

TECHNICAL BRIEF

**Technical appendix for:
“The Power of Connectedness: A Case for a Coherent
Instructional System for Reading and Science
Improvement”**

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1. Introduction

This technical appendix provides additional detail about the sample, data, and methods used in the research brief, *The Power of Connectedness: A Case for a Coherent Instructional System for Reading and Science Improvement*. We sought to identify schools showing unusually high growth in both reading and science and to describe the contexts in which that growth occurred. Specifically, we address one research question:

RQ: What do teachers and leaders in a bright spot school identify as key school conditions or practices that supported high growth in reading and science?

2. Data and Metrics

NWEA MAP Growth

This study uses data from NWEA's anonymized longitudinal student achievement database. School districts use the [NWEA® MAP® Growth™](#) assessments to measure reading, language usage, mathematics, and science achievement and growth among elementary and secondary students. The MAP Growth data also include student demographics—race/ethnicity, gender, grade, and age at assessment.

Overview of MAP Growth

MAP Growth is a computer-adaptive assessment designed to measure achievement for students performing at, above, or below grade level. The assessment is vertically scaled, enabling the estimation of student growth across multiple test administrations. Student achievement in this study was measured using RIT (Rasch unit) scores from the NWEA MAP Growth assessments in science and reading.

RIT scores are based on a linear transformation of the logit scale from the Rasch item response theory model, allowing for comparisons across grade levels and over time. Although MAP Growth is often administered in fall, winter, and spring, this study uses only fall and spring scores.

Conditional Growth Index (CGI)

Growth in this study was measured with the Conditional Growth Index (CGI). The CGI is a standardized measure—essentially a z-score—that quantifies how much a student's observed growth deviates from their projected growth based on NWEA's 2020 student growth norms. These norms reflect typical (median) growth among similar students nationally.

- A CGI of 0 indicates growth equal to the norm.
- A positive CGI indicates growth that exceeds the norm.
- A negative CGI indicates growth below the norm.
- For example, a CGI of +1.0 means the student’s growth was one standard deviation above the expected growth norm.

The CGI allows for valid comparisons of growth across students conditioned on starting score, as well as on grade and subject.

Formula for CGI:

$$CGI = \frac{\text{Observed Growth} - \text{Projected Growth}}{\text{Standard Deviation of Growth}}$$

For more detail, see [Conditional Growth Index: Definition and Calculation \(NWEA\)](#).

We used fall and spring RIT scores in reading and science to compute **student-level CGI** for each school year. These student scores were then **aggregated to the school level** by calculating the **mean CGI** for each school, separately for reading and science, by year.

To summarize school performance across both subjects each year, we used the **minimum of the school mean reading and science CGI** scores. For example, if a school had a mean reading CGI of 0.23 and a mean science CGI of 0.31 in 2023–24, the value used to represent that school for that year was **0.23**. This approach ensured that only schools demonstrating strong growth in *both* subjects were considered high-performing. A higher minimum CGI reflects a higher baseline of growth across both reading and science for that school in that year.

Common Core of Data

For, school-level characteristics not available in MAP Growth, we used indicators from the 2022–23 and 2023–24 [Common Core of Data \(CCD\)](#) files published by the National Center for Education Statistics. These include school-level eligibility rates for free or reduced-price lunch (FRL), charter status, percent Black and percent Hispanic at the school level, and urbanicity classification (i.e., city, suburb, town, rural)

School Context Index from CCD

We aimed to identify schools achieving high growth in traditionally underserved and high-need contexts. Prior research (Kowalski et al., 2024; Lewis & Kuhfeld, 2024) has documented that low-income and Black and Hispanic students have faced persistent

academic challenges—particularly in science, reading, and mathematics—since the COVID-19 pandemic.

To capture school-level context, we developed a Context Index that combines two factors:

1. **Racial/ethnic composition:** We summed the percentage of Black and Hispanic students enrolled at each school. For example, a school with 25% Black students and 50% Hispanic students would have a combined value of 75%.
2. **Economic disadvantage:** We multiplied this sum by the school's percentage of students eligible for free or reduced-price lunch (FRL).

The resulting Context Index is calculated as:

$$\text{Context Index} = (\%Black + \%Hispanic) \times (\%FRL)$$

This composite value ranges from 0 to 1. Higher values represent schools with greater concentrations of historically underserved students and higher levels of economic disadvantage—contexts in which supporting academic growth is often more challenging.

3. Sample

Tested Sample

We focused on school years following the return to full in-person instruction after COVID-19 disruptions. Therefore, our study includes schools that administered **both** reading and science MAP Growth assessments in **both fall and spring** of the 2022–23, 2023–24, and/or 2024–25 school years. Schools needed to administer the test in both terms at least one of the three years to be included. We removed from the sample any students without both fall and spring scores in both reading and science in any given school year.

To ensure results were not due to **statistical noise or selective testing**, we applied two inclusion criteria for schools to be considered part of our tested sample:

- **Minimum tested sample size:** Schools must have tested **at least 10 students per grade**.
- **High participation rate:** Schools must have tested **at least 90% of enrolled students** within each grade level.

Note that by first eliminating students from the file who lacked complete data, our 10 student/90% participation rule applied to students with complete data.

The tested sample included just under 1200 schools that were more rural (37% vs. 30%) and less urban (21% vs. 29%) than the national population. Our tested sample was also heavily weighted toward Texas, with approximately 44% of schools from Texas compared with 9% nationally. Demographics, including percent FRL, Black, Hispanic, and Emergent bilingual were similar to the national population of schools. See Table 1 for details.

Analytic Sample

To identify our analytic sample, we examined the relationship between school growth and school context by plotting minimum mean school CGI (reading or science) on the vertical axis against the Context Index on the horizontal axis (see Figure 1). We observed a downward trend in CGI values as the Context Index increased, with a steeper decline beginning around a Context Index of 0.825. We selected this value as a cut point and defined our analytic sample as all schools in the tested sample with a Context Index greater than or equal to 0.825.

Schools in the analytic sample are characterized by:

- High percentages of Black and/or Hispanic students AND
- High rates of FRL eligibility

These criteria reflect school contexts where students typically face systemic barriers to academic opportunity.

By design, the Context Index requires *both* high percentages of Black or Hispanic students *and* high percentages of students eligible for FRL. For example, a school with 100% eligibility for FRL would *also* need at least 82.5% of students to be Black or Hispanic.

We acknowledge that a Context Index above 0.825 is restrictive. Because we wanted to identify schools that are excelling by serving students who are traditionally underserved, the restrictiveness of the Context Index is intentional. Nationally, ten states have a substantial number of schools with sufficient student populations to meet our Context Index criterion. Alabama, Georgia, Louisiana, Mississippi, New Mexico, Nevada, New York, Pennsylvania, South Carolina, and Texas each have 10% or more of schools with a Context Index of 0.825 or higher. That said, not all states serving high-needs schools meet the other inclusion criteria for this study: administration of both MAP Growth reading and science, in Fall and Spring, to 90% of 4th or 5th grade students, with at least 10 students per grade.

Examination of our analytic sample reveals that the test administration criteria alongside the Context Index heavily selected for Texas schools in this analysis. In 2024-25, over 80% of schools in our analytic sample were in Texas.

To a lesser extent, the inclusion criteria also select for city schools. Just under 70 percent of schools in 2024-25 analytic sample were in cities. See Table 1.

Bright Spot Schools

Bright Spot schools were identified as schools in the analytic sample that were making exceptional growth, defined as growth at or above the 95th percentile of the broader tested sample (CGI = 0.335 or higher). Following our sample selection criteria, all Bright Spot schools met the following criteria:

- Context Index ≥ 0.825
- Minimum of reading and science CGI ≥ 0.335
- At least 10 students tested per grade
- At least 90% of enrolled students tested per grade
- Testing in grades 4 and/or 5
 - Science *and* reading
 - Fall *and* spring

These schools—meeting a high bar for growth **and** serving students in traditionally challenging contexts—constitute our final set of **Bright Spots**.

By design, Bright Spot schools had high percentages of Black (19%), Hispanic (79%), emergent multilingual (47%) students, and students eligible for FRL (95%). These values far exceed national averages as shown in Table 1. Furthermore, given that our selection criteria favored Texas schools, it is unsurprising that 100% of Bright Spot schools were in Texas.

Case Site and Interview Sample

After identifying candidate bright-spot schools, we refined our sample to focus on schools located in districts where more than one school demonstrated high growth in both reading and science during the 2024–25 school year. We did not intend to evaluate district-wide policies or make general claims about district effectiveness. Rather, the presence of multiple high-growth schools within the same district suggested the possibility of shared priorities, supports, or instructional expectations that could plausibly shape individual school practice. By selecting a focal school embedded in such a context, we aimed to examine how broader district priorities may have been interpreted and enacted at the school level. This approach allowed us to trace potential throughlines between state content standards, system-level guidance, and classroom instruction, while keeping the analytic focus of this study on understanding instructional practice within schools.

We identified two districts that met these criteria, representing a total of seven potential bright-spot schools out of 103 elementary schools in the two districts, and invited both districts to participate in the study. Ultimately, one elementary school in one district agreed to participate. The focal district is located in a large metropolitan area in Texas and serves a predominantly economically disadvantaged student population. The district and its surrounding community face significant structural constraints, including concentrated poverty, limited access to healthcare and food resources, declining school enrollment, and persistent school staffing challenges. In the aftermath of the COVID-19 pandemic, these pressures were amplified by sharp declines in student achievement and a workforce characterized by high turnover and an above-average share of early-career and alternatively certified teachers.

At this school, we worked with the principal to identify teachers who taught grades 4–5 in either science or literacy to participate in the study. Between February and March 2026, we conducted qualitative, semi-structured interviews with one district leader, as well as the principal and four teachers at the focal district’s Bright Spot school.

4. Methods

RQ: What do teachers and leaders in a bright spot school identify as key school conditions or practices that supported high growth in reading and science?

Interviews of Teachers and School and District Leaders

Interviews

Interviews focused on topics related to literacy and science instruction, including district and school priorities; local history and context; curriculum adoption and instructional use for literacy and science; opportunities for integrating literacy and science instruction; staffing models in grades 4 and 5 (e.g., generalist versus departmentalized approaches); professional development; accountability and improvement processes; reflections on instructional successes; and perceived areas for improvement. Interviews lasted between 30 minutes and one hour and were audio-recorded and professionally transcribed.

In addition to interview data, we reviewed contextual materials to inform analysis and interpretation, including local and regional news coverage related to the district and relevant policy artifacts such as Texas state standards and accountability guidance for literacy and science. These materials were used to develop background knowledge about the district’s instructional and policy context and to situate participants’ perspectives within the broader state-level vision for literacy and science teaching and learning.

Qualitative Data Analysis

Interview data were analyzed using an iterative coding process designed to capture both classroom-level instructional practices and the system-level conditions supporting them. Initial deductive codes focused on district and school structures shaping instruction, including curriculum alignment, leadership and instructional vision, professional learning systems, staffing and scheduling, accountability practices, and implementation challenges. A second analytic pass introduced more fine-grained inductive codes to document how reading, writing, and structured discourse were enacted in daily classroom practice, including engagement with complex texts, extended writing and argumentation, structured academic talk, vocabulary development, multilingual supports, and active learning environments.

Following coding, researchers developed analytic memos to synthesize patterns across excerpts and to connect instructional practice with broader system conditions. We first examined all classroom-level instructional codes, reading across excerpts to develop a holistic account of what was occurring inside classrooms to support student growth in reading and science assessments. We then examined system-level excerpts in greater depth to elaborate on the organizational, curricular, and leadership mechanisms that supported and reinforced rigorous literacy and science instruction across classrooms. This analytic approach allowed us to examine instructional coherence across levels of the system, rather than attributing observed practices solely to individual teachers. Interview protocols are available upon request.

Table 1. Characteristics of Bright Spots schools relative to national, tested, and analytic samples

School Year	School Characteristic	National Sample	Tested Sample	Analytic Sample	Bright Spots Schools
2023-24	Number of schools in set	76,674	1,175	49	1
	City %	29	21.1	38.8	100
	Rural %	29.6	36.6	12.2	0
	Suburb %	31.1	32.1	36.7	0
	Town %	10.3	10.2	12.2	0
	Charter %	8.4	5.8	2	0
	Mean School Size	453.4	478.5	452.2	370
	Median CGP (minimum)	NA	44.0	42.2	60.7
	Median CGI (minimum)	NA	-0.19	-0.23	0.36
	Mean Science (Fall)	NA	201.5	194.5	193.9
	Mean Science (Spring)	NA	208.6	201.7	203.8
	Mean Reading (Fall)	NA	202.4	194.4	193.0
	Mean Reading (Spring)	NA	208.8	201.8	207.0
	In Texas %	9.4	43.7	57.1	100
	FRL %	50.0	49.4	95.0	98.9
	Black %	14.5	11.0	21.9	0.0
	Hispanic %	26.5	26.6	73.5	97.8
	Emergent bilingual %	9.6 [†]	9.7	29.4	17.8
	EISA %	NA	12.3	2	0
2024-25	Number of schools in set	76,674*	1,167	131	13
	City %	29*	29.5	68.7	100
	Rural %	29.6*	33.5	4.6	0
	Suburb %	31.1*	27.7	23.7	0
	Town %	10.3*	9.3	3.1	0
	Charter %	8.4*	4.5	3.1	0
	Mean School Size	453.4*	479.6	447.9	429.9
	Median CGP (minimum)	NA	45.6	50.3	66.5
	Median CGI (minimum)	NA	-0.15	-0.06	0.45

School Year	School Characteristic	National Sample	Tested Sample	Analytic Sample	Bright Spots Schools
	Mean Science (Fall)	NA	200.1	193.7	194.9
	Mean Science (Spring)	NA	207.8	203.3	207.9
	Mean Reading (Fall)	NA	200.6	192.8	193.9
	Mean Reading (Spring)	NA	207.7	202.0	207.0
	In Texas %	9.4*	53.6	81.7	100
	FRL %	50.0*	53.0	95.1	95.3
	Black %	14.5*	13.5	28.0	18.6
	Hispanic %	26.5*	32.4	68.3	78.8
	Emergent bilingual %	9.6 [†]	13.8	38.6	46.9
	EISA %	NA	18.9	1.5	0

Note: * Indicates 2024-25 school characteristics estimated from the 2023-24 CCD.

[†]Indicates that 2024-25 emergent bilingual characteristics are estimated from the 2018 CRDC data and pulled from the cleaned SEDA 5.0 school-level covariate data for 2018 (2018 school LEP percentiles applied to all years).

Figure 1. Minimum School CGI by Context Index (percent of Black or Hispanic by FRL)

