The Impact of i-Ready Personalized Instruction With Fidelity on 2021 MCAS Mathematics Achievement

Final Report

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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 Instruction on student achievement in five Massachusetts school districts. The present report presents findings from quantitative analyses comparing achievement gains, as measured by the Massachusetts Comprehensive Assessment System (MCAS), between students who experienced i-Ready Instruction at Curriculum Associates' recommended levels and Diagnostic testing and students who only participated in Diagnostic testing.

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. It 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 instruction adapted to each student's level, helps them problem solve, and keeps students motivated to continue their progress. The 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.

Previous research (Cook & Ross, 2022) examined the effectiveness of i-Ready Instruction on student achievement in the 2020-21 school year, during the COVID-19 pandemic. This study expands on the previous research by comparing math achievement gains for i-Ready Instruction students who met recommended usage levels, and those for otherwise similar comparison students.

Research questions for this evaluation include the following:

1. What is the effectiveness of i-Ready Instruction that meets CA's recommended usage guidelines 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 Instruction on achievement impacted by student characteristics and implementation variables?
    a. By student prior achievement demographic characteristics (subgroups), such as grade level

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. 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 Instruction. As i-Ready Instruction was implemented by school, Hierarchical Linear Modeling (HLM), with students as the Level-1 unit of analysis and schools (representing treatment) as the Level-2 unit of analysis, was used to compare student achievement between students who received Instruction and met usage guidelines, and comparison students who did not receive i-Ready Instruction.

Participants

Student data were originally obtained from a total of just over 18,000 students from five school districts in Massachusetts. We received student 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.

CA usage guidelines. Curriculum Associates provides recommended i-Ready Personalized Instruction usage guidelines to educators. Specifically, individual students should 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 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. Slightly less than half of treatment students with non-missing pretest, posttest, and demographic data (44.6%) were classified as having met CA's recommended usage guidelines.

Student demographics for participants in this study are displayed in Table 1. We also include demographics of treatment students who did not meet recommended usage guidelines and were thus not included in these analyses. "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 (Met Usage requirements)	Treatment (Did not meet usage requirements)	Comparison
% White	63.34	63.91	71.30*
% Hispanic	64.48*	65.48	13.87
% Black	28.20*	29.37	16.89
% Other Race	3.88	2.64	8.21
% Female	48.58	51.24	49.54
% SPED	21.42	23.58	19.79
% ELs	13.25*	12.36	2.90
N	3,170	3,940	2,582

Note. Analytic sample consists of students in either the Treatment (met usage requirements) or Comparison column in Table 1; * $p < .05$.

Measures

Data sources for the current study include student i-Ready Diagnostic scores, i-Ready 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 Instruction throughout the school year.

MCAS scores. MCAS mathematics scores were obtained from the spring of the 2020-21 school years for all Grades 3-8 students. Spring 2021 mathematics and ELA scores were used as the outcome variables 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 variables. Not all of the districts provided data on all of 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 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 Instruction Usage data. i-Ready Instruction mathematics usage data were obtained for all students who were tested by i-Ready in the 2020-21 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. In the current set of analyses, usage metrics were used mainly to determine whether i-Ready Instruction students met recommended usage guidelines.

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 Instruction and met usage guidelines (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 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. 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 0.25 and 0.79 SDs. Unadjusted means for 2020 mathematics i-Ready scores by grade are presented in

Table 3
Baseline equivalence, unadjusted, by grade

Grade	Treatment	Comparison	Stan. Mean Diff.
Grade 3	418.39	438.18	-0.785
Grade 4	438.00	452.71	-0.624
Grade 5	457.32	469.54	-0.496

Grade	Treatment	Comparison	Stan. Mean Diff.
Grade 6	463.03	482.63	-0.704
Grade 7	481.06	495.62	-0.250
Grade 8	484.37	506.98	-0.310

Note. Fall 2020 i-Ready 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 ELA and 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.

Results

Achievement descriptive statistics. Grade-level descriptive data are presented in Table 4 for the fall 2020 i-Ready and unadjusted spring 2021 MCAS scores. As noted previously, comparison students consistently scored higher on the fall i-Ready Diagnostic assessment than did treatment students. These differences may be due in part to the characteristics of schools that decided to implement i-Ready Personalized Instruction as opposed to the Diagnostic-only program. The types of students who tended to meet i-Ready usage guidelines for Personalized Instruction may also have an impact on patterns of scores. In addition, i-Ready Personalized Instruction is commonly used for remediation purposes for middle school students. Unadjusted spring MCAS scores tended to be higher, on average, for comparison students, with differences ranging from 3-17 points.

Table 4
Average i-Ready and MCAS mathematics scores, 2020-21

	Fall i-Ready		***Spring MCAS***		***N***	
Grade	Treatment	Comparison	Treatment	Comparison	Treat	Comp
Grade 3	418.39	437.27	479.11	496.08	1112	342
Grade 4	438.00	451.73	478.05	492.43	886	470
Grade 5	457.32	468.37	484.92	487.79	702	692
Grade 6	463.03	479.66	479.74	487.17	237	436
Grade 7	484.06	492.80	483.17	490.65	136	486
Grade 8	484.37	497.04	479.85	482.26	97	156

Grade-level achievement analyses

In this section, we present the results of grade-level analyses examining the effect of i-Ready Personalized Instruction, and specifically meeting usage guidelines for Personalized Instruction, in relation to Diagnostic-only usage. We will present results for each of Grades 3-8 in mathematics. Separate analyses were conducted on each grade-level, resulting in a total of six separate analyses.

Grade-level analyses. Table 5 shows the results of grade-level analyses for Grades 3-8 examining the effect of i-Ready Personalized Instruction on MCAS mathematics scores.

Table 5
Grade-level analyses of i-Ready Personalized Instruction on MCAS Mathematics scores

Grade	Estimate	Standard Error	p-value	Effect size
Grade 3 (*n* = 1454)	16.737***	2.308	<.001	0.716
Grade 4 (*n* = 1356)	14.488	7.787	.063	0.668
Grade 5 (*n* = 1394)	10.062*	4.125	.015	0.520
Grade 6 (*n* = 673)	9.947**	3.604	.006	0.526
Grade 7 (*n* = 622)	2.420	2.904	.405	0.106
Grade 8 (*n* = 253)	5.231*	2.114	.013	0.264

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

Statistically significant positive effects of i-Ready Personalized Instruction usage were observed on MCAS mathematics scores for Grades 3, 5, 6, and 8. i-Ready Personalized Instruction was associated with a nearly 17-point larger gain in MCAS mathematics scores for Grade 3 students, in relation to comparison students. Similarly, it was associated with 10-point larger gains for Grades 5 and 6 students, and 5-point larger gains for Grade 8 students. In Grade 4, Personalized Instruction was associated with over 14-point larger gains, in relation to comparison students, and this difference approached statistical significance ($p = .063$).

Grade-band analyses. We also conducted a series of supplementary analyses in which we examined the impact of i-Ready Personalized Instruction that meets usage guidelines 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 Grades 6-8. 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. Additionally, since baseline equivalence was achieved at each grade level without re-weighting, the same propensity weights

used in prior analyses were also used in this set of analyses. The results of these analyses are shown in Table 6.

Table 6
Impacts of i-Ready Personalized Instruction on MCAS mathematics achievement, by grade band

Grade	Estimate	Standard Error	p-value	Effect size
Elementary (*n* = 4204)	9.419***	1.582	<.001	0.433
Middle (*n* = 1548)	6.519**	2.188	.003	0.312

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

Statistically significant positive effects of i-Ready Personalized Instruction usage that meets recommended guidelines were observed on MCAS mathematics across both grade bands. Elementary students who used Personalized Instruction outgained comparison students by nearly 9.5 points, while middle school students who used Personalized Instruction outgained comparison students by more than 6 points. Effect sizes were comparable for elementary and middle school students, indicating consistent practically significant positive effects of Personalized Instruction on mathematics achievement.

Combined analysis. As an additional supplementary analysis, we also conducted an analysis using the entire sample of Grades 3-8 students to examine the effect of i-Ready Personalized Instruction that meets usage guidelines on mathematics achievement. These analyses were identical to the grade-level analyses and, as baseline equivalence was met for this analysis, 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 analysis for mathematics achievement are found in Table 7.

Table 7
Impacts of i-Ready Personalized Instruction on mathematics achievement, Grades 3-8

N = 5752	Estimate	Standard Error	p-value	Effect size
i-Ready Personalized Instruction	7.954***	1.260	<.001	0.369

Note. *** $p < .001$.

The estimated impact of i-Ready Personalized Instruction on spring 2021 MCAS mathematics scores was statistically significant, with students who received Personalized Instruction and met recommended usage guidelines scoring nearly 8 points higher, on average, then did comparison students. Taken together, the results of the prior analyses show that i-Ready Personalized Instruction that meets usage guidelines had a statistically significant positive impact on mathematics achievement across all of Grades 3-8.

Discussion

The purpose of this evaluation was to examine the impact of i-Ready Personalized Instruction on mathematics achievement, as measured by MCAS scores. This particular set of analyses focused on treatment students who used i-Ready Personalized Instruction in a way that met Curriculum Associates' recommended usage guidelines.

As with the initial set of analyses and findings, some limitations of this evaluation should be noted. First, while we controlled for as many demographic variables as possible, some usually influential variables, namely economic disadvantage and ELL status, were not available from all school districts involved in this evaluation. Consequently, we were unable to control for these variables or conduct relevant subgroup analyses. Similarly, we had access only to spring 2021 MCAS scores and i-Ready Diagnostic score data from the 2020-21 school year. This limited our analyses to only one year and to strictly quantitative measures. Even though we restricted these analyses to include only treatment students who met recommended usage guidelines, we are unable to draw any conclusions regarding fidelity of implementation within classrooms.

Statistically significant positive effects of i-Ready Personalized Instruction on MCAS mathematics scores were observed in Grades 3, 5, 6, and 8 throughout the 2020-21 school year. Treatment students in these grades averaged 5-17 points higher on the MCAS mathematics assessment than did comparison students. Supplementary analyses showed that, when combined across grade bands, i-Ready Personalized Instruction that met usage guidelines had a statistically significant positive impact on both elementary and middle school students' mathematics achievement. As in the initial set of analyses, it is important to note that the present analyses compared the incorporation of i-Ready's Personalized Instruction component to the Diagnostic Assessment component only, which itself has already been shown to be an effective research-based intervention. Thus, it is possible that efficacy estimates for the treatment group may have been conservative. On the other hand, the treatment selection procedure may have corrected for this bias by including only students who met CA's usage guidelines and therefore, might have been more interested or motivated than their counterparts who exhibited lower usage. These indeterminate factors notwithstanding, the overall findings suggest that meaningful student achievement benefits can result when usage levels of i-Ready Personalized Instruction meet or exceed recommended levels.

Appendix A: Baseline Equivalence 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	420.69	418.39 (25.74)	423.17 (19.88)	-4.87	24.01	-0.203
4th grade	438.95	438.00 (25.90)	439.92 (22.19)	-3.56	24.37	-0.146
5th grade	457.62	457.32 (28.51)	457.91 (25.23)	-1.47	26.72	-0.055
6th grade	464.69	463.03 (35.33)	466.51 (25.22)	-7.00	28.26	-0.248
7th grade	480.32	481.06 (35.80)	479.58 (28.99)	-2.49	30.28	-0.082
8th grade	482.61	484.37 (38.78)	480.51 (35.94)	0.19	36.53	0.005

Notes. 1. SD=standard deviation; all estimates include propensity-score weights. 2. Baseline equivalence was calculated only for students with non-missing pretest and posttest data.