RESEARCH UPDATE

Estimated Average HMH *Math Inventory* Annual Growth

September 2015

Introduction

This brief is designed to provide an updated depiction of estimated average student growth on *The Math Inventory* for an academic year. There are a variety of factors that influence the level of growth in mathematical understanding that a student exhibits in an academic year. In addition, there are several factors that influence the accuracy of how that understanding is measured. Although these factors exist, they are outside the scope of this paper. The purpose of this document is to describe average student growth on *The Math Inventory* over the course of an academic year.

Since changes in student growth in math achievement may vary by grade and initial achievement level, growth estimates were broken out across these two dimensions. As a result, average growth was computed for Grades 2 through 8 using 100-point Quantile starting bands.

Participants and Methodology

A sample of 84,738 sets of scores from grades 2 through 8 was available for analysis. Table 1 breaks out the available sets of scores by grade level. The students came from 13 school districts varying in size, demographic characteristics, and location throughout the country. Districts were chosen based on their identified use of *The Math Inventory* as a universal screener. Although students may take *The Math Inventory* multiple times throughout the year, with three to five administrations being typical, growth data focused on only two of these administrations (fall and spring) within an academic year. A fall administration was defined as the first administration occurring in the August through October testing window. A spring administration was defined as the last administration occurring in the March to June testing window. Data were collected from three years of student test administrations spanning the 2010–2011 through 2012–2013 school years. Only students with a date range greater than 180 days were used to compute growth. Scores from each year's fall and spring administrations were aggregated across grade and performance level to form the growth comparisons. Although only one fall and one spring score were used for any student in a given year, students who took the assessment over multiple years were counted separately in the calculations for each of those years.

Table 1. Student Score Pair Counts by Grade Level

Grade	n
2	6595
3	12826
4	15617
5	16579
6	12350
7	11242
8	9529

Utilizing this data, the following procedures were followed to create the score bands shown in Table 2.

1. The mean Spring *Math Inventory* Quantile measure was computed for each Quantile group and grade.
2. For each grade, the mean Spring *Math Inventory* Quantile measures were regressed on their associated Quantile groups (the 0Q group was excluded) using a linear model, and the predicted values and their standard errors were retained for later use.

3. The expected *Math Inventory* growth was computed from the expected Spring *Math Inventory* Quantile measures, along with the low and high ends of the expected growth range. The low and high ends of the expected growth range were computed by taking the expected growth estimate and adding or subtracting the standard error of the expected growth estimate multiplied by 0.25. The factor of 0.25 was chosen since the U.S. Department of Education's What Works Clearinghouse Procedures and Standards Handbook Version 2.1 uses it as a criterion to define a "substantively important" effect.

Table 2. Estimated Average Fall–Spring Math Inventory Growth by Grade Level and Student Starting Quantile Measure

Student Fall Quantile Measure	Grade Level 2	3	4	5	6	7	8
EM-99	215-255	270-305	290-350	295-355	210-305	190-325	180-325
100-199	180-225	245-285	260-320	270-320	200-295	200-285	175-285
200-299	145-185	225-255	230-275	240-280	190-235	185-240	180-250
300-399	100-145	195-225	195-235	200-240	165-205	165-205	165-215
400-499	60-115	170-200	160-200	165-205	145-175	140-180	150-190
500-599	0-85	140-175	120-160	130-170	120-150	120-155	130-165
600-699	n/a	110-150	85-125	95-135	95-125	95-125	110-140
700-799	n/a	75-130	45-90	60-100	65-95	70-100	90-120
800-899	n/a	n/a	0-55	25-65	40-70	45-75	70-100
900-999	n/a	n/a	n/a	0-30	10-45	20-50	50-75
1000-1099	n/a	n/a	n/a	n/a	0-25	0-30	25-55
1100-1199	n/a	n/a	n/a	n/a	n/a	0-25	0-40
1200-1299	n/a	n/a	n/a	n/a	n/a	n/a	0-25

Score Variation and Limitation

When comparing fall test scores to spring test scores in the same year, it is important to understand what formal and informal instruction has taken place during that time frame. When viewing changes in performance within an academic year, several factors may come into play. A student's state of body and mind at the time of testing can greatly affect any test score. The student may be tired, hungry, or distracted during an administration, which can impact performance. Students may also vary with respect to their motivation for taking the test. If they perceive the test as important and valid, they may exert a greater amount of effort toward answering the questions as accurately as possible.

There are also factors internal to the test that can lead to differences in scores, even if the scores are being reported on the same scale. Every test has a predictable amount of measurement error that affects the consistency of a student's reported score and its validity. This error is referred to as the standard error of measurement (SEM). Tests typically do not provide a student's true score; they produce an approximation of their true level of achievement in a domain. The key in any administration is to reduce this error to tolerable levels. *The Math Inventory* accomplishes this by utilizing SEM in the exit criteria during administrations. There may also be instances where differential levels of error occur at varying points along the score continuum or distribution. At the extremes floor effects (for lower performing students) and ceiling effects (for higher performing students) may be present.

These floor and ceiling effects are less common on adaptive assessments, such as *The Math Inventory*, because the items are tailored to a student's estimated ability level, which provides more appropriate items for them to solve.

As a final note, the growth estimates in Table 2 do not depict longitudinal growth across multiple years. Each grade is represented by a unique sample of students; therefore it is not advisable to use this table to project trajectories of future student scores on *The Math Inventory*. Examinations of growth should be confined to a single school year with the understanding that individual growth varies from student to student.

RESEARCH UPDATE

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