Student Performance in Math Domains Across School Settings: Technical Appendix

Data Description

Primary analyses were conducted using two data sources, both of which were prepared by and accessed in partnership with Curriculum Associates (CA). We began with anonymized individual-level information for the universe of i-Ready diagnostic users who took a spring math assessment from school year (SY) 2018-19 to SY2021-22 and were enrolled in grades 1 through 5 during the sample period. We omit records from SY2019-20 due to data limitations. CA's i-Ready diagnostic tests are computer-delivered diagnostic assessments typically administered three times per school year (fall, winter, and spring quarters). Unlike summative assessments (such as mandated state tests), the i-Ready Diagnostic is a "low-stakes" evaluation intended to serve as a metric of student progress that school leaders and teachers can use to inform practice.

The variables used in the analyses include on-grade placement levels in math overall and in math subdomains, location of diagnostic assessment (beginning in SY2020-21), rush flag, and student grade level. We merged individual student diagnostic records with school-level information for the universe of i-Ready schools that administered at least one i-Ready diagnostic math assessment during SY2018-19. These data were obtained by CA from the National Center for Education Statistics (NCES). The variables used in the analyses include two demographic measures: the proportion of students who qualified for free or reduced-price lunch (FRL) and the proportion of students of color.

Analysis Sample

The analyses were conducted using spring i-Ready Diagnostic scores and were limited to schools with non-missing demographics measures (FRL and racial/ethnic composition) in SY2018-19. We defined school-level characteristics as time-invariant based on SY2018-19 to avoid confounding differences in achievement by school types (e.g., defined by the percent of students of color) with enrollment changes following the COVID-19 pandemic (Dee et al., 2021; Musaddiq et al., 2022). We also limited our sample to only include schools who were i-Ready Diagnostic users in math in SY2018-19, SY2020-21, and SY2021-22 to ensure that findings were not driven by compositional changes in the group of schools using i-Ready.

The sample was further restricted to students with a valid spring i-Ready diagnostic assessment score completed in a school setting. In an analysis of over 900 schools using i-Ready, CA reported a positive correlation between in-home test taking and diagnostic scores in the fall of SY2020-21, which they speculated to be related to the possibility that students "received extra support from parents and others" (Curriculum Associates, 2020). Other comparable studies likewise find large score improvements among at-home test takers suggesting a pattern across a broader set of assessment types (see e.g., Kuhfeld et al. 2020).

Considering the findings from multiple national analyses, we omit students who reported taking the i-Ready Diagnostic at home. All observations in the sample prior to SY219-20 were assumed to take the diagnostic in a school setting.

Lastly, following Goldhaber et al. (2022), we restricted the sample to schools that had non-missing test scores for at least 10 students in a grade-year combination. This condition was used to minimize the number of schools that might use i-Ready as a small-scale intervention rather than a school-wide diagnostic tool.

After applying these sample conditions, the final analysis data consisted of a cross-sectional dataset covering students in grades 1-5 who took the spring i-Ready diagnostic assessment at least once over the sample period. In total, there were 7,743 unique schools, 4,149,860 unique students, and 5,776,287 unique assessment records represented in the analytic sample.

Variable Definitions

Learning Outcomes

Our main outcome variable is whether or not a student scored on grade level on the spring i-Ready diagnostic assessment in math overall and in each math domain (Algebra and Algebraic Thinking, Geometry, Measurement and Data, Numbers and Operations). Thresholds for on grade level placement are set by Curriculum Associates (2019).

School Characteristics

We use school-level demographic information from SY2018-19 to construct time-invariant variables for the average share of students of color by school and the average share of free or reduced-price lunch recipients. From here, we organized schools into dichotomous groups based on FRL and racial/ethnic composition:

- High %FRL: schools where 90-100% of students are eligible for free or reduced-price lunch (1 standard deviation or greater above the mean)
- Low %FRL: schools where 0-85% of students are eligible for free or reduced-price lunch (less than 1 standard deviation above the mean)
- High %SoC: schools with populations that are 90-100% students of color (1 standard deviation or greater above the mean)
- Low %SoC: schools with populations that are 0-85% students of color (less than 1 standard deviation above the mean)

Methodology

We began first by conducting a descriptive analysis of student performance in SY2021-22. We calculated the proportion of students who scored on grade level in math overall and in each math subdomain in each school type defined above. Once we calculated the proportion of students on grade level in each school type, we subtracted these values to generate the percentage point difference by school type. For example, 55% of grades 1-5 students in Low %FRL schools were on grade level in SY2021 compared to 31% of students from High %FRL schools, indicating a 22 percentage point gap.

After analyzing data from students in grades 1-5 collectively, we looked specifically at differences in learning outcomes for students in grade 1 and grade 5. Here we considered the likelihood of a student in a “High %FRL” or “High %SoC” school scoring on grade level relative to their same-grade peers in a “Low %FRL” or “Low %SoC” school. These likelihoods were calculated by dividing the proportion of students on grade level in a “High %FRL” or “High %SoC” school by the proportion of students on grade level in a “Low %FRL” or “Low %SoC” school. When students in grade 5 were less likely than their first-grade peers to score on grade level, we consider the difference to be “increasing.” In contrast, when students in grade 5 were more likely to be on grade level than their first-grade peers, this was labeled as “decreasing.”

Next, we considered longitudinal trends in differences in math performance by calculating the proportion of students on grade level in math overall and each domain by school type and year (SY2018-19, SY2020-21, and SY2021-22). These values were displayed in line graphs to allow the reader to view trends in learning over time.

Follow-up Algebra Analysis

Lastly, we conducted a follow-up analysis on a subset of students who also used i-Ready personalized learning in SY2021-22. i-Ready personalized learning provides students with targeted lessons based on their performance on the i-Ready diagnostic assessment. We limited this follow-up analysis to a subset of students from our main analysis. This subset of 1,524,675 unique students completed at least one lesson in Algebra and Algebraic Thinking during SY2021-22, resulting in an analysis of 27,882,471 unique lesson attempts. We identified the 20 lessons for which students were least likely to receive a passing score and then identified the Common Core State Standards (CCSS) associated with these lessons. We identified 15 CCSS represented among these lessons. Linkage between i-Ready lessons and CCSS was completed using a crosswalk provided by CA.

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