

The Impacts of i-Ready Personalized Instruction on Student Math Achievement in Multiple School Districts

Michael A. Cook, PhD
Ashley A. Grant, PhD
Steven M. Ross, PhD

February 2022



JOHNS HOPKINS
SCHOOL of EDUCATION

Center for Research and
Reform in Education

Contents

EXECUTIVE SUMMARY:	1
The Impacts of i-Ready Personalized Instruction on Student Math Achievement in Multiple School Districts.....	1
i-Ready Personalized Instruction was associated with mathematics achievement gains.	1
i-Ready Personalized Instruction usage metrics were higher in elementary schools. ...	2
i-Ready Personalized Instruction usage that met usage guidance was associated with mathematics gains.....	2
Conclusions	2
The Impacts of i-Ready Personalized Instruction on Student Math Achievement in Multiple School Districts.....	3
Method.....	4
Research Design	4
Participants	4
Measures	5
MCAS scores	5
Demographic variables.	5
i-Ready Diagnostic Scores.....	5
i-Ready Usage data.	6
Analytical Approach	6
Results	8
i-Ready usage.	8
Achievement descriptive statistics.....	8
Grade-level achievement analyses	9
Grade-level analyses.....	9
Grade-band analyses.	9
Combined analysis.....	10
Usage Analyses	11
Math usage.....	11
Usage quartiles.	11
Usage quartiles and mathematics achievement.	12

CA usage guidelines.	13
Discussion	15
Grade-level Achievement Gains.....	15
Usage Patterns	15
Conclusions	16
Appendix A: ESSA Tables.....	18
Appendix B: Descriptive Analyses.....	19
Appendix C: Grade-level Regression Tables	23

EXECUTIVE SUMMARY:

The Impacts of i-Ready Personalized Instruction on Student Math Achievement in Multiple School Districts

In July 2021, The Center for Research and Reform in Education (CRRE) at Johns Hopkins University contracted with Curriculum Associates (CA) to conduct a quantitative efficacy study of the effects of i-Ready Personalized Instruction on student achievement in five Massachusetts school districts. The present report examines findings from quantitative analyses comparing achievement gains, as measured by the Massachusetts Comprehensive Assessment System (MCAS), between students who experienced both i-Ready Personalized Instruction and Diagnostic testing and students who only participated in i-Ready Diagnostic testing. Additional analyses examined relationships between i-Ready usage metrics and both i-Ready and MCAS scores. Outcome data from the 2020-21 school year, which was disrupted due to the COVID-19 pandemic, were used in all present analyses.

Research questions for this evaluation include the following:

1. What is the effectiveness of i-Ready Personalized Instruction on student achievement on summative state assessments in mathematics in a year of learning disruptions from the COVID-19 pandemic?
2. How are the effects of i-Ready Personalized Instruction on achievement impacted by student and implementation variables?
 - a. By student prior achievement demographic characteristics (subgroups), such as grade level
 - b. Student i-Ready testing and instruction usage?

The study sample consisted of about 11,000 students in grades 3-8 from five school districts in Massachusetts. All schools used i-Ready Diagnostic assessments, but each district assigned some students to receive both the Diagnostic and Instruction products, while other students only received the Diagnostic product.

Key findings of the current study include:

i-Ready Personalized Instruction was associated with mathematics achievement gains. Use of i-Ready Personalized Instruction was associated with significantly higher mathematics achievement on the MCAS in grades 3, 5, and 6. i-Ready Personalized Instruction students scored 5-7 points higher, on average, than did comparison students who only participated in the i-Ready Diagnostic Assessment

program. In grade-aggregated analyses, i-Ready Personalized Instruction students showed significantly higher mathematics achievement than did comparison students, with Instruction students averaging five points higher MCAS scores.

i-Ready Personalized Instruction usage metrics were higher in elementary schools. Instructional usage metrics were considerably higher in elementary school grades than in middle school grades. Specifically, elementary students averaged four more hours of usage and 16 more completed lessons than did middle school students.

i-Ready Personalized Instruction usage that met usage guidance was associated with mathematics gains. Students who met CA's recommended i-Ready usage guidelines of 30 minutes per week for at least 18 weeks and passing more than 70% of lessons had significantly higher mathematics achievement in relation to comparison students. Specifically, mathematics Instruction students who met CA's usage guidelines had 6–17-point higher MCAS math scores than did comparison students.

Conclusions

The key results and conclusions of this evaluation are as follows:

- Students in grades 3, 5, and 6 who used i-Ready Personalized Instruction showed significantly higher mathematics achievement on the MCAS mathematics assessment than did comparison students.
- i-Ready Personalized Instruction metrics including total time and lesson count variables were significantly positively associated with MCAS mathematics achievement across all grades.
- i-Ready Personalized Instruction usage was generally higher in elementary grades, in relation to middle school grades.
- All quartiles of i-Ready Personalized Instruction usage were associated with significantly higher mathematics achievement, in relation to comparison students, in grades 5 and 6. Quartiles 2-4 of i-Ready Personalized Instruction usage were associated with significantly higher mathematics achievement in grade 3, as well.
- Students who met i-Ready Personalized Instruction usage guidelines generally showed significantly higher MCAS mathematics achievement, in relation to Diagnostic-only students.

The Impacts of i-Ready Personalized Instruction on Student Math Achievement in Multiple School Districts

In July 2021, The Center for Research and Reform in Education (CRRE) at Johns Hopkins University contracted with Curriculum Associates (CA) to conduct a quantitative efficacy study of the effects of i-Ready Personalized Instruction on student achievement in five Massachusetts school districts. The present report examines findings from quantitative analyses comparing achievement gains, as measured by the Massachusetts Comprehensive Assessment System (MCAS), between students who experienced i-Ready Personalized Instruction and Diagnostic testing and students who only participated in Diagnostic testing. Additional analyses examined relationships between i-Ready usage metrics and both i-Ready and MCAS scores. Outcome data from the 2020-21 school year, which was disrupted due to the COVID-19 pandemic, were used in all present analyses.

The i-Ready Diagnostic assessment is an adaptive assessment designed to provide teachers with actionable insight into student needs. The Diagnostic assessment offers a complete picture of student performance and growth, eliminating the need for multiple, redundant tests. The i-Ready Diagnostic assessment pinpoints student ability level, identifies specific skills students need to learn to accelerate their growth, and charts a personalized learning path for each student.

The i-Ready Personalized Instruction suite delivers online lessons for grades K-8 students that provide tailored instruction that meets learners at their level, helps them problem solve, and keeps students motivated to continue their progress. Instruction uses data obtained from the i-Ready Diagnostic assessment to deliver personalized learning paths for each student, balancing rigor and reachability. Online lessons offer students explicit instruction when they need it, along with systematic practice and scaffolded feedback that helps to promote a growth mindset.

Research questions for this evaluation include the following:

1. What is the effectiveness of i-Ready Personalized Instruction on student achievement on summative state assessments in mathematics in a year of learning disruptions from the COVID-19 pandemic?
2. How are the effects of i-Ready Personalized Instruction on achievement impacted by student characteristics and implementation variables?
 - a. By student prior achievement demographic characteristics (subgroups), such as grade level
 - b. Student i-Ready testing and instruction usage?

Method

Research Design

This study was a quasi-experimental design (QED) that analyzed end-of-year summative state test data and i-Ready Diagnostic assessment and usage data from the 2020-21 school year. Specifically, Mathematics MCAS scores from the 2020-21 school year were obtained for all students in grades 3-8. Mathematics MCAS scores were also obtained from the 2019-20 school year, but due to sparseness of data (only about 10% of observations contained non-missing data), MCAS scores from this school year were not used in analyses. We also obtained i-Ready Diagnostic scores from the fall, winter, and spring of the 2020-21 school year, along with i-Ready usage data for students who used i-Ready Personalized Instruction. Fall 2020 i-Ready scores were used as the prior achievement variable, in place of spring 2020 MCAS scores. As i-Ready Personalized Instruction usage tends to be implemented by school, Hierarchical Linear Modeling (HLM) was used to compare student achievement between students who did and did not receive i-Ready Personalized Instruction. We also conducted similar analyses to examine the relationships between usage variables and ELA and mathematics achievement.

Participants

Student data were originally obtained from a total of just over 18,000 students from five school districts in Massachusetts. We received data for all grades K-8 students in these five districts, but since only grades 3-8 students had outcome (MCAS) variable data, we dropped grades K-2 students from our analytic sample, leaving a sample of approximately 11,000 students from 69 schools.

Student demographics for participants in this study are displayed in Table 1. “Other Race” is defined as ethnicities other than White, Hispanic, or Black. The treatment sample contained significantly higher percentages of Hispanic, Black, and ELL students, while the comparison sample contained a larger percentage of non-Hispanic White students.

Table 1

Student characteristics for analytic sample, by percentage

	Treatment	Comparison
% White	64.52	75.86*
% Hispanic	64.52*	12.83
% Black	27.66*	13.32
% Other Race	3.58	7.50
% Female	49.33	49.83
% Students with Disabilities/SPED	25.43	19.12

% ELs	13.97*	3.10
N	7,646	3,881

Note: * $p < .05$

Measures

Data sources for the current study include student i-Ready Diagnostic scores, i-Ready Personalized Instruction usage data, student demographic data, and student MCAS achievement data. Mathematics scores were obtained from both i-Ready and MCAS assessments. Student achievement data from the 2020-21 school year were analyzed to compare achievement gains between students who did and did not receive i-Ready Personalized Instruction throughout the school year. In addition, i-Ready Personalized Instruction usage data were analyzed to examine relationships between i-Ready usage and MCAS test scores, in relation to comparison students who did not receive i-Ready Personalized Instruction.

MCAS scores. MCAS mathematics scores were obtained from the spring of the 2019-20 and 2020-21 school years for all grades 3-8 students. Initially, spring 2020 scores were intended to be used as prior achievement controls for our analytic models; however, the sparseness of the data (only about 10% of students recorded valid scores for this administration), due to the COVID-19 pandemic, rendered this not feasible, and were replaced in our models by fall 2020 i-Ready Diagnostic scores. Spring 2021 mathematics scores were used as the outcome variable in our analyses. MCAS scores ranged from 440-560 and are not vertically scaled, meaning a score of 500 in grade 4 is not equivalent to a score of 500 in grade 5 in terms of academic achievement, for example. Table 2 shows the classification of MCAS scores into achievement levels across all grades and subjects.

Table 2

MCAS achievement level score bands

Achievement Level	Scaled Scores
Not Meeting Expectations	440-469
Partially Meeting Expectations	470-499
Meeting Expectations	500-529
Exceeding Expectations	530-560

Demographic variables. The data also included a series of demographic variables including race, gender, ethnicity, economic disadvantage, special education, and English Language Learner status. Not all the districts included data on all these variables, especially economic disadvantage and ELL status.

i-Ready Diagnostic Scores. Overall and sub-domain i-Ready Diagnostic assessment scores were obtained for all elementary and middle school students (grades

K-8) in the 2020-21 school year. Mathematics sub-domains included numbers and operations, algebra, geometry, and measurement. We focused on overall mathematics scores for the present analyses. We obtained fall, winter, and spring i-Ready Diagnostic scores, but focused mainly on the fall scores as a prior achievement control in our main achievement analyses. i-Ready Diagnostic assessment scores range from 0-800 and are vertically scaled and nationally normed across grades, meaning that scores can be directly compared to each other, regardless of a student's current grade level. In our analyses, i-Ready Diagnostic scores tended to range between 400-700.

i-Ready Usage data. i-Ready mathematics usage data were obtained for all students who were tested by i-Ready in the 2021 school year. The usage data consists of time spent on lessons and instruction only and does not include time spent on diagnostic assessments. Thus, students who were Diagnostic-only (comparison students) had 0's on nearly all usage metrics. Usage metrics included: total lessons completed, unique lessons completed, passed lessons, minutes of usage, weeks of instruction, and weeks with at least one completed lesson. We focused on total instructional time, lessons completed, unique lessons completed, and passed lessons in our main analyses.

Analytical Approach

Data for students in grades 3-8 were analyzed by descriptively examining patterns of MCAS and i-Ready Diagnostic scores and usage, as well as by comparing achievement patterns between students who received i-Ready Personalized Instruction (Treatment students) and students who only received i-Ready Diagnostic assessments (Comparison students). Hierarchical Linear Modeling (HLM) at each grade level was used to compare differences in achievement, as measured by the MCAS, between treatment and comparison students. Schools were used as the Level 2 (cluster-level) variable, as i-Ready Personalized Instruction usage is typically clustered at the school level. Demographic variables such as gender, ethnicity, ELL status, and special education status were included in all models. We also included HLM models that tested the unique effect of each usage metric by replacing the treatment variable (i-Ready Personalized Instruction vs. Diagnostic testing only) with the usage metric. This allowed us to estimate the effect of individual units of instruction, such as one hour of usage or one completed lesson, on MCAS scores, in relation to students who did not use i-Ready Personalized Instruction. All covariates in regression models were grand-mean centered to enable interpretation of the intercept.

Initially, baseline equivalence was not met for fall 2020 mathematics i-Ready scores, across all grade levels. Baseline equivalence is defined as being met if the standardized mean difference between treatment and comparison groups is less than 0.25 SD (WWC, 2020). Here, the differences all favored the Comparison group, and ranged between approximately 0.60 and 0.87 SDs. Unadjusted means for 2020 mathematics i-Ready scores by grade are presented in Table 3.

Table 3
Baseline equivalence, unadjusted, by grade

Grade	Treatment	Comparison	Stan. Mean Diff.
Grade 3	416.14	438.18	-0.873
Grade 4	434.50	452.71	-0.724
Grade 5	452.01	469.54	-0.662
Grade 6	465.02	482.63	-0.606
Grade 7	474.39	495.62	-0.716
Grade 8	483.00	506.98	-0.664

Note: Fall 2020 i-Ready is baseline achievement variable

To adjust for the large standardized mean differences between treatment and comparison students on baseline achievement, propensity score weighting (PSW) was used in all analyses for the purpose of creating comparison groups that were as similar as possible to groups of treatment students. As analyses were intended to be performed by grade-level, PSW was also conducted separately at each grade level. Within each grade level, treatment students were each given a weight of one, and comparison students were each given a weight of:

$$Weight_i = \frac{Probability_i}{1 - Probability_i}$$

Students with weights of greater than 10 were dropped from analyses, as weights of these magnitudes are indicative of individual students who would have outsized influence on analytic results. This only occurred in a handful of observations and did not appreciably change the makeup of the comparison samples.

The result of these PSW procedures was that comparison students who were more similar to treatment students (in terms of prior achievement and demographic covariates) were weighted more heavily in the analyses, and comparison students who were less similar to treatment students were weighted less. This approach resulted in the creation of weighted comparison groups at each grade level that were as similar as possible to the observed groups of treatment students. After these weights were applied to comparison students, baseline equivalence was achieved for fall 2020 mathematics scores across all grades of students, with standardized mean differences all having magnitudes of less than 0.24. These adjusted mean scores can be found by grade level and subject in Appendix A. However, after taking into account attrition, which was especially high in the upper grade levels, baseline equivalence remained in grades 3-6, but was not achieved in grades 7 and 8, even with the application of propensity score weights. As a result, these grade levels were not included in further analyses.

Results

i-Ready usage. We first descriptively examine patterns of i-Ready usage by school level. Usage data refers only to i-Ready Personalized Instructional usage time, and not to Diagnostic assessment time, so only treatment students had usage data. Grades 3-5 were grouped together as Elementary students, and grade 6 students were considered Middle students, as grades 7 and 8 were excluded from analysis. Table 4 shows descriptive statistics relating to i-Ready math usage metrics.

Table 4

I-Ready usage means and standard deviations for elementary and middle school students in Mathematics

	Elementary (grades 3-5)	Middle (grade 6)
Total lessons	35.88 (26.49)	19.72 (19.49)
Unique lessons	30.41 (21.58)	16.47 (15.69)
Passed lessons	29.64 (22.41)	14.86 (14.88)
Minutes of Usage	1077.27 (714.39)	824.49 (751.15)
N	5427	822

Usage metrics were consistently higher for elementary students than they were for middle school students, and to a considerable degree. Elementary students averaged approximately 16 more total lessons, 14 more unique lessons, 15 more passed lessons, and slightly greater than four more hours of usage than did middle school students.

Achievement descriptive statistics. We now examine descriptive patterns of achievement throughout the 2020-21 school year. We present fall 2020 i-Ready and spring 2021 MCAS scores, as MCAS scores were the main outcome variable in our analyses. These scores are displayed by grade in Table 5.

Table 5

Average i-Ready and MCAS mathematics scores, 2020-21

	Fall i-Ready		Spring MCAS	
	Treatment	Comparison	Treatment	Comparison
Grade 3	416.14	438.18	475.39	497.95
Grade 4	434.50	452.71	472.84	494.15
Grade 5	452.01	469.54	479.96	489.02
Grade 6	465.02	482.63	476.58	490.33

As noted previously, comparison students consistently scored higher on the fall i-Ready Diagnostic assessment than did treatment students. This difference may be

related to characteristics of schools that decided to implement i-Ready Personalized Instruction as opposed to the Diagnostic-only program, but another important consideration is that, in the middle school grades, i-Ready Personalized Instruction is typically used for remediation purposes. Unadjusted spring MCAS scores also tended to be higher, on average, for comparison students, with differences ranging from 10-22 points. Further descriptive analyses may be found in Appendix B.

Grade-level achievement analyses

In this section, we present the results of grade-level analyses examining the effect of i-Ready Personalized Instruction, in relation to Diagnostic-only usage. We will present results for each of grades 3-6 in mathematics. Separate analyses were conducted on each grade-level, resulting in a total of 4 separate regression analyses.

Grade-level analyses. Table 6 shows the results of grade-level analyses examining the effect of i-Ready Personalized Instruction on MCAS mathematics scores. Separate analyses were performed for each grade level.

Table 6

Grade-level analyses of i-Ready Personalized Instruction on MCAS Mathematics scores

Grade	Estimate	Standard Error	P-value	Effect size
Grade 3	7.223*	2.928	.014	0.306
Grade 4	3.550	5.773	.539	0.170
Grade 5	5.860***	1.376	<.001	0.310
Grade 6	5.145**	1.946	.008	0.275

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Statistically significant positive effects of i-Ready Personalized Instruction on MCAS mathematics scores were observed in grades 3, 5, and 6. I-Ready Personalized Instruction usage was associated with a greater than 7-point gain in MCAS mathematics scores for grade 3 students, nearly a 6-point increase for grade 5 students, and just over a 5-point increase for grade 6 students. Effect sizes were also robust in these three grades, indicating that treatment students scored nearly one-third of a standard deviation higher than did comparison students. Even in grade 4, with a non-significant finding, the directional association with i-Ready Personalized Instruction was positive.

Grade-band analyses. We also conducted a series of supplementary analyses in which we examined the impact of i-Ready Personalized Instruction across grade bands. Specifically, we defined the “elementary” grade band as consisting of students in grades 3-5, while we defined the “middle” grade band as consisting of students in grade 6. The models used in these analyses are identical to those used in the grade-level analyses, with the addition of dummy variables to control for student grade level. The results of these analyses are shown in Table 7.

Table 7

Impacts of i-Ready Personalized Instruction on MCAS mathematics achievement, by grade band

Grade	Estimate	Standard Error	P-value	Effect size
Elementary	5.973***	1.174	<.001	0.278
Middle	5.145**	1.946	.008	0.275

Note: *** $p < .001$, ** $p < .01$

Consistent with the grade-level analyses, results were positive across both grade bands. I-Ready mathematics Instruction had a statistically significant positive impact on MCAS scores for elementary students, with i-Ready Personalized Instruction students averaging nearly 6 points higher on the MCAS mathematics assessment than comparison students. Instruction impacts were also evidenced in the middle grades, as students who received i-Ready Personalized Instruction averaged approximately 5 points higher on the MCAS mathematic assessment than did comparison students.

Combined analysis. As an additional set of supplementary analyses, we also conducted analyses using the entire sample of grades 3-6 students to examine the effect of i-Ready Personalized Instruction on mathematics achievement. These analyses were identical to the grade-level analyses and included the same propensity score weights. To account for grade-level differences, a set of dummy variables was included in these models to control for grade. Results of the overall analyses for math achievement are found in Table 8.

Table 8

Impacts of i-Ready Personalized Instruction on mathematics achievement, grades 3-6

Grade	Estimate	Standard Error	P-value	Effect size
i-Ready Personalized Instruction	5.427***	1.051	<.001	0.258

Note: *** $p < .001$

The estimated impact of i-Ready Personalized Instruction on MCAS mathematics scores was statistically significant, with students who received i-Ready Personalized Instruction scoring nearly 5.5 points higher, on average, on the MCAS mathematics assessment than did comparison students. Taken together, the results of these analyses show that i-Ready Personalized Instruction had a statistically significant positive impact on mathematics achievement across all of grades 3-6.

Usage Analyses

Next, we present a series of analyses examining the associations between i-Ready usage metrics and achievement. These analyses were identical to the previous achievement analyses, with the treatment variable being replaced with an i-Ready usage variable in each model. Separate models were run for each variable in each grade level. i-Ready usage metrics used in these analyses include total hours of usage and counts of completed lessons, unique lessons, and passed lessons. We follow this up with similar analyses examining the relationships between instructional usage quartiles and achievement, as well as the effects of meeting CA's usage guidelines on achievement.

Math usage. We present the results of analyses examining the effects of i-Ready Personalized Instruction variables on mathematics achievement. Table 9 shows the unstandardized coefficients of the same four usage variables as in the previous analyses, across each grade.

Table 9

Associations between i-Ready Personalized Instruction usage and mathematics achievement

Grade	Total time (hours)	Completed Lessons	Unique Lessons	Passed Lessons
Grade 3	0.470***	0.224***	0.283***	0.294***
Grade 4	0.352***	0.183***	0.249***	0.251***
Grade 5	0.264***	0.141***	0.201***	0.211***
Grade 6	0.240***	0.159***	0.215***	0.264***

Note: *** $p < .001$

i-Ready usage metrics were significantly positively associated with MCAS mathematics scores. All of the coefficients listed in Table 9 were statistically significant at the .001 alpha level. Coefficients in Table 9 can be interpreted as the expected change in MCAS mathematics score for every unit of a usage variable. For example, each hour of i-Ready Personalized Instruction usage was associated with a nearly half-point MCAS mathematics score increase for grade 3 students. Similarly, each completed lesson for a grade 3 student was associated with a nearly quarter-point increase in MCAS math score, and each unique and passed lesson was associated with a nearly three-tenths of a point MCAS math score increase. The largest magnitudes of associations were generally found in the elementary grades.

Usage quartiles. We next examined the relationships between i-Ready Personalized Instruction quartiles, as measured by hours of total usage, and achievement, as measured by MCAS scores. Usage quartiles were created because, in previous analyses relating curriculum usage and achievement, these relationships

tended to be curvilinear, with the lowest and highest users tending to have the highest levels of achievement. Thus, these relationships are potentially underestimated in simple correlational and regression analyses. The construction of usage quartiles allows for a more partitioned investigation of the relationship between instructional usage and achievement for different levels of usage. We constructed usage quartiles on the basis of minutes of instructional usage for students with non-missing MCAS scores, with quartile 1 indicating the lowest levels (i.e., 25th percentile and lower) of usage and quartile 4 (i.e., 75th percentile and higher) indicating the highest levels of usage. This was done at each grade level. A positive association would indicate that a usage quartile was associated with higher MCAS scores, in relation to comparison students, who had no instructional usage.

Analyses were performed for mathematics usage quartiles and achievement. The models used in these analyses are identical to those used in previous variables, with the treatment variable being replaced by four dummy variables representing the quartiles of usage. Tables of usage quartiles ranges are shown in Table 10.

Table 10

Usage quartile ranges (in hours) and sample sizes, by grade

Grade	Quartile 1	N	Quartile 2	N	Quartile 3	N	Quartile 4	N
Grade 3	<9.94	483	9.94-17.74	484	17.75-26.02	484	>26.02	483
Grade 4	<8.98	451	8.98-15.67	453	15.68-24.25	449	>24.25	451
Grade 5	<8.18	422	8.18-15.45	423	15.46-23.32	421	>23.32	423
Grade 6	<4.20	232	4.20-10.30	233	10.31-18.53	234	>18.53	232

Usage quartiles in elementary school were considerably larger than in middle school in terms of math usage, with median mathematics usage ranging between 15.46-17.75 hours for elementary students. By contrast, median mathematics usage in middle school was 10.31 hours.

Usage quartiles and mathematics achievement. We now present the results of grade-level analyses examining the association between i-Ready Personalized Instruction usage quartiles and MCAS mathematics scores. Table 11 shows the unstandardized regression coefficients for each usage quartile, in relation to comparison students, for each grade.

Table 11

Associations between i-Ready Personalized Instruction usage quartiles and mathematics achievement

Grade	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Grade 3	5.987	10.795***	15.883***	21.945***

Grade 4	1.046	5.394	8.585	12.121*
Grade 5	4.884***	7.615***	8.758***	13.202***
Grade 6	3.938*	6.035**	8.400**	12.801***

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Positive significant relationships between usage and mathematics achievement were predominant across most grades. Specifically, the strongest positive associations were observed in grades 3, 5, and 6, with all or nearly all quartiles of instructional usage associated with significantly higher MCAS mathematics scores in relation to comparison students. A statistically significant positive relationship between quartile 4 usage and mathematics achievement was also observed in grade 4. In general, quartile 4 usage was associated with the strongest effects on mathematics achievement, as evidenced by a statistically significant positive association in all grades, and quartile 1 usage was associated with the weakest effects, as statistically significant positive effects were only observed in grades 5 and 6. Similarly, the magnitudes of effects were generally largest for quartile 4 usage and weakest for quartile 1 usage.

CA usage guidelines. Curriculum Associates provides recommended i-Ready Personalized Instruction usage guidelines to educators. Specifically, Curriculum Associates recommends individual students aim for a consistent 30-45 minutes of i-Ready Personalized Instruction usage per subject per week and an average of at least 70% of lessons passed for the year. However, to identify students who met Curriculum Associates' recommended guidelines, and consistent with previous i-Ready Personalized Instruction efficacy studies, we operationalized this guidance as follows:

- At least 18 weeks of i-Ready Personalized Instruction use
- An average of at least 30 minutes per week of Instruction use
- An average lesson pass rate of greater than 70%

Although at least 18 weeks of i-Ready Personalized Instruction use is not formal educator guidance, this rule was included to ensure consistent usage of i-Ready Personalized Instruction. Similarly, while educators are recommended that 45 minutes per week of Instruction usage is recommended, 30 minutes per week of Instruction usage has been a common usage benchmark for CA. Students that met all three of these guidelines were classified as having met usage guidelines, while those that did not meet all three criteria were classified as not having met usage guidelines. Table 12 displays the percentages of i-Ready Personalized Instruction students who met i-Ready Personalized Instructional usage guidelines.

Table 12

<i>Percentages of students meeting i-Ready Mathematics Instruction usage guidelines</i>	
Grade	Met i-Ready usage guidelines

Grade 3 ($n = 1784$)	62.33
Grade 4 ($n = 1666$)	53.18
Grade 5 ($n = 1570$)	44.71
Grade 6 ($n = 822$)	28.83

Over half of the i-Ready mathematics Instruction students met usage guidelines in grades 3 and 4, while percentages of students reaching usage guidelines declined through later grades, with about 45% of grade 5 students and only 29% of grade 6 students reaching usage guidelines.

We also conducted grade-level analyses that examined the relationship between meeting or not meeting i-Ready usage guidelines on achievement, in relation to comparison students. The models used in these analyses are similar to those used in previous analyses, except the treatment variable is replaced by dichotomous variables indicating i-Ready Personalized Instruction students who did or did not meet usage guidelines. Comparison students were assigned a "0" for both dichotomous variables. This allowed us to uniquely estimate the relationship between MCAS achievement and instructional usage that did or did not meet CA's guidelines. Results of these analyses are shown in Table 13.

Table 13

Associations between meeting i-Ready usage guidelines and MCAS mathematics achievement

Grade	Did not meet usage guidelines	Met Usage Guidelines
Grade 3	6.644*	16.66***
Grade 4	1.893	9.222
Grade 5	5.330***	10.397***
Grade 6	4.638**	12.641***

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Patterns of achievement gains differed between treatment students who did and did not meet i-Ready Personalized Instructional usage guidelines in mathematics, even though most of the associations were significant and positive. Any sort of i-Ready usage, whether it met recommended usage guidelines or not, was associated with significantly higher MCAS mathematics scores in grades 3, 5, and 6, although the magnitude of the increases was consistently lower for treatment students who did not meet usage guidelines. In these grades, treatment students who met usage guidelines averaged over 10-point larger MCAS mathematics gains than did comparison students, while treatment students who did not meet usage guidelines averaged 4.5-7-point MCAS mathematics gains. These results suggest the importance of students to not just receive i-Ready Personalized Instruction, but to meet instructional usage guidelines, to fully realize the potential benefits of i-Ready Personalized Instruction on achievement.

Discussion

The purpose of this evaluation was to examine the impact of i-Ready Personalized Instruction on mathematics achievement, as measured by MCAS scores. We compared students who received i-Ready Personalized Instruction with students who only participated in i-Ready Diagnostic testing. We also examined associations between various i-Ready usage metrics and achievement.

In interpreting the findings of this evaluation, some limitations should be noted. First, while we controlled for as many demographic variables as possible, some, namely economic disadvantage and ELL status, were not available from all school districts involved in this evaluation, meaning we were unable to control for these variables or conduct relevant subgroup analyses. Similarly, we had access only to spring MCAS scores and i-Ready Diagnostic score and usage data from the 2020-21 school year. This limited our analyses to only one year and to strictly quantitative measures, which precluded drawing any conclusions regarding the fidelity of implementation within classrooms by teachers and students, outside of the quantitative usage data supplied to us by Curriculum Associates. Qualitative implementation data would have been instrumental in explaining differences in instructional usage between grades and schools, especially given the rapidly changing school environments of the 2020-21 school year caused by the COVID-19 pandemic.

Grade-level Achievement Gains

Statistically significant positive effects of i-Ready Personalized Instruction on MCAS mathematics scores were observed in grades 3, 5, and 6 throughout the 2020-21 school year. Treatment students in these grades averaged 5-7 points higher on the MCAS mathematics assessment than did comparison students. Supplementary analyses showed that, when combined across grade bands, i-Ready Personalized Instruction had a statistically significant positive impact on elementary students' mathematics achievement, as well as on grade 6 students' mathematics achievement. It is important to note that the present analyses compared the incorporation of i-Ready's Instruction component to the Diagnostic Assessment component only, which itself has already been shown to be an effective research-based intervention. Thus, it is likely that efficacy estimates of the combined Instruction with Diagnostic Assessment treatment condition may have been conservative, relative to a design where comparison students received neither of the i-Ready components.

Usage Patterns

Descriptive analysis of usage by grade revealed that usage metrics were generally greater in elementary school than in middle school. Elementary treatment students averaged approximately four more hours of mathematics usage than did middle school treatment students. Similarly, elementary treatment students averaged

considerably more completed lessons, unique lessons, and passed lessons in mathematics i-Ready Personalized Instruction than did middle school treatment students.

Regression analyses with usage variables showed that each of the four usage metrics we considered were significantly positively related to student mathematics achievement. These relationships were consistently strong and positive across all grade levels.

When examining associations between usage quartiles and achievement, statistically significant associations between usage quartiles and MCAS mathematics achievement scores were observed. Nearly all quartiles of mathematics usage were consistently associated with significantly higher MCAS math scores in relation to comparison students. This pattern held across all grades, with higher quartiles (i.e., quartiles 3 and 4) of usage associated with the greatest MCAS mathematics score gains. Notably, larger proportions of students met i-Ready's instructional usage guidelines in elementary school than in middle school. This may be attributed in part to i-Ready Personalized Instruction being used largely for remediation purposes in middle school, which is different from how i-Ready Personalized Instruction is typically implemented in elementary schools. Grade-level analyses showed that students who met usage guidelines showed significant achievement gains at nearly every grade level. In addition, students in grades 3, 5, and 6 who used i-Ready Personalized Instruction but did not meet usage requirements still significantly outscored comparison students. Magnitudes of effects were consistently larger for students who met usage guidelines, in relation to those who did not meet guidelines.

Conclusions

The key results and conclusions of this evaluation are as follows:

- Students in grades 3, 5, and 6 who used i-Ready Personalized Instruction showed significantly higher mathematics achievement on the MCAS mathematics assessment than did comparison students.
- i-Ready Personalized Instruction metrics including total time and lesson count variables were significantly positively associated with mathematics achievement across all grades.
- i-Ready Personalized Instruction usage was generally higher in elementary grades, in relation to middle school grades.
- All quartiles of i-Ready Personalized Instruction usage were associated with significantly higher mathematics achievement, in relation to comparison students, in grades 5 and 6. Quartiles 2-4 of i-Ready Personalized Instruction usage were associated with significantly higher mathematics achievement in grade 3, as well.

- Students who met i-Ready Personalized Instruction usage guidelines generally showed significantly higher MCAS mathematics achievement, in relation to Diagnostic-only students.

Appendix A: ESSA Tables

Table A1

Baseline equivalence by grade

	Overall Mean	Treatment Mean (SD)	Control Mean (SD)	Adjusted T v C Difference	Pooled Unadjusted SD	Stan. Mean Diff.
3rd grade	420.28	416.14 (26.42)	425.31 (20.12)	-5.39	25.10	-0.215
4th grade	437.11	434.50 (26.23)	439.94 (22.23)	-5.98	25.14	-0.238
5th grade	452.98	452.01 (27.69)	453.97 (25.98)	2.77	27.08	0.102
6 th grade	467.53	465.02 (31.89)	470.42 (25.36)	4.97	29.18	0.170
7 th grade	474.48	474.39 (32.00)	473.60 (27.21)	7.65	29.76	0.257
8 th grade	484.01	483.00 (37.02)	485.03 (35.03)	10.01	36.28	0.276

NOTE: SD=standard deviation; all estimates include propensity-score weights. Baseline equivalence was calculated only for students with non-missing pretest and posttest data.

Table A2

Summary of student attrition, by grade

C Student N	T Student N	N Randomized to C	N Randomized to T	Attrited C Students	Attrited T Students	Overall Student Attrition Rate (%)	Differential Student Attrition Rate (%)
540	1814	557	1934	17	120	5.50	3.15
684	1690	703	1804	19	114	5.31	3.54
912	1592	944	1689	32	97	4.90	2.35
653	833	698	931	45	98	8.78	4.08
705	706	746	785	41	79	7.84	4.56
327	626	428	704	101	78	15.81	12.52

Appendix B: Descriptive Analyses

Table B1
Sample sizes, by grade and district, 2020-21

	Treatment	Comparison
District 1		
Grade 3	58	276
Grade 4	8	312
Grade 5	21	343
Grade 6	50	295
Grade 7	7	346
Grade 8	0	0
District 2		
Grade 3	110	0
Grade 4	0	103
Grade 5	5	100
Grade 6	0	103
Grade 7	0	90
Grade 8	0	88
District 3		
Grade 3	19	64
Grade 4	4	50
Grade 5	12	241
Grade 6	0	20
Grade 7	0	4
Grade 8	0	7
District 4		
Grade 3	0	197
Grade 4	0	214
Grade 5	2	220
Grade 6	7	217
Grade 7	1	217
Grade 8	3	170
District 5		
Grade 3	1597	2
Grade 4	1654	5
Grade 5	1530	8
Grade 6	765	18
Grade 7	671	46
Grade 8	599	61

Table B2
Sample sizes by grade, 2020-21

	Treatment	Comparison
Grade 3	1784	539
Grade 4	1666	684
Grade 5	1570	912
Grade 6	653	822
Grade 7	703	679
Grade 8	326	602

Table B3
Average math achievement scores, by grade and district, 2020-21

	Fall -i-Ready`		Spring MCAS	
	Treatment	Comparison	Treatment	Comparison
District 1				
Grade 3	424.84	439.63	502.28	498.96
Grade 4	n/a	454.10	n/a	498.33
Grade 5	465.62	474.13	490.86	489.00
Grade 6	490.90	482.29	494.36	489.16
Grade 7	n/a	497.60	n/a	495.47
Grade 8	n/a	n/a	n/a	n/a
District 2				
Grade 3	425.38	n/a	479.75	n/a
Grade 4	n/a	443.78	n/a	474.39
Grade 5	n/a	455.79	n/a	475.34
Grade 6	n/a	472.97	n/a	483.81
Grade 7	n/a	486.53	n/a	480.41
Grade 8	n/a	509.84	n/a	489.77
District 3				
Grade 3	415.37	432.77	476.47	484.66
Grade 4	n/a	454.30	n/a	495.76
Grade 5	456.67	471.32	488.42	491.84
Grade 6	n/a	486.20	n/a	489.75
Grade 7	n/a	n/a	n/a	n/a
Grade 8	n/a	n/a	n/a	n/a
District 4				
Grade 3	n/a	438.02	n/a	501.19
Grade 4	n/a	454.87	n/a	497.93
Grade 5	n/a	473.23	n/a	492.87
Grade 6	n/a	488.59	n/a	496.69
Grade 7	n/a	501.94	n/a	495.65
Grade 8	n/a	516.11	n/a	492.73
District 5				
Grade 3	415.19	n/a	474.10	n/a

Grade 4	434.46	n/a	472.76	n/a
Grade 5	451.84	n/a	479.76	n/a
Grade 6	463.56	467.56	475.50	470.94
Grade 7	474.71	473.61	477.57	477.09
Grade 8	483.07	484.90	475.79	473.97

Table B4

I-Ready usage means and standard deviations for the 2020-21 school year, by grade

Grade 3	<i>N</i> = 1784
Total lessons	41.21 (27.55)
Unique lessons	35.91 (23.27)
Passed lessons	35.59 (24.00)
Minutes of Usage	1171.96 (743.64)
Grade 4	<i>N</i> = 1666
Total lessons	36.21 (25.74)
Unique lessons	30.62 (21.03)
Passed lessons	29.78 (21.80)
Minutes of Usage	1087.35 (693.50)
Grade 5	<i>N</i> = 1550
Total lessons	30.14 (22.65)
Unique lessons	24.74 (17.35)
Passed lessons	23.35 (17.78)
Minutes of Usage	1023.36 (675.06)
Grade 6	<i>N</i> = 822
Total lessons	41.21 (27.55)
Unique lessons	35.91 (23.27)
Passed lessons	35.59 (24.00)
Minutes of Usage	1171.96 (743.64)
Grade 7	<i>N</i> = 679
Total lessons	16.62 (15.93)
Unique lessons	13.72 (12.86)
Passed lessons	11.88 (12.27)
Minutes of Usage	832.71 (799.45)
Grade 8	<i>N</i> = 602
Total lessons	13.93 (14.08)
Unique lessons	11.16 (10.91)
Passed lessons	9.52 (10.31)
Minutes of Usage	703.36 (673.49)

Table B5

I-Ready usage means and standard deviations for the 2020-21 school year, by district

District 1	N = 144
Total lessons	3.19 (3.83)
Unique lessons	3.08 (3.60)
Passed lessons	2.91 (3.60)
Minutes of Usage	55.43 (67.37)
District 2	N = 115
Total lessons	34.02 (25.86)
Unique lessons	30.29 (22.78)
Passed lessons	30.80 (23.77)
Minutes of Usage	893.17 (806.45)
District 3	N = 35
Total lessons	15.66 (14.80)
Unique lessons	14.17 (13.58)
Passed lessons	13.63 (13.44)
Minutes of Usage	325.24 (303.64)
District 4	N = 13
Total lessons	7.00 (7.47)
Unique lessons	6.46 (6.78)
Passed lessons	6.23 (6.78)
Minutes of Usage	127.76 (155.53)
District 5	N = 6816
Total lessons	31.10 (25.13)
Unique lessons	26.26 (20.73)
Passed lessons	25.13 (21.31)
Minutes of Usage	1034.59 (9.62)

Appendix C: Grade-level Regression Tables

Table C1

Overall impact of i-Ready Personalized Instruction on spring 2021 mathematics achievement, by grade

Variable	Estimate	Standard Error	P-value	Effect Size
Grade 3				
i-Ready Personalized Instruction	7.22*	2.923	.014	0.306
Constant	473.57***	2.53	<.001	
Variance of constant	29.32			
Residual	315.92			
Student <i>N</i>	2126			
Class <i>N</i>	44			
Grade 4				
i-Ready Personalized Instruction	3.55	5.77	.539	0.170
Constant	474.94***	4.69	<.001	
Variance of constant	8.02			
Residual	208.05			
Student <i>N</i>	2136			
Class <i>N</i>	43			
Grade 5				
i-Ready Personalized Instruction	5.860***	1.38	<.001	0.310
Constant	478.95***	1.11	<.001	
Variance of constant	6.00			
Residual	171.51			
Student <i>N</i>	2260			
Class <i>N</i>	43			
Grade 6				
i-Ready Personalized Instruction	5.15**	1.95	.008	0.275
Constant	477.78***	1.90	<.001	
Variance of constant	6.84			
Residual	168.05			
Student <i>N</i>	1251			
Class <i>N</i>	16			