2.54	0.498	2	3
FoRM	1,130	0.74	0.437	0	1	1,130	0.74	0.437	0	1
ELL Status	1,130	0.48	0.500	0	1	1,130	0.48	0.500	0	1
Disability Status	1,130	0.15	0.360	0	1	1,130	0.15	0.360	0	1
Minority Status	1,134	0.81	0.391	0	1	1,134	0.81	0.391	0	1
Teacher's Years of Experience	1,083	9.63	9.614	0	35	1,134	9.67	9.462	0	35
Teacher's Education Level	1,083	2.10	1.982	0	7	1,132	2.10	1.953	0	7
Percentage of Students on FoRM	1,134	77%	14%	28%	91%	1,134	77%	14%	28%	91%
Percentage of ELL	1,134	46%	12%	10%	64%	1,134	46%	12%	10%	64%
Percentage of Students with Disability	1,134	18%	12%	7%	51%	1,134	18%	12%	7%	51%
School's RR Contract Status	1,134	0.54	0.498	0	1	1,134	0.54	0.498	0	1
Median Fall Assessment Score of the School	1,134	76.09	8.431	18	88	1,134	76.07	9.336	6.5	91
Median Spring Assessment Score of the School	1,134	114.09	7.852	46	124	1,134	114.09	7.852	46	124

As seen in the Table-C1, data imputation added 36 missing data values for Fall assessment, and 51 missing data points for both teacher education and years of experience variables. A reason why imputation could not be used for all missing data in each of the 1,134 observations was that multiple data points were missing for the same student in a few cases. Those observations were excluded from the analysis. Data imputation did not cause any drastic change among the variables.

Appendix-D: *Results of Matching Methods*

Table-D1: *Sample Mean and Standardized Percentage Bias Comparison of Matched and Unmatched Samples based on the Matching Method*

		Nearest Neighborhood (1-to-1 Matching)			**Nearest Neighborhood (1-to-Many Matching)**			**Radius**			**Kernel**			**Local Linear Regression**		
VARIABLE	**Sample Type**	Mean		% Bias	Mean		% Bias	Mean		% Bias	Mean		% Bias	Mean		% Bias
		Treated	Control		Treated	Control		Treated	Control		Treated	Control		Treated	Control	
Fall Assessment Score	Unmatched	50.48	82.03	-91.2	50.48	82.03	-91.2	50.48	82.03	-91.2	50.48	82.03	-91.2	50.48	82.03	-91.2
	Matched	50.87	50.92	-0.1	50.37	50.37	0.0	50.87	50.51	1.0	50.37	50.37	0.0	50.37	50.26	0.3
Gender (Female=1)	Unmatched	0.52	0.49	5.6	0.52	0.49	5.6	0.52	0.49	5.6	0.52	0.49	5.6	0.52	0.49	5.6
	Matched	0.53	0.58	-11.4	0.53	0.56	-6.2	0.53	0.54	-1.9	0.53	0.53	0.3	0.53	0.59	-12.3
Race (White=1)	Unmatched	0.83	0.89	-15.9	0.83	0.89	-15.9	0.83	0.89	-15.9	0.83	0.89	-15.9	0.83	0.89	-15.9
	Matched	0.85	0.85	-1.6	0.83	0.84	-1.6	0.85	0.84	1.4	0.83	0.84	-2.2	0.83	0.84	-3.2
Grade Level	Unmatched	2.55	2.54	2.0	2.55	2.54	2.0	2.55	2.54	2.0	2.55	2.54	2.0	2.55	2.54	2.0
	Matched	2.54	2.52	3.4	2.54	2.52	5.6	2.54	2.53	2.4	2.54	2.53	3.7	2.54	2.52	5.6
FoRM	Unmatched	0.85	0.72	32.4	0.85	0.72	32.4	0.85	0.72	32.4	0.85	0.72	32.4	0.85	0.72	32.4
	Matched	0.85	0.89	-9.9	0.85	0.89	-10.4	0.85	0.85	-0.7	0.85	0.85	-0.7	0.85	0.89	-9.7
Disability Status	Unmatched	0.15	0.15	0.0	0.15	0.15	0.0	0.15	0.15	0.0	0.15	0.15	0.0	0.15	0.15	0.0
	Matched	0.15	0.15	0.0	0.15	0.15	0.8	0.15	0.16	-2.2	0.15	0.17	-2.07	0.15	0.15	0.0
Ethnicity (Hispanic=1)	Unmatched	0.78	0.70	16.8	0.78	0.70	16.8	0.78	0.70	16.8	0.78	0.70	16.8	0.78	0.70	16.8
	Matched	0.79	0.78	1.3	0.78	0.79	-4.5	0.79	0.78	1.1	0.78	0.77	0.1	0.78	0.79	-2.6
AVERAGE		***Unmatched***		***15.9***	***Unmatched***		***15.9***	***Unmatched***		***15.9***	***Unmatched***		***15.9***	***Unmatched***		***15.9***
		Matched		***1.6***	***Matched***		***4.5***	***Matched***		***1.4***	***Matched***		***0.7***	***Matched***		***3.2***

Table-D2: *Regression Analysis Results of different Matching Methods.*

VARIABLES	Nearest Neighborhood (1-to-1 Matching)			Nearest Neighborhood (1-to-Many Matching)			Radius Matching Method			Kernel Matching Method			Local Linear Regression Matching Method		
	Model-2	Model-3	Model-4	Model-2	Model-3	Model-4	Model-2	Model-3	Model-4	Model-2	Model-3	Model-4	Model-2	Model-3	Model-4
RR Participation	4.154**	3.860**	5.250**	4.376**	4.312**	4.270*	4.761***	4.291**	4.604**	4.761***	4.291**	4.604**	4.522**	4.244**	5.525**
	(0.025)	(0.023)	(0.018)	(0.025)	(0.016)	(0.052)	(0.009)	(0.011)	(0.010)	(0.009)	(0.011)	(0.010)	(0.015)	(0.013)	(0.012)
Fall Assessment Score	0.990***	0.956***	0.955***	0.991***	0.982***	0.979***	1.049***	1.015***	1.017***	1.049***	1.015***	1.017***	1.003***	0.976***	0.975***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Gender (Female=1)		-1.834	-2.283		-3.889**	-3.840**		-1.200	-1.106		-1.200	-1.106		-2.760	-3.272*
		(0.299)	(0.194)		(0.039)	(0.040)		(0.395)	(0.428)		(0.395)	(0.428)		(0.123)	(0.068)
Race (White=1)		3.853*	4.893**		3.111	3.341		2.486	2.368		2.486	2.368		5.509**	6.287***
		(0.089)	(0.029)		(0.196)	(0.164)		(0.281)	(0.293)		(0.281)	(0.293)		(0.021)	(0.007)
Grade Level		-4.166*	-3.463		-4.657**	-4.195**		-4.533***	-4.433***		-4.533***	-4.433***		-4.532**	-3.807*
		(0.052)	(0.108)		(0.024)	(0.047)		(0.004)	(0.004)		(0.004)	(0.004)		(0.033)	(0.079)
FoRM		-3.793	-3.107		-3.450	-2.492		-2.458	-1.182		-2.458	-1.182		-3.943	-3.166
		(0.142)	(0.233)		(0.175)	(0.341)		(0.147)	(0.506)		(0.147)	(0.506)		(0.128)	(0.221)
ELL Status		0.687	1.900		-0.196	0.728		-1.695	-0.827		-1.695	-0.827		1.242	2.328
		(0.709)	(0.297)		(0.922)	(0.708)		(0.273)	(0.575)		(0.273)	(0.575)		(0.509)	(0.209)
Disability Status		-19.546***	-20.317***		-17.087***	-17.586***		-15.992***	-16.270***		-15.992***	-16.270***		-19.097***	-19.863***
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
Minority Status		6.876**	9.942***		6.934**	8.887**		-0.373	1.320		-0.373	1.320		6.537**	9.959***
		(0.025)	(0.004)		(0.040)	(0.011)		(0.861)	(0.540)		(0.861)	(0.540)		(0.036)	(0.004)
Teacher's Years of Experience			0.789**			0.386			0.118			0.118			0.951**
			(0.031)			(0.296)			(0.677)			(0.677)			(0.010)
Teacher Experience Squared			-0.025**			-0.011			-0.006			-0.006			-0.028**
			(0.026)			(0.342)			(0.450)			(0.450)			(0.013)
Teacher's Education Level			0.191			-0.366			-0.152			-0.152			-0.198
			(0.801)			(0.630)			(0.787)			(0.787)			(0.794)
Percentage of Students on FoRM			-23.504			-18.550			-6.187			-6.187			-25.141*
			(0.115)			(0.259)			(0.574)			(0.574)			(0.090)
Percentage of Students as ELL			-19.752			-24.666*			-22.095*			-22.095*			-22.355
			(0.158)			(0.099)			(0.052)			(0.052)			(0.110)
Percentage of Students with Disability			19.089*			11.144			5.677			5.677			22.997**
			(0.085)			(0.438)			(0.433)			(0.433)			(0.043)
School's RR Contract Status			5.182*			6.528*			3.438			3.438			6.649**
			(0.098)			(0.051)			(0.112)			(0.112)			(0.040)
Median Fall Assessment Score of the School			-0.623***			-0.442**			-0.428***			-0.428***			-0.642***
			(0.002)			(0.021)			(0.001)			(0.001)			(0.001)
Median Spring Assessment Score of the School			0.376**			0.227			0.326**			0.326**			0.345**
			(0.030)			(0.219)			(0.016)			(0.016)			(0.046)
Constant	35.351***	45.196***	60.842***	34.963***	46.042***	68.969***	33.012***	50.793***	55.269***	33.012***	50.793***	55.269***	34.215***	43.761***	64.839***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	350	350	350	396	396	396	1,035	1,035	1,035	1,035	1,035	1,035	356	356	356
R-squared	0.748	0.797	0.813	0.749	0.788	0.798	0.781	0.81	0.818	0.781	0.81	0.818	0.75	0.796	0.813

p-values in parentheses

*** p<0.01, ** p<0.05, * p<0.1