Back-to-School Learning Trends: Grades 1-5, 2018-2022
Technical Appendix

Data Description

This brief draws on two datasets (math and reading) that were each prepared by and accessed in partnership with Curriculum Associates (CA). The datasets each contain deidentified student-level information for the universe of i-Ready Diagnostic users who completed math or reading assessments during the sample period. Analytic datasets were constructed in two steps: I first identified the schools that were eligible for inclusion and then narrowed the sample to students who met inclusion criteria (described below).

The i-Ready Diagnostic assessment is an adaptive, computer-delivered assessment. Schools are encouraged to administer the formative assessment three times per year: in the fall, winter, and spring. The assessments are intended to function as low-stakes tests (in contrast to high-stakes standardized tests) that can inform teacher practice and students' enrichment opportunities throughout the year. My analyses include student grade, on-grade placement levels, scale scores, and the location[1] in which the diagnostic assessment was completed.

Analytic sample

As mentioned above, the analytic dataset was constructed in two steps, identifying first the schools and then the student-level records that met inclusion criteria for analysis. The process was conducted in parallel for math and reading datasets, such that a given student (school) may appear in one or both datasets, but their presence in one is not conditional on the other.

Determining which schools are included in analytic dataset

This brief focuses on assessment scores in a given spring and the corresponding fall, in order to examine changes surrounding the summer break.[2] Schools were considered for inclusion in the sample if they had administered the i-Ready diagnostic in the spring and fall that correspond to a given summer. Accordingly, schools were included in the analytic sample if they administered the i-Ready diagnostic in the spring and fall of at least one pre-pandemic summer (2018 or 2019) and at least one summer following the return to in-person learning

[1] This variable became available in Fall 2020 following the widespread use of virtual learning during the COVID-19 pandemic. Diagnostic assessments completed prior to the pandemic are assumed to have taken place in school.

[2] This report does not aim to distinguish between the summer break itself and the weeks of school that occur after a spring assessment or between the return to school and the fall assessment (see Briggs and Wellberg [2022] for a detailed discussion of analytic approaches to this question).

(2021 or 2022).[3] We confirm that results are similar if we restrict the sample to schools that used the platform in all four summers (2018, 2019, 2021, and 2022).

Next, I restrict the sample to summer transitions that span traditional elementary grades—that is, to students completing grades one through four in the spring (and, by extension, beginning grades two through five in the fall). This allows us to avoid capturing disruptions in learning that might arise from structural moves, in which students must leave their school because they have completed the highest grade that it offers.[4]

Following Goldhaber and colleagues (2022) and Bahena and Morales (2023), I retain schools in the analysis that had 10 or more students complete the diagnostic in a given grade-year. This step limits the inclusion of schools that use the platform for targeted intervention, versus as a tool for school-wide monitoring and support.

These steps leave 10,248 schools in the math dataset and 9,212 schools in the reading dataset. (The total number of schools across both datasets is 10,928, so very few schools in one sample are not present in the other.)

Determining which students are included in the analytic dataset

The second phase of analytic sample construction begins with the student-level records of students enrolled in grades 1 through 4 at a school that is included in the sample. To be included in the analytic dataset, students must have assessment scores for both spring and fall terms that correspond to a given summer. These assessments must not have been completed outside of school.[5] I also drop any record that was flagged as substantially rushed and therefore unlikely to be valid.

I use the anonymized student identifier to merge spring records with data from the fall term that immediately follows a given spring (e.g., fall 2019 is merged onto data from spring 2019). I observe fall data for 87.3% of students who had completed a spring assessment and met the inclusion criteria described above.[6]

The dataset prepared by Curriculum Associates allows me to follow students who moved to a different school within the same district (presuming the second school also uses the i-Ready platform). It does not include students who left their district (either via geographic more or by transferring to a private or homeschool context). The analytic sample that I use retains

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[3] In practice, this meant a given school must have utilized the platform during two consecutive academic years in order to have data for the spring and fall that correspond to a given "summer" (e.g., data from 2017-18 corresponds to the spring assessment for summer 2018 and data from 2018-19 corresponds to the fall assessment for summer 2018).

[4] Schwartz, Stiefel, & Cordes, 2017

[5] This criterion is applied beginning in the 2020-21 academic year, when the variable became available.

[6] This is true for math; double-check reading and add statistic.

students who changed schools within the district; I confirm that results are similar when I exclude students who changed schools between a given spring and fall assessment.

Variable Definitions

The main outcome we examine is spring and fall i-Ready diagnostic scores in reading and math. The assessment is scored on a scale of 100-800, with vertical integration that allows for comparisons across grades.[7] The difference between fall and spring scores is regarded as a measure of student learning change (loss or gain) across both the summer and the weeks of schooling (spring and fall) that bookend the summer break.

In light of COVID-related learning disruptions, we exclude the spring and fall that correspond to Summer 2020 from our analysis. By spring 2021, fourteen US states mandated schools return to in-person learning for some or all grades,[8] with many others offering hybrid options for students to experience at least some in-person learning during periods with lower levels of coronavirus community spread.[9]

Timing of Assessments

When examining pre-pandemic and current summer learning patterns, it is important to establish whether the timing of assessments has changed substantially—whether due to shifts in school calendars (e.g., longer school years) or for other reasons. In our analytic sample, we observe that, across all four summers we examine, the average spring assessment occurred between May 6 and May 10 and the average fall assessment between September 2 and September 5. That is, we see no evidence that the timing of i-Ready assessments has shifted over the time period we examine.

Grade level subgroups

We also categorize students according to whether they began the initial academic year (i.e., the fall that precedes a given summer) at or above, versus below, grade level. Curriculum Associates sets thresholds for on grade level placement (2019). The figure on page 10 of the brief shows the proportion of students who were classified as below grade level for each grade-year in question. In addition, the figure on the following page plots the distance from the grade-level threshold to each subgroup's average score.

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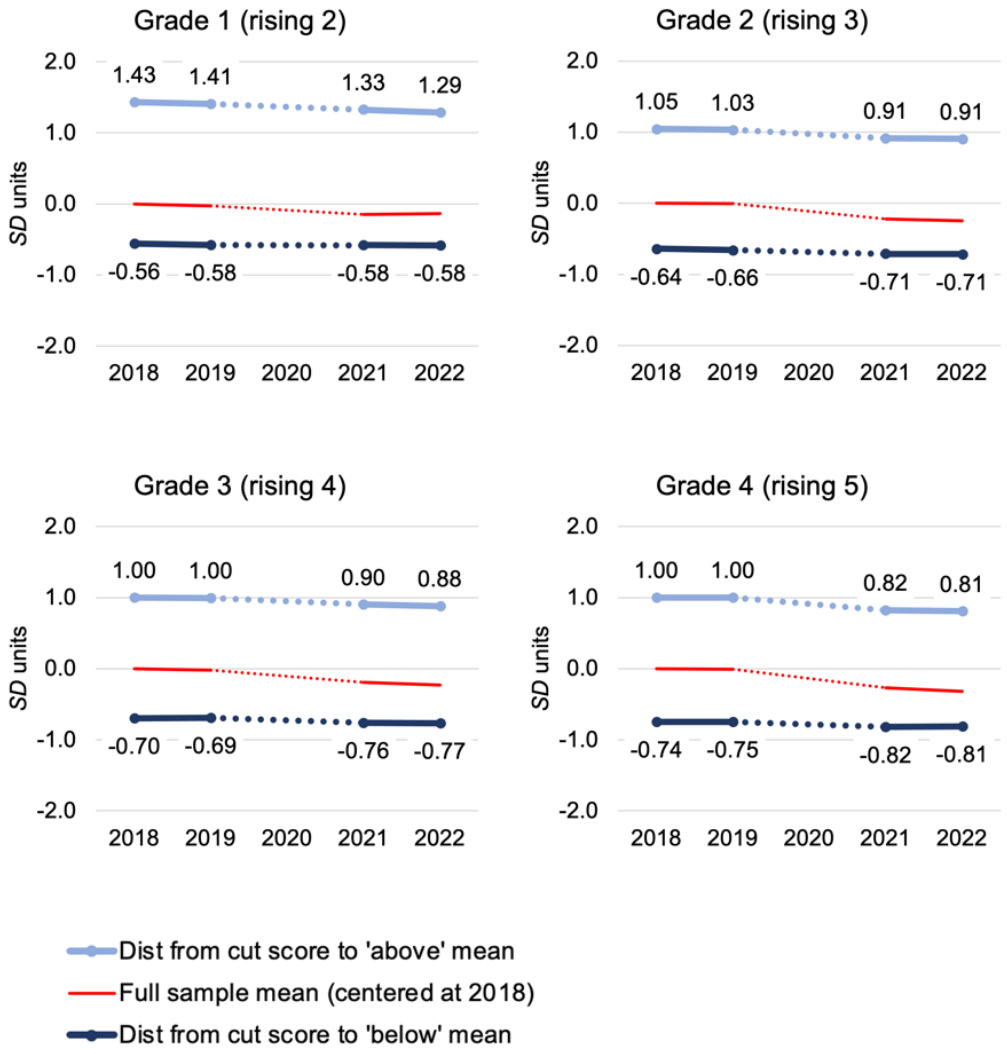
[7] This is known as vertical scaling, meaning that all students' scores can be placed along a continuum from kindergarten through twelfth-grade skills, with the difference between any two assessments capturing the student's growth over the corresponding time period (see Briggs, 2013 and Curriculum Associates, 2014).

[8] https://www.edweek.org/leadership/map-where-are-schools-closed/2020/07

[9] See, for example, remarks from Delaware governor John Carney regarding the goal of a full return to in-person instruction by Fall 2021: https://www.wdel.com/news/carney-goal-is-to-have-students-back-in-classroom-100-this-fall/article_9b1d5e34-97cb-11eb-b1bf-4bee7a75c42f.html



Results

First, we examine spring and fall scores for students completing first through fourth grade (rising to second through fifth) across the summers in the sample period. After examining spring and fall scores for the national sample, I grouped students according to whether their fall placement was on or above[10] versus below grade level.

Descriptive statistics

Sample sizes, means and standard deviations, and the change in scores between spring and fall assessments appear for the national sample in Tables 1 (math) and 2 (reading). Descriptive statistics are then presented for students who began the academic year on (Table 3) or below (Table 4) grade level in math. Finally, descriptive statistics are presented by student subgroup for reading, for students who began the academic year on (Table 5) or below (Table 6) grade level.

[10] hereafter, "on"

Table 1. Descriptive statistics for math full sample (N = 10,248 schools)

A. Grade 1 (rising 2)

	N	Spring score	Fall score	Summer change
Summer 2018	292,682	410 (26)	405 (25)	-4.44
Summer 2019	396,384	409 (26)	402 (26)	-7.29
Summer 2021	266,914	402 (28)	398 (27)	-3.85
Summer 2022	373,122	402 (28)	398 (28)	-3.77

B. Grade 2 (rising 3)

	N	Spring score	Fall score	Summer change
Summer 2018	324,207	433 (27)	428 (26)	-4.53
Summer 2019	433,609	432 (27)	426 (26)	-5.81
Summer 2021	286,723	422 (29)	422 (28)	-0.37
Summer 2022	403,566	423 (29)	421 (29)	-1.50

C. Grade 3 (rising 4)

	N	Spring score	Fall score	Summer change
Summer 2018	346,119	456 (30)	451 (28)	-5.01
Summer 2019	437,018	455 (30)	447 (28)	-8.04
Summer 2021	285,955	446 (31)	443 (30)	-3.36
Summer 2022	414,182	447 (32)	443 (31)	-4.37

D. Grade 4 (rising 5)

	N	Spring score	Fall score	Summer change
Summer 2018	353,538	475 (32)	469 (30)	-6.28
Summer 2019	439,145	474 (32)	465 (29)	-9.59
Summer 2021	283,104	464 (34)	460 (32)	-4.09
Summer 2022	401,907	464 (35)	460 (33)	-4.62

Table 2. Descriptive statistics for reading full sample (N = 9,212 schools)

A. Grade 1 (rising 2)

	N	Spring score	Fall score	Summer change
Summer 2018	274,203	458 (48)	463 (50)	5.05
Summer 2019	353,385	458 (48)	459 (51)	1.28
Summer 2021	239,485	446 (50)	450 (54)	4.04
Summer 2022	324,047	447 (51)	452 (54)	4.97

B. Grade 2 (rising 3)

	N	Spring score	Fall score	Summer change
Summer 2018	301,432	503 (49)	501 (51)	-1.89
Summer 2019	391,052	501 (50)	498 (52)	-2.93
Summer 2021	258,171	491 (56)	492 (56)	0.59
Summer 2022	354,967	490 (57)	491 (58)	1.04

C. Grade 3 (rising 4)

	N	Spring score	Fall score	Summer change
Summer 2018	322,229	530 (51)	530 (51)	0.00
Summer 2019	401,385	528 (52)	528 (53)	-0.70
Summer 2021	262,536	522 (57)	523 (58)	0.95
Summer 2022	372,504	521 (59)	523 (60)	1.39

D. Grade 4 (rising 5)

	N	Spring score	Fall score	Summer change
Summer 2018	323,091	552 (52)	554 (52)	1.68
Summer 2019	395,975	552 (54)	552 (54)	0.43
Summer 2021	252,805	546 (58)	547 (58)	0.90
Summer 2022	361,680	547 (59)	549 (59)	1.57

Math

Table 3. Math summer learning trend for students who began school year on grade level

A. Grade 1 (rising 2)

	N	spring score	fall score	summer change
Summer 2018	259,548	413 (24)	409 (23)	-4.58
Summer 2019	346,170	413 (23)	406 (23)	-7.25
Summer 2021	234,905	406 (26)	402 (25)	-3.90
Summer 2022	309,766	408 (24)	404 (24)	-3.86

B. Grade 2 (rising 3)

	N	spring score	fall score	summer change
Summer 2018	243,727	442 (22)	437 (21)	-4.83
Summer 2019	329,366	441 (22)	435 (20)	-6.03
Summer 2021	208,554	432 (23)	431 (23)	-0.25
Summer 2022	264,463	436 (20)	435 (21)	-1.55

C. Grade 3 (rising 4)

	N	spring score	fall score	summer change
Summer 2018	245,302	468 (22)	463 (21)	-5.39
Summer 2019	306,227	468 (21)	459 (20)	-8.93
Summer 2021	192,820	459 (24)	455 (23)	-3.74
Summer 2022	255,790	464 (22)	459 (21)	-4.80

D. Grade 4 (rising 5)

	N	spring score	fall score	summer change
Summer 2018	262,094	488 (23)	480 (22)	-7.33
Summer 2019	323,017	487 (22)	476 (21)	-10.92
Summer 2021	192,457	479 (25)	474 (23)	-4.95
Summer 2022	254,123	483 (23)	477 (22)	-5.49

Table 4. Math summer learning trend for students who began the school year below grade level

A. Grade 1 (rising 2)

	N	spring score	fall score	summer change
Summer 2018	33,134	380 (24)	377 (22)	-3.34
Summer 2019	50,214	380 (24)	372 (24)	-7.61
Summer 2021	32,009	372 (27)	369 (25)	-3.50
Summer 2022	63,356	371 (27)	368 (25)	-3.33

B. Grade 2 (rising 3)

	N	spring score	fall score	summer change
Summer 2018	80,480	406 (23)	402 (21)	-3.63
Summer 2019	104,243	404 (23)	399 (23)	-5.13
Summer 2021	78,169	397 (26)	396 (25)	-0.66
Summer 2022	139,103	397 (26)	396 (25)	-1.40

C. Grade 3 (rising 4)

	N	spring score	fall score	summer change
Summer 2018	100,817	427 (26)	423 (24)	-4.10
Summer 2019	130,791	426 (26)	420 (24)	-5.94
Summer 2021	93,135	419 (28)	416 (26)	-2.58
Summer 2022	158,392	420 (28)	416 (27)	-3.68

D. Grade 4 (rising 5)

	N	spring score	fall score	summer change
Summer 2018	91,444	440 (28)	437 (25)	-3.25
Summer 2019	116,128	439 (28)	433 (25)	-5.88
Summer 2021	90,647	433 (29)	430 (27)	-2.27
Summer 2022	147,784	433 (29)	430 (28)	-3.13

Reading

Table 5. Reading summer learning for students who began the school year on grade level

A. Grade 1 (rising 2)

	N	spring score	fall score	summer change
Summer 2018	251,793	463 (45)	468 (47)	5.14
Summer 2019	323,856	463 (45)	465 (48)	1.50
Summer 2021	224,333	450 (48)	455 (51)	4.32
Summer 2022	289,220	455 (47)	460 (49)	5.33

B. Grade 2 (rising 3)

	N	spring score	fall score	summer change
Summer 2018	232,224	520 (36)	518 (39)	-1.59
Summer 2019	298,970	519 (37)	517 (40)	-2.46
Summer 2021	193,514	511 (44)	512 (46)	0.79
Summer 2022	237,432	518 (40)	519 (41)	0.86

C. Grade 3 (rising 4)

	N	spring score	fall score	summer change
Summer 2018	227,657	552 (35)	552 (37)	0.41
Summer 2019	278,908	552 (35)	552 (36)	-0.06
Summer 2021	177,929	548 (41)	550 (42)	1.55
Summer 2022	231,918	554 (36)	556 (38)	1.56

D. Grade 4 (rising 5)

	N	spring score	fall score	summer change
Summer 2018	245,970	571 (38)	573 (38)	1.63
Summer 2019	297,132	572 (38)	573 (38)	0.60
Summer 2021	184,455	570 (41)	571 (41)	1.04
Summer 2022	252,884	575 (38)	576 (38)	1.34

Table 6. Reading summer learning trend for students who began the school year below grade level

A. Grade 1 (rising 2)

	N	spring score	fall score	summer change
Summer 2018	22,410	397 (39)	401 (40)	4.01
Summer 2019	29,529	398 (39)	397 (42)	-1.12
Summer 2021	15,152	384 (38)	384 (40)	-0.01
Summer 2022	34,827	383 (39)	385 (41)	1.99

B. Grade 2 (rising 3)

	N	spring score	fall score	summer change
Summer 2018	69,208	445 (42)	442 (40)	-2.91
Summer 2019	92,082	443 (41)	438 (40)	-4.47
Summer 2021	64,657	432 (43)	432 (41)	0.00
Summer 2022	117,535	432 (43)	434 (43)	1.39

C. Grade 3 (rising 4)

	N	spring score	fall score	summer change
Summer 2018	94,572	478 (45)	477 (42)	-1.00
Summer 2019	122,477	475 (45)	473 (44)	-2.16
Summer 2021	84,607	469 (48)	468 (48)	-0.31
Summer 2022	140,586	467 (49)	468 (48)	1.13

D. Grade 4 (rising 5)

	N	spring score	fall score	summer change
Summer 2018	77,121	492 (46)	494 (44)	1.82
Summer 2019	98,843	490 (47)	490 (46)	-0.07
Summer 2021	68,350	483 (51)	484 (50)	0.51
Summer 2022	108,796	484 (51)	486 (50)	2.09

My analysis describes the difference in scores between spring and fall assessments for each grade and year we consider. I do this in scale score points and then express the scale scores from the summers of 2021 and 2022 as a proportion of the observed academic-year gains (fall-to-spring) in the 2018-19 school year.

I then repeated this process for student subgroups, presenting the difference in scores between spring and fall assessments, first in scale score points and then as a proportion of the academic-year gains (fall-to-spring) that were observed for each subgroup in the 2018-19 school year.

Numeric results that accompany the figures in the Brief are presented below, both overall (Table 7) and for grade-level subgroups (Tables 8 and 9).

Overall

Table 7. Pandemic-era math scores, as a percentage of 2018-19 academic-year gains

	2021		2022	
	Spring	Fall	Spring	Fall
Grade 1 (rising 2)	-25%	-13%	-24%	-13%
Grade 2 (rising 3)	-35%	-16%	-32%	-17%
Grade 3 (rising 4)	-33%	-17%	-28%	-16%
Grade 4 (rising 5)	-43%	-21%	-41%	-21%

By grade-level subgroup

Table 8. Math spring and fall scores in 2021 and 22, as % of 2018-19 gains

On grade level

		2021			2022	
	N	Spring	Fall	N	Spring	Fall
Grade 1 (rising 2)	234,905	-24%	-14%	398,552	-18%	-7%
Grade 2 (rising 3)	208,554	-33%	-13%	264,463	-16%	-1%
Grade 3 (rising 4)	192,820	-30%	-13%	255,790	-13%	1%
Grade 4 (rising 5)	192,457	-35%	-11%	254,123	-18%	4%

Below grade level

		2021			2022	
	N	Spring	Fall	N	Spring	Fall
Grade 1 (rising 2)	32,009	-15%	-7%	398,552	-18%	-9%
Grade 2 (rising 3)	78,169	-19%	-6%	139,103	-18%	-8%
Grade 3 (rising 4)	93,135	-22%	-11%	158,392	-19%	-12%
Grade 4 (rising 5)	90,647	-22%	-9%	147,784	-20%	-10%

Table 9. Reading spring and fall scores in 2021 and 22, as % of 2018-19 gains

On grade level

		2021			2022	
	N	Spring	Fall	N	Spring	Fall
Grade 1 (rising 2)	224,333	-23%	-18%	289,220	-15%	-8%
Grade 2 (rising 3)	193,514	-21%	-13%	237,432	-2%	6%
Grade 3 (rising 4)	177,929	-13%	-7%	231,918	10%	15%
Grade 4 (rising 5)	184,455	-10%	-8%	252,884	12%	16%

Below grade level

		2021			2022	
	N	Spring	Fall	N	Spring	Fall
Grade 1 (rising 2)	15,152	-20%	-18%	34,827	-21%	-16%
Grade 2 (rising 3)	64,657	-20%	-12%	117,535	-20%	-8%
Grade 3 (rising 4)	84,607	-16%	-11%	140,586	-19%	-12%
Grade 4 (rising 5)	68,350	-19%	-17%	108,796	-18%	-12%

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