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An Impact Evaluation of the *Blended Core Mathematics* Program for Elementary Grades

Final Report

Prepared for: Curriculum Associates
153 Rangeway Road
North Billerica, MA 01862

Authors: Matthew Swain
Bruce Randel (Century Analytics)
Rebecca Norman Dvorak

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Introduction

Founded in 1969, Curriculum Associates provides a variety of educational products and services with the goal of improving education for students and teachers. Three Curriculum Associates products include *i-Ready® Diagnostic* (available for K–12), *i-Ready® Instruction* (available for K–8), and *Ready® Mathematics* Core Curriculum (available for K–8). The *i-Ready Diagnostic* assessments (a) are online, computer-adaptive assessment that pinpoint student needs at the sub-skill level and (b) help monitor the extent to which students are on track to achieve end-of-year targets. The *i-Ready® Instruction* provides online, individualized instruction for students and is designed for use with the *i-Ready Diagnostic. Ready Mathematics* is a curriculum program that can be used as a core curriculum or to enhance mathematics instruction. It is based on the Common Core State Standards (CCSS) that offers rigorous instruction and practice for students and resources and tools for teachers.

Ready Mathematics is a rigorous, yet reachable mathematics program that, when layered with *i-Ready Diagnostic* and *i-Ready Instruction*, offers a fully integrated blended learning program. When *i-Ready Diagnostic*, *Instruction*, and *Ready Mathematics* are used together as a core curriculum, they are referred to as a *Blended Core Mathematics* Implementation. This innovative solution was built from scratch by a print and digital development team to align to the standards and to work together seamlessly. When *Ready Mathematics* is implemented as a core curriculum with *i-Ready* as a complementary digital program, teachers get robust data to guide their instruction, while each student receives a personalized *i-Ready Instruction* path to complement the instruction and practice in *Ready Mathematics*.

The Human Resources Research Organization (HumRRO) conducted an evaluation to examine the impact of *Blended Core Mathematics* on mathematics achievement for students in grades K–5 compared to use of *i-Ready Diagnostic* only. This study was designed to meet the required rigor of the What Works Clearinghouse (WWC) 4.0 standards to achieve a rating of *Meets WWC Group Design Standards with Reservations (*WWC, 2017a), and to meet guidelines for a Level 2 (or *Moderate*) rating for the Every Student Succeeds Act (ESSA) guidance for evidence-based research (U.S. Department of Education, 2016). This was achieved by using quasi-experimental design (QED), establishing baseline equivalence between the treatment and comparison groups, using an outcome measure acceptable by WWC, including baseline achievement as a covariate, and sampling design that mitigates the effects of any confounding factors.

Defining Blended Core Mathematics

Curriculum Associates has developed a *Blended Core Mathematics* Logic Model highlighting the key resources that make up *Blended Core Mathematics*, the strategies and activities important for implementation, the expected outputs, the intended outcomes, and the intended impacts. The strategies and activities describe actions by teachers recommended to obtain the long-term outcome of improved student learning in mathematics. Among others, these include the use of *i-Ready Diagnostic* data to determine students' learning needs, use of *Ready* mathematics in class every day as the core curriculum, and use of *i-Ready Instruction* for student support outside of whole-class instruction. Curriculum Associates believes assessment results (i.e, *i-Ready Diagnostic*) should inform targeted student instruction and intervention. For

the full suite of *Blended Core Mathematics*, we can consider the *Diagnostic* as the monitoring tool, and *Ready* curriculum and *i-Ready Instruction* as the intervention piece. The *Blended Core Mathematics Logic Model* is provided in Appendix A.

In addition to the *Blended Core Mathematics* logic model, Curriculum Associates provides guidance to districts and schools on how to implement *i-Ready Instruction* to best benefit student learning (Curriculum Associates, 2019). Guidance indicates students receive greater gains with at least 30 – 49 minutes of *i-Ready Instruction* use for each subject area. In addition, Curriculum Associates recommends use for at least 18 weeks between a fall *i-Ready Diagnostic* administration and a spring administration (Curriculum Associates, 2018).

Though Curriculum Associates intends some flexibility in *Ready* and *i-Ready Instruction* use, the logic model and guidance documents provide direction for implementing *Ready* and *i-Ready Instruction* with fidelity. This information was used to help identify schools and students eligible for participation in this *Blended Core Mathematics* evaluation.

Research Questions and Study Design

The primary purpose of this evaluation was to estimate the impact of using *Blended Core Mathematics* on student achievement. Particularly, we were interested in how the use of the three products that make up *Blended Core Mathematics* impact student achievement in mathematics beyond the use of *i-Ready Diagnostic* only for mathematics. Our research was focused on one primary research question, addressed separately for each elementary grade from kindergarten to grade 5.

- What is the impact of *Blended Core Mathematics* on student achievement in mathematics compared to the use of *i-Ready Diagnostic* alone?

Our hypothesis was student mathematics achievement would improve at schools using *Blended Core Mathematics* over use of *i-Ready Diagnostic* only. This hypothesis was based on the belief that students benefit from the *i-Ready Instruction* targeted to their specific needs, and from *Ready Mathematics* as their core curriculum. We predicted that the use of these products would benefit student achievement in mathematics and would be reflected in *i-Ready Diagnostic* scores in the spring following one school-year of use.

Cluster-Level Design

The unit of assignment for this study was the school, because assignment into *Blended Core Mathematics* (treatment) or *i-Ready Diagnostic* Only (comparison) group occurred at the school level. The unit of observation in this study was the student, with student-level achievement on the *i-Ready Diagnostic* serving as the baseline measure and the outcome measure.

Outcome Measure

The mathematics *i-Ready Diagnostic* assessment was designed to be aligned to today's college- and career-ready standards and to provide results that inform student placement decisions, offer explicit instructional advice, and prescribe resources for targeted instruction and intervention. The *i-Ready Diagnostic* is currently used by more than 6.5 million students across the United States – and users sometimes incorporate other *i-Ready* products (i.e., *Instruction*, Teacher Resources), though this is not a requirement.

To provide evidence the *i-Ready Diagnostic* measures skills consistent with student expectations, Curriculum Associates has conducted multiple linking studies to examine the correlation of *i-Ready Diagnostic* scores with scores from national and state summative tests for mathematics at grades 3 – 8. Linking studies using 2016 data examined the correlation between *i-Ready Diagnostic* and the Smarter Balanced summative assessments, the Partnership for Assessment of Readiness for College and Careers (PARCC), and multiple state testing programs (North Carolina, New York, Tennessee, Ohio, Mississippi, Michigan, Indiana, Florida, and Georgia). These studies show strong correlations between *i-Ready Diagnostic* scores and scores on these national and state tests. The average correlations across grades between the *i-Ready Diagnostic* for mathematics and the national and state mathematics assessments ranged from 0.82 (North Carolina End-of-Grade assessments) to 0.88 (Smarter Balanced and Michigan M-STEP). These studies provide evidence that the *i-Ready Diagnostic* content is highly consistent with what students across the United States are expected to learn (Curriculum Associates, 2019). Curriculum Associates has also recently completed linking studies for Colorado, Kentucky, and Missouri. In addition, Curriculum Associates has commissioned Odell Education and others to complete alignment studies to demonstrate the degree of alignment between the content on *i-Ready Diagnostic* and current sets of state standards. Specifically, they have conducted alignment studies for the Common Core State Standards (CCSS), and for the Louisiana, Indiana, Ohio, Michigan, Florida, and South Carolina state standards.

Curriculum Associates released *i-Ready Diagnostic* in the summer of 2011. Since then, *i-Ready* has been reviewed and approved at the state level as an assessment, instructional resource, or intervention in Arizona, California, Colorado, Connecticut, Delaware, Florida, Georgia, Idaho, Indiana, Massachusetts, Mississippi, Nevada, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Tennessee, Utah, and Virginia.

i-Ready Diagnostic for mathematics measures achievement aligned to common content and skills with demonstrated test score reliability. Marginal reliability ranges from .92 to .96 and test-retest reliabilities range from .71 to .86 for mathematics in kindergarten through grade 5. Therefore, this assessment meets the WWC 4.0 standards for an acceptable outcome measure (WWC, 2017a). The *i-Ready Diagnostic* was used as the baseline and outcome measure for all students participating in this study (i.e., *i-Ready Instruction* students and comparison group students).

The *i-Ready Diagnostic* is intended to be administered in a standardized manner across schools (Curriculum Associates, 2019b). Specifically, at grades K–5 teachers are to schedule the first (fall) Diagnostic 2 – 3 weeks into the school year in two 45- to 50-minute sessions. They are to test technology to ensure proper function and have pencils and paper available as scratch paper. Test administrators are to provide instructions to their students and motivate them to do their best. As students are testing, teachers are to monitor students.

Identifying Schools and a Baseline

Treatment Schools

Curriculum Associates defines *Blended Core Mathematics* as contemporaneous use of three key components: (a) *Ready Mathematics* as their core curriculum, (b) *i-Ready Diagnostic*, and (c) *i-Ready Instruction*. A primary goal for this study was to include schools that implemented *Blended Core Mathematics* with fidelity. Prior to identifying a sample of schools, HumRRO and Curriculum Associates worked collaboratively to establish the definition of an adequate *Blended Core Mathematics* implementation. This definition was based primarily on the directions given by Curriculum Associates to districts and schools for implementing *Blended Core Mathematics*.

For a school to be considered as implementing *Blended Core Mathematics* with adequate fidelity it needed to meet the following eligibility criteria:

- Administer the *i-Ready Diagnostic* for mathematics a minimum of two times during the school year – fall and spring – to most students. Schools using the *i-Ready Diagnostic* for students requiring extra support only were eliminated from inclusion. Information on this eligibility criterion was obtained through review of *i-Ready* data.

- Show solid use of *i-Ready Instruction*. Schools had general education students engaging with *i-Ready Instruction,* with at least some engaging for an average of at least 30 minutes per week for a minimum of 18 weeks between the fall and spring *i-Ready Diagnostic* administrations. Information on this eligibility criterion was obtained through review of i-Ready data., and discussions with Curriculum Associate staff who worked closely with the *Blended Core Mathematics* districts. Consistent with the *i-Ready Diagnostic* criterion, those using *i-Ready Instruction* only for students requiring extra support were eliminated.

- Schools from districts that had adopted *Ready Mathematics* as approved curriculum and selected it as their primary, core mathematics curriculum. Eligibility was determined through conversations with Curriculum Associates staff who had worked closely with the *Blended Core Mathematics* districts and schools by providing professional development and ongoing leadership. We eliminated those schools and districts that had not yet established *Ready Mathematics* as their primary curriculum.

Our study sought to include recent data, thus we used only schools that began *Blended Core Mathematics* implementation during the 2016-17 school year and continued use during the 2017-18 school year. To maximize power, we sought to include all schools that met our definition of *Blended Core Mathematics* use. We began with a list of ten school districts identified as potential *Blended Core Mathematics* users based on purchase information. Through discussions with the Curriculum Associates staff working directly with the schools in these districts, we learned that all schools in two of the districts were not using *Ready Mathematics* as their core curriculum. These districts were eliminated. In the 8 remaining districts there were 37 schools with *i-Ready Diagnostic* and *Instruction* data. These schools included various configurations of grade-levels. HumRRO's review of *i-Ready Instruction* data indicated two middle schools used *i-Ready Instruction* for very few students - Curriculum Associates staff confirmed that these schools used *i-Ready Instruction* only for students identified through response to intervention (RtI). This left 35 *Blended Core Mathematics* schools that met our definition of full *Blended Core Mathematics implementers*.

Identifying the Baseline

Curriculum Associates research staff identified elementary schools across the United States that purchased the *Blended Core Mathematics* program. HumRRO and Curriculum Associates research staff then held multiple discussions with Curriculum Associates professional staff who worked closely with these schools, providing professional development, conducting site visits, and providing ongoing leadership support. Through these conversations we learned that schools were typically asked to concentrate on implementing *Ready Mathematics* first, the *i-Ready Diagnostic* administrations second, and add in *i-Ready Instruction* as a final priority. Curriculum Associates staff noted there is a learning curve for implementing the new *Ready* curriculum; it tends to take time for educators to become familiar with the *Ready Mathematics* teaching practices. Curriculum Associates staff also noted that at some schools, educators used

familiar materials and lessons instead of *Ready Mathematics* curriculum while they were familiarizing themselves with the new curriculum.

We also inquired about *i-Ready Diagnostic* and *Instruction* use. Because using the *i-Ready Diagnostic* is less time consuming than *i-Ready Instruction*, Curriculum Associates professional staff noted many schools start using the diagnostic early in the adoption process for *Blended Core Mathematics*. *i-Ready Instruction*, however, is often the last focus, incorporated once other pieces of the program are in place. School leaders and educators need to strategize for how they can carve out time for *i-Ready Instruction* and ensure the necessary technology is available. At some schools, it took a semester or more to have the resources in place to implement *i-Ready Instruction*.

Using Curriculum Associates' internal *i-Ready* data, HumRRO examined *i-Ready Diagnostic* and *Instruction* use over time for the schools that met the eligibility criteria for inclusion in the treatment group. We found, consistent with what we learned through discussions, the number of students using *i-Ready Diagnostic* and *Instruction* increased for the *Blended Core Mathematics* schools between the first and second year of having purchased the *Blended Core Mathematics* program. These data suggest full implementation of *Blended Core Mathematics* did not occurring during the first year. Based on the information collected, we determined the starting point for full implementation of *Blended Core Mathematics* was the start of the school year following the purchase of the *Blended Core Mathematics* program. In other words, because all schools identified for our study purchased *Blended Core Mathematics* for the 2016–17 school-year, our baseline was identified as the start of the 2017–18 school year.

Comparison Schools

Once treatment schools were identified and the baseline determined, we identified a set of potential comparison schools. We examined 2016–17 and 2017–18 *i-Ready* data to identify a set of schools with grade K–5students for whom (a) *i-Ready Instruction* was not used by any student both years, and (b) the mathematics *i-Ready Diagnostic* was administered to a minimum of 40 students for both the fall and spring administration for the 2017–18 school year.

Analysis

Power Analysis

Power analyses were conducted to identify the number of schools required in the treatment and comparison group at each grade level for sufficient power to reject the null hypothesis that there is a true difference in student mathematics achievement between the treatment and comparison group. Statistical power is influenced by various factors. We considered the relationship between the baseline and outcome variable, typical number of students in our eligible treatment and comparison schools, and estimated intraclass correlation coefficients (ICCs) based on a previous *i-Ready* impact study to identify the number of schools needed at each grade level to reach a power level of 0.80. A 0.80 power level provides an 80% chance of detecting a significant difference with 95% confidence.

Our power analysis suggested having greater than 40 schools for each analysis would be ideal for determining an impact. Though we had 32 total treatment schools with at least one grade in K—5, not all schools included use of *Blended Core Mathematics* at each grade level. Similarly, our potential comparison group of schools had various grade compositions and did not always use *i-Ready Diagnostic* at every grade. However, we had a much larger pool of potential

comparison groups from which to select. Based on our power analysis, we determined to match two comparison schools to every one treatment school to increase power.

Achieving Baseline Equivalence

Once schools meeting the eligibility criteria for the treatment and comparison group were identified, matching was conducted to select comparable groups of schools and students. First, matching was conducted at the school level to ensure key school demographic characteristics were similar between the groups of treatment schools and comparison schools. Schools were matched on the following variables:

- Percent students eligible for free or reduced lunch (FRL)
- Percent students limited English proficient (LEP)
- Percent students with disabilities (SWD)
- Percent students white

These variables were selected as they are known to be related to student achievement, and reliable data are available for public schools across the country, including all schools meeting the criteria for our sample. The Department of Education Civil Rights Data Collection Website[1] was used to obtain the most recent publicly available school-level information, from the 2015–16 school year, on percent white, percent limited English proficiency (LEP), and percent students with disabilities (SWD). The Common Core of Data[2], also provided by the Department of Education through the National Center for Education Statistics, was used to obtain school-level information on the percent of students eligible for the free and reduced lunch program (FRL) and to ensure only public institutions were included in the comparison group, to be consistent with the school type of the treatment group.

Logistic regression was used to compute a propensity score for each school in the treatment group and the comparison pool. The model predicted the chance that each school belonged to the treatment group through a propensity score between 0 and 1. In order to increase the number of schools at each grade level, two comparison schools were matched to each treatment school. Using a nearest neighbor matching approach, baseline equivalence was met on the sample characteristics with no effect size larger than 0.50 (WWC, 2015). We began by matching all initially identified 35 treatment schools to two comparison schools. This resulted in 35 treatment schools and 70 matched comparison schools. To account for our focus on elementary schools (K-5), we removed the three treatment schools and 11 comparison schools for which no grades K-5 were present, resulting in 32 treatment and 59 comparison schools with at least one grade K-5. We found baseline equivalence was maintained for this reduced set of schools. Table 1 provides descriptive statistics for each matching variable for the elementary schools in the *Blended Core Mathematics* (treatment) group and *i-Ready Diagnostic* only (comparison) elementary group, as well as the effect sizes of the difference between the means.

[1] https://www2.ed.gov/about/offices/list/ocr/data.html
[2] https://nces.ed.gov/ccd/

Table 1. School Demographic Variables and Effect Size Differences Between the Blended Core Mathematics (Treatment) and i-Ready Only (Comparison) Group.

Variable	*Blended Core Mathematics* (N = 32) Mean (SD)	*i-Ready Diagnostic* only (N = 59) Mean (SD)	Hedge's *g* Effect Size
Percent FRL	65.57 (19.55)	57.88 (21.83)	-0.36
Percent LEP	12.50 (12.56)	15.02 (20.27)	0.14
Percent SWD	12.24 (4.26)	13.09 (4.03)	0.21
Percent White	48.84 (39.56)	47.56 (34.91)	-0.03

Following school-level matching, we compared the baseline mathematics achievement at the student level. For each grade level, we compared the fall *i-Ready Diagnostic* scores of all students in the sampled treatment and comparison schools. Within the treatment schools, only those students who met the inclusion criteria for using *i-Ready Instruction* with fidelity were included in the sample (e.g., students using *i-Ready Instruction* for an average of at least 30 minutes per week for a minimum of 18 weeks). For grades 1 through 5, baseline equivalence was achieved at the student level on the fall 2017 mathematics achievement using all students in the schools. That is, for these grades, the baseline difference in student achievement had an effect size of less than 0.25 (Table 2). This is below the WWC threshold for baseline equivalence (WWC, 2017b). Student-level matching was required for kindergarten to create samples of treatment and comparison students with baseline mathematics achievement within the WWC threshold.

For kindergarten, student-level baseline equivalence was achieved using propensity score matching similar to what was used for the school matching. We used the fall 2017 mathematics *i-Ready Diagnostic* score as our matching variable. We matched one comparison student to each treatment student.

Table 2 provides student-level baseline descriptive statistics on mathematics achievement for the study sample used in the impact analyses. The adjusted mean difference between students at each grade level was estimated using a mixed model that nested students within schools and estimated the difference between the treatment group and the comparison group at the school level. This model mirrors the model used to estimate impacts described in the next section.

Table 2. Baseline Equivalence Statistics for i-Ready Diagnostic Only (Comparison) and Blended Core Mathematics (Treatment) Groups, by Grade.

Grade	Group	ICC	Schools	Students	i-Ready Mean	i-Ready SD	Adj Mean Diff (SE)	Hedge's *g* Effect Size
K	*i-Ready* Only	0.19	21	889	337.98	20.74	-1.84 (3.35)	-0.08
	BCM		18	889	336.14	23.00		
1	*i-Ready* Only	0.20	38	1,987	375.69	23.81	-0.70 (3.00)	-0.03
	BCM		25	1,470	374.99	24.87		
2	*i-Ready* Only	0.15	44	2,347	402.34	24.09	-4.08 (2.68)	-0.17
	BCM		24	1,588	398.26	24.92		
3	*i-Ready* Only	0.17	47	2,221	425.72	26.21	-0.44 (2.95)	-0.02
	BCM		24	1,751	425.28	26.52		
4	*i-Ready* Only	0.15	51	2,628	451.09	26.85	-2.25 (2.86)	-0.08
	BCM		26	1,782	448.84	27.62		
5	*i-Ready* Only	0.24	42	2,167	466.92	31.50	5.16 (4.38)	0.16
	BCM		25	1,796	472.07	32.24		

Notes: BCM = *Blended Core Mathematics*, ICC = intraclass correlation, SD = standard deviation of *i-Ready* scores, Adj Mean Diff = adjusted mean difference between *Blended Core Mathematics* and *i-Ready Diagnostic* only groups, and SE = standard error of the adjusted mean difference.

Impact Analysis

Following the selection of baseline equivalent groups, hierarchical linear modeling (HLM) was used to address our research question to estimate the impact of *Blended Core Mathematics* on student mathematics achievement. A two-level model was used to account for the clustered nature of the data with students nested within schools. Because effect size differences between the treatment and comparison on student achievement at baseline fell between 0.05 and 0.25 standard deviations, baseline mathematics achievement was included in the model as a covariate.

Level 1 of the model was specified as follows:

$$Y_{ij} = \beta_{0j} + \beta_{1j}(PRE\_MATH_{ij} - PRE\_MATH_{.j})_{ij} + e_{ij}$$

where Y_{ij} is the spring *i-Ready* mathematics diagnostic score for student *i* in school *j*. β_{0j} is the adjusted mean outcome for students in school *j*. β_{1j} is the adjusted difference in outcome due to the student's pretest score in mathematics (cluster mean centered). e_{ij} is the random error in the achievement outcome associated with student *i* in school *j* not accounted for in the model.

Level 2 of the model was specified as follows:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(GROUP)_j + \gamma_{02}(PRE\_MATH._j - PRE\_MATH..)_j + \Sigma\gamma_K(SCHOOL) + u_{0j}$$

where γ_{00} is the adjusted comparison group grand mean of the outcome, γ_{01} is the adjusted mean difference in the outcome between school study groups, and GROUP is an indicator variable coded as 1 for schools in the *Blended Core Mathematics* group and 0 for schools in the *i-Ready Diagnostic* Only comparison group. γ_{02} is the regression slope of the school-level pretests in mathematics (grand mean centered) to explain additional between-school variance not explained in level 1 of the model. γ_K is a vector of school-level demographic dummy variables added to increase statistical precision. u_{0j} is the random error in the achievement outcome associated with school *j*.

The student-level covariate used in each analysis was:

- *i-Ready Diagnostic* mathematics baseline performance

The school-level covariates included:

- Group membership
- Average *i-Ready Diagnostic* fall score
- Demographic variables
  - Percent white students
  - Percent Limited English Proficient (LEP) students
  - Percent of students eligible for free and reduced-price lunch (FRL)
  - Percent of students with disabilities (SWD)

The above variables were selected for inclusion in the model because they are exogenous and could reasonably be expected to be related to student achievement.

To indicate the size of impacts, effect sizes were computed for all comparisons using Hedge's *g* with an adjustment for small sample sizes (WWC, 2017b).

Impact Analysis Results

This section describes the results of the HLM analysis. Full information on the HLM model results, including student- and school-level covariate parameters, can be found in Appendix B. Table 3 summarizes the impact analysis findings. As shown, the *Blended Core Mathematics* schools were found to perform significantly better (with p-values of less than 0.05) than the *i-Ready Diagnostic* only schools on mathematics achievement as measured by student mathematics *i-Ready Diagnostic* scores for all six grades examined.

The effect sizes, as measured by Hedge's *g*, for the six positive impacts ranged from 0.17 (grade 3) to 0.36 (grades K and 1). The effect sizes for grades K, 1, 2, 4, and 5 are all 0.20 or larger, and four of the six effect sizes were .25 or larger which can be considered large (Lipsey et al., 2012) and substantively important (WWC, 2018b).

The intraclass correlations (ICCs) are also presented in Table 3. The ICCs measure the proportion of the variance that is between schools—that is, how much of the variance in mathematics *i-Ready Diagnostic* scores that can be explained by school-level differences. The ICCs range from 0.17 (grade 1) to 0.30 (grade K). This suggests the majority of variance is due to factors other than school-level differences.

The adjusted mean differences presented in Table 3 indicate students in the *Blended Core Mathematics* (treatment) schools earned higher scores on the spring mathematics *i-Ready Diagnostic* as compared to students in the *i-Ready Diagnostic* only (comparison) schools. Figure 1 graphically presents the gains in student mathematics performance for each group between the fall of 2017 and spring of 2018. As shown, both groups saw gains in mathematics achievement at all grade levels. At all grade levels, those in the *Blended Core Mathematics* experienced greater gains than those in the *i-Ready Diagnostic* only group.

Table 3. Impact Analysis Results for Blended Core Mathematics (Treatment) Schools Compared to i-Ready Diagnostic Only (Comparison) Schools for Mathematics Student Achievement at grades K–5.

Grade	Group	ICC	Schools	Students	i-Ready Mean	i-Ready SD	Adj Mean Diff (SE)	*p*-value	Hedge's *g* Effect Size
K	*i-Ready* Only	0.30	21	889	368.89	23.79	9.25 (3.72)	.013	0.36
	BCM		18	889	378.13	27.67			
1	i-Ready Only	0.17	38	1,987	404.38	25.94	9.33 (1.62)	<.001	0.36
	BCM		25	1,470	413.71	25.99			
2	*i-Ready* Only	0.18	44	2,347	429.58	27.36	6.88 (1.43)	<.001	0.25
	BCM		24	1,588	436.46	27.01			
3	*i-Ready* Only	0.21	47	2,221	455.92	28.92	5.06 (1.81)	.005	0.17
	BCM		24	1,751	460.98	30.25			
4	*i-Ready* Only	0.23	51	2,628	475.42	30.39	6.33 (1.37)	<.001	0.21
	BCM		26	1,782	481.75	31.57			
5	*i-Ready* Only	0.29	42	2,167	485.96	33.59	8.72 (1.54)	<.001	0.26
	BCM		25	1,796	494.67	33.74			

Notes: BCM = *Blended Core Mathematics*, ICC = intraclass correlation, SD = standard deviation of *i-Ready* scores, Adj Mean Diff = adjusted mean difference between *Blended Core Mathematics* and *i-Ready Diagnostic* only groups, and SE = standard error of the adjusted mean difference.

Figure 1. Changes in Mathematics Achievement Between Fall 2017 and Spring 2018, by Grade.

Impact Summary and Discussion

Our findings suggest participation in *Blended Core Mathematics* resulted in higher student-level achievement in mathematics, as measured by the *i-Ready Diagnostic*, compared to use of *i-Ready Diagnostic* only. The mean mathematics achievement for the *Blended Core Mathematics* group was statistically significantly higher for all of the grades K–5. Moreover, the effect sizes showed additional support that students in *Blended Core Mathematics* schools benefitted from their school's adoption and implementation of *i-Ready Instruction* and *Ready Mathematics* curriculum. For four of the six grades, the effect sizes were 0.25 or higher. A standardized effect size of this magnitude is considered noteworthy in educational research (Lipsey et al., 2012; WWC, 2017b) where it is often difficult to observe large effects. All schools attempt to provide a valuable education to their students by implementing quality curriculum and classroom assessments. Therefore, all students should expect to see gains in student achievement. It is important to note the effects of the *Blended Core Mathematics* treatment were beyond the mean performance of schools that used other curriculum options.

The study was conducted as a rigorous quasi-experimental design (QED) to meet the standards described in the WWC 4.0 standards to achieve a rating of *Meets WWC Group Design Standards with Reservations*. In addition, because we found statistically significant positive results for all grades examined, this study meets the guidelines set forth by ESSA for a *Level 2* (or *Moderate*) rating for evidence-based research (U.S. Department of Education, 2016).

This study was a QED. Schools in both groups were not participants in a research study but actual customers and everyday users of educational products, and we relied on implementation of *Blended Core Mathematics* carried out in real-world conditions. Implementation of *Blended Core Mathematics*, therefore, likely varied between schools. We may have found different results had the study been conducted under more controlled circumstances. Impacts are typically greater for studies that aim for ideal or close to ideal implementation and less for studies that examine real-world implementation. However, despite this limitation, we were able to find solid impacts for all elementary grade levels examined.

Finally, our treatment group was compared to an *i-Ready Diagnostic* only group. It is possible that use of *i-Ready Diagnostic* increases student achievement; however, the design of this study did not allow for an estimation of that impact. Further, use of the *i-Ready Diagnostic* only schools as a comparison group may have attenuated the effects of the treatment had that group been compared to a "business-as-usual" comparison group. Future studies might seek to examine the impact of *Blended Core Mathematics* or *i-Ready Diagnostic* Only to a set of a comparison schools not implementing any Curriculum Associates products. This would require an external achievement measure, potentially state assessments, for use as an achievement baseline measure and outcome variable.

Quality Control Procedures

We employed various quality control checks throughout the data cleaning, analysis, and reporting process. HumRRO, Curriculum Associates, and Century Analytics worked together to identify a rigorous methodology based on proper implementation of *Blended Core Mathematics*, the WWC 4.0 standards, and ESSA Level 2 guidelines.

Rules for identifying treatment and comparison groups were determined upfront through collaboration between the three groups. Curriculum Associates provided information on the various components of *Blended Core Mathematics*, and the frequency for which they should be

used for solid implementation. They provided *i-Ready Diagnostic* and *Instruction* data to allow HumRRO and Century Analytics to empirically examine the extent to which these recommendations were followed by *Blended Core Mathematics* schools, and they provided information on *Ready Mathematics* implementation based on their experiences interacting with identified schools. These discussions led to a treatment and comparison school criteria that all partners were confident in.

Data analysis work was completed collaboratively by HumRRO and Century Analytics. Century Analytics and HumRRO independently conducted matching and HLM analyses for each grade. The researchers reviewed results against each other and worked out any discrepancies. All data reported in this study were verified by both researchers.

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Appendix A.

Ready Blended Core Mathematics Logic Model

Ready Blended Core Mathematics Logic Model

Resources	Strategies and Activities	Outputs	Outcomes	Impacts
▪ *i-Ready Diagnostic* ▪ *i-Ready Online Instruction* ▪ *Ready Mathematics as a Core program*	▪ Teachers attend professional development and utilize PD resources to acquire teaching and product skills ▪ Teachers use Ready Mathematics daily to facilitate student-driven learning experiences and are implementing instructional and assessment components with fidelity ▪ Teachers receive information on students' skills and progress through Ready assessments, informal classroom discourse and mathematical practices ▪ Teachers administer the Diagnostic to determine students' learning needs ▪ Teachers use i-Ready Instruction to support students in content areas outside of whole-class instruction ▪ Teachers use i-Ready and Ready Mathematics data to inform and deliver differentiated instruction	▪ Students actively participate in Ready Mathematics instruction ▪ Students take lessons based on their performance on the i-Ready diagnostic ▪ Teachers regularly differentiate instruction based on i-Ready reports and information gathered through Ready mathematics tools	▪ Students' personal learning needs are met ▪ Students have a stronger understanding of grade level mathematics content ▪ Students develop habits of mind and standards of practice to improve mathematical reasoning and perseverance through challenging topics	▪ Increased student achievement ▪ Increased student learning gains

Appendix B. Impact HLM Coefficients

Table B.1. HLM Results for Blended Core Mathematics Compared to i-Ready Diagnostic Only for Kindergarten.

Covariates	Coef.	SE	z	*p*-value	95% Conf. Interval	
Treatment Group Membership	9.25	3.72	2.48	0.013	1.95	16.54
Fall Mathematics i-Ready Cluster Mean Centered	0.70	0.22	3.19	0.001	0.27	1.14
School-Level Covariates						
Percent FRL	23.73	14.32	1.66	0.097	-4.34	51.79
Percent SWD	42.29	45.37	0.93	0.351	-46.63	131.20
Percent LEP	-4.75	9.78	-0.49	0.628	-23.92	14.43
Percent White	0.19	0.08	2.36	0.019	0.03	0.35
Fall Mathematics i-Ready School-Level Grand Mean Centered	0.71	0.02	34.96	<0.001	0.67	0.75
Intercept	342.97	10.88	31.53	<0.001	321.65	364.29

Notes: FRL = free or reduced lunch, SWD = students with disabilities, LEP = limited English proficient, Coef. = coefficient, SE = standard error of the coefficient, z = standardized score

Table B.2. HLM Results for Blended Core Mathematics Compared to i-Ready Diagnostic Only for Grade 1.

Covariates	Coef.	SE	z	p-value	95% Conf. Interval	
Treatment Group Membership	9.33	1.62	5.77	<0.001	6.16	12.50
Fall Mathematics i-Ready Cluster Mean Centered	0.72	0.09	8.01	<0.001	0.54	0.90
School-Level Covariates						
Percent FRL	-0.65	5.30	-0.12	0.903	-11.04	9.75
Percent SWD	-6.88	19.80	-0.35	0.728	-45.68	31.92
Percent LEP	-0.80	4.23	-0.19	0.850	-9.09	7.48
Percent White	0.04	0.04	1.22	0.222	-0.03	0.12
Fall Mathematics i-Ready School-Level Grand Mean Centered	0.82	0.01	65.68	<0.001	0.79	0.84
Intercept	402.13	4.45	90.43	<0.001	393.41	410.85

Table B.3. HLM Results for Blended Core Mathematics Compared to i-Ready Diagnostic Only for Grade 2.

Covariates	Coef.	SE	z	p-value	95% Conf. Interval	
Treatment Group Membership	6.88	1.43	4.81	<0.001	4.07	9.68
Fall Mathematics *i-Ready* Cluster Mean Centered	0.76	0.08	9.45	<0.001	0.60	0.92
School-Level Covariates						
Percent FRL	-4.47	5.06	-0.88	0.377	-14.38	5.45
Percent SWD	-14.55	17.62	-0.83	0.409	-49.08	19.99
Percent LEP	6.08	3.76	1.62	0.106	-1.29	13.46
Percent White	0.12	0.03	3.94	<0.001	0.06	0.18
Fall Mathematics *i-Ready* School-Level Grand Mean Centered	0.88	0.01	82.01	<0.001	0.86	0.90
Intercept	424.66	4.13	102.74	<0.001	416.56	432.77

Table B.4. HLM Results for Blended Core Mathematics Compared to i-Ready Diagnostic Only for Grade 3.

Covariates	Coef.	SE	z	p-value	95% Conf. Interval	
Treatment Group Membership	5.06	1.81	2.79	0.005	1.51	8.61
Fall Mathematics *i-Ready* Cluster Mean Centered	0.95	0.10	10.02	<0.001	0.77	1.14
School-Level Covariates						
Percent FRL	-4.86	6.52	-0.75	0.456	-17.63	7.91
Percent SWD	-2.10	22.42	-0.09	0.925	-46.03	41.84
Percent LEP	16.39	4.98	3.29	0.001	6.62	26.15
Percent White	0.05	0.04	1.31	0.191	-0.03	0.13
Fall Mathematics *i-Ready* School-Level Grand Mean Centered	0.90	0.01	86.98	<0.001	0.88	0.92
Intercept	449.46	5.24	85.71	<0.001	439.18	459.74

Table B.5. HLM Results for Blended Core Mathematics Compared to i-Ready Diagnostic Only for Grade 4.

Covariates	Coef.	SE	z	p-value	95% Conf. Interval	
Treatment Group Membership	6.33	1.37	4.61	<0.001	3.64	9.03
Fall Mathematics *i-Ready* Cluster Mean Centered	1.10	0.06	18.69	<0.001	0.99	1.22
School-Level Covariates						
Percent FRL	-2.72	4.50	-0.60	0.545	-11.53	6.09
Percent SWD	-38.88	17.29	-2.25	0.025	-72.76	-4.99
Percent LEP	12.77	4.22	3.02	0.002	4.50	21.05
Percent White	0.07	0.03	2.52	0.012	0.02	0.13
Fall Mathematics *i-Ready* School-Level Grand Mean Centered	0.95	0.01	102.49	<0.001	0.93	0.96
Intercept	471.29	3.77	125.09	<0.001	463.91	478.67

Table B.6. HLM Results for Blended Core Mathematics Compared to i-Ready Diagnostic Only for Grade 5.

Covariates	Coef.	SE	z	p-value	95% Conf. Interval	
Treatment Group Membership	8.72	1.54	5.65	<0.001	5.69	11.75
Fall Mathematics *i-Ready* Cluster Mean Centered	1.03	0.05	19.19	<0.001	0.93	1.14
School-Level Covariates						
Percent FRL	-1.18	5.23	-0.23	0.821	-11.43	9.07
Percent SWD	-4.68	21.47	-0.22	0.828	-46.76	37.40
Percent LEP	4.38	4.93	0.89	0.374	-5.28	14.04
Percent White	0.02	0.03	0.49	0.628	-0.05	0.08
Fall Mathematics *i-Ready* School-Level Grand Mean Centered	0.91	0.01	106.15	<0.001	0.89	0.92
Intercept	480.74	4.52	106.35	<0.001	471.88	489.60