Pathway to Proficiency: Linking Star Reading® and Star Math® Scales with Performance Levels on the Minnesota Comprehensive Assessments (MCAs)

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Introduction

At Renaissance, we know that as an educator, chief among your responsibilities is making decisions about how to allocate limited resources to best serve diverse student needs. A good assessment system supports your efforts, by providing timely, relevant information to help address key questions about which students are on track to meet important standards and who may need additional assistance.

Assessments that identify early any students at risk of missing academic standards are especially useful, as they inform instructional decisions to improve student performance and reduce gaps in achievement. Assessments that do this while taking little time away from instruction are particularly valuable. *Interim assessments*, one of three broad categories of educational assessment,[1] indicate which students are on track to meet later expectations (Perie et al., 2007).

This linking study applied results from two interim assessments, Renaissance Star Reading® and Renaissance Star Math®, to help you predict whether individual students are on track or need more assistance to succeed on the year-end summative Minnesota Comprehensive Assessments (MCA) tests in Reading and Mathematics in grades 3 through 8.[2]

> Assessments that identify early any students at risk of missing academic standards are especially useful.

Main Findings

Results from the linking analysis revealed that Star Reading and Star Math are accurate predictors of the MCA tests, meaning as an educator you can use Star scores to:

1. Identify early in the year students likely to miss reading and math yearly progress goals in time to make meaningful adjustments to instruction well before the year-end test.

2. Forecast the percent of students at each MCA performance level to serve as an early warning system for building and district administrators and allow redirection of resources as needed.

Study

To determine if Star Reading and Star Math can predict student achievement on the end-of-year MCA tests in reading and mathematics, we began by linking the score scales for each assessment.

School-Level Data collection

To find a sample of students who were assessed by both the MCA Series III (MCA-III) and Star Assessments, we began by gathering all 2012–2013 and 2013–2014 Star Reading and 2010–2011, 2011–2012, 2012–2013, and 2013–2014 Star Math test records for Minnesota. Then, each school's Star

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1 **Formative assessments** are short and frequent processes, embedded in instruction, that support learning and provide specific feedback on what students know and can do versus where gaps in knowledge exist. **Summative assessments** evaluate whether students have met a set of standards, and serve most commonly as year-end state-mandated tests. **Interim assessments** represent the middle ground, in terms of duration and frequency and can serve purposes including informing instruction, evaluating curriculum and student responsiveness to intervention, and forecasting performance on high-stakes summative year-end tests.

2 Technical manuals are available for Star Reading and Star Math by request to research@renaissance.com.

Reading and Star Math data were aggregated by grade and subject area. The next step was to match Star data with the MCA data from the same school year by district and school name. To do this, performance level distribution data from the MCA was obtained from the public data provided by the Minnesota Department of Education. The file included the number of students tested in each grade and the percentage of students who were *Not Meeting, Partially Meeting, Meeting, and Exceeding*.

Sample characteristics

Once we determined how many students in each grade at a school were tested on the MCA Reading and took a Star Reading assessment, we calculated the percentage of students assessed on both tests. Then we repeated this exercise for the math assessments. In each grade at each school, if between 95% and 105% of the students who tested on the MCA had taken a Star assessment, that grade was included in the sample. This method of sample selection ensured that our sample consisted of cases in which all or nearly all the enrolled students who took the MCA also took a Star test within the specified window of time. If a total of approximately 1,000 or more students per grade met the sample criteria, that grade's sample was considered sufficiently large for analysis.

The reading sample included 35,713 Star Reading students from 230 schools. The math sample included 20,737 Star Math students from 113 schools. Table 1 displays by-grade test summaries for the reading and math samples. It also includes percentages of students in the *Not Meeting, Partially Meeting, Meeting, and Exceeding* performance levels, both for the sample and statewide.

Table 1. Performance characteristics of reading and math samples

Star Reading® sample performance										
Grade	Star Reading® students	MCA Reading students	Not Meeting		Partially Meeting		Meeting		Exceeding	
			Sample	State	Sample	State	Sample	State	Sample	State
3	9,263	9,085	21%	25%	19%	17%	47%	44%	13%	14%
4	10,214	9,987	20%	22%	25%	23%	41%	40%	14%	15%
5	5,487	5,376	13%	13%	22%	19%	50%	48%	15%	20%
6	4,883	4,824	17%	20%	21%	19%	41%	39%	21%	22%
7	2,402	2,658	24%	23%	22%	21%	37%	37%	17%	19%
8	3,464	3,391	6%	11%	41%	39%	45%	41%	8%	8%
Star Math® sample performance										
Grade	Star Math® students	MCA Math students	Not Meeting		Partially Meeting		Meeting		Exceeding	
			Sample	State	Sample	State	Sample	State	Sample	State
3	6,299	6,162	10%	13%	16%	15%	47%	40%	27%	32%
4	6,041	5,929	12%	15%	16%	15%	42%	35%	30%	35%
5	3,988	3,922	18%	16%	27%	22%	43%	40%	13%	21%
6	2,287	2,249	19%	20%	26%	23%	38%	35%	17%	22%
7	1,326	1,299	18%	16%	34%	27%	34%	35%	14%	22%
8	796	802	19%	17%	30%	23%	33%	32%	18%	28%

Results

Scale linkage

Renaissance linked the Star test scale to the MCA by applying equipercentile linking analysis (Kolen & Brennan, 2004). First, we aggregated the sample of schools to calculate the percentage of students performing *Does Not Meet, Partially Meets, Meets, and Exceeds* for each subject and grade. Then we analyzed the distribution of Star scores to determine the scaled score corresponding to the same percentile as specific MCA level. For example, as shown in Table 1, in our fifth-grade reading sample, 13% of students were classified as *Does not meet the standards,* 22% *Partially Meets*, 50% *Meets*, and 15% *Exceeds.* Therefore, the cutscores for proficiency levels in the fifth grade are at the 13th percentile for *Partially Meets*, the 35th percentile for *Meets*, and the 85th percentile for *Exceeds.*

MCA cut scores and corresponding Star score equivalents

MCA results are reported in scaled scores that are split into four achievement levels: *Does Not Meet, Partially Meets, Meets, and Exceeds*. The main purpose in linking Star Reading and Star Math to the MCA was to identify Star scores at the time of the state test that are approximately equivalent to the cut-off scores that separate the MCA levels. Table 2 displays these equivalent Star scores at the time of the state test for grades 3-8.[3] The corresponding MCA cut scores can be found in Appendix B.

Table 2. Star Reading® and Star Math® score equivalents for each MCA achievement level range

Grade	Does Not Meet	Partially Meets	Meets	Exceeds
Star Reading® cut-score equivalents				
3	< 350	350 − 428	429 − 614	≥ 615
4	< 425	425 − 529	530 − 750	≥ 751
5	< 463	463 − 579	580 − 875	≥ 876
6	< 564	564 − 693	694 − 975	≥ 976
7	< 665	665 − 840	841 − 1158	≥ 1159
8	< 734	734 − 905	906 − 1243	≥ 1244
Star Math® cut-score equivalents				
3	< 540	540 − 595	596 − 676	≥ 677
4	< 613	613 − 665	666 − 746	≥ 747
5	< 678	678 − 757	758 − 835	≥ 836
6	< 717	717 − 790	791 − 869	≥ 870
7	< 740	740 − 830	831 − 893	≥ 894
8	< 764	764 − 845	846 − 903	≥ 904

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3 The Star Reading and Star Math cut-score equivalents presented in Table 2 apply only to the time of the state test. Some Renaissance reports adjust the Star Reading and Star Math cut-score equivalents based on date.

Accuracy of scale linkage confirmed

Nine Minnesota schools shared student level MCA-III scores from the spring 2017, 2018, and 2019 administrations of the MCA-III to explore the accuracy of using Star Reading and Star Math for forecasting MCA-III performance. The Star Reading sample consisted of 8,783 students and the Star Math sample consisted of 7,478 students. We took students' Star scores from tests taken prior to the mid-date of the MCA-III administration and used national growth norms (Renaissance Learning, 2019a, 2019b) to project what their Star scores would be at the date of the MCA-III administration. We used the projected Star scores (or the average of the projected scores for students with multiple Star scores prior to the mid-date of the MCA-III administration) to examine the accuracy of the linkage to the MCA-III scale.

Classification diagnostics were derived from counts of correct and incorrect classifications when using Star scores to predict whether a student would achieve proficiency on the MCA-III. The results indicate that Star Assessments provide an effective means of estimating end-of-year achievement on the MCA-III.

Predictive Star scores correlate highly with actual MCA-III scores

To summarize the predictive power of Star Reading and Star Math, we calculated correlations between observed MCA-III scores and projected Star scores. As seen in figure 1, the correlations were strong, averaging .85 for both Star Reading and Star Math.

> Star scores have a strong relationship with end-of-year MCA-III scores.

Figure 1. Star Reading® and Star Math® scores highly correlate with MCA-III scores

■ Projected Star Reading Scale Scores   ■ Projected Star Math Scale Scores

Star scores discriminate well between students who score proficient or not

We compared actual MCA-III performance to students' estimated MCA-III performance based on projected Star scores and the estimated Star cut score equivalents. Table 3 displays classification diagnostics about whether students were correctly or incorrectly classified as proficient or not on the MCA-III using projected Star scores. On average, students were correctly classified (i.e., overall classification accuracy) 86% of the time by Star Reading and 87% of the time by Star Math.

For Area Under the ROC Curve (AUC), a summary measure of diagnostic accuracy, both Star Reading and Star Math averaged .94. By-grade AUC values are displayed in table 3. AUC values closer to 1 indicate an assessment perfectly distinguishes between students who are proficient versus those who are not, whereas values of .50 indicate prediction no better than chance. In general, an AUC of .70 to .80 is considered acceptable, .80 to .90 is excellent, and greater than .90 is outstanding (Hosmer et al., 2013).

Table 3. Proficiency forecasting using Star Reading® and Star Math® scores yields accurate results

Measure	Grade					
	3	4	5	6	7	8
Overall classification accuracy (percentage of correct classifications)	84%	85%	89%	87%	85%	85%
Area Under the ROC Curve	0.93	0.93	0.96	0.94	0.93	0.94

Star Math®						
Measure	Grade					
	3	4	5	6	7	8
Overall classification accuracy (percentage of correct classifications)	88%	88%	87%	85%	83%	90%
Area Under the ROC Curve	0.94	0.94	0.95	0.93	0.93	0.95

Other diagnostic accuracy measures studied:

✓ **Sensitivity** represents the percentage of proficient students that were correctly forecasted, which for Star Reading averaged 86% and for Star Math averaged 84%.

✓ **Specificity** represents the percentage of not-proficient students that were correctly forecasted, which for Star Reading averaged 86% and for Star Math averaged 85%.

✓ **Positive predictive values,** which indicate that when Star scores forecasted students to be proficient, they actually were proficient, were 93% for Star Reading and 87% for Star Math.

✓ **Negative predictive values,** which indicate that when Star scores forecasted students to miss proficiency, they actually weren't proficient, were 74% for reading and 79% for math.

✓ **Proficiency status projection error**, the difference between actual and projected proficiency rates, indicates how well scores accurately predict proficiency within each grade. Star Reading averaged -5% and Star Math averaged -3% (negative scores indicate under-prediction while positive scores show over-prediction).

Appendix A: About Star Reading® and Star Math®

The computer-adaptive Star Reading and Star Math assessments serve multiple purposes including screening, progress monitoring, instructional planning, forecasting proficiency, standards mastery, and measuring growth. These highly reliable, valid, and efficient standards-based measures of student performance in reading and math provide valuable information regarding the acquisition of skills along a continuum of learning expectations. The assessments can be completed in about 20 minutes, and we recommend administering them two to five times a year for most purposes and more frequently when used for progress monitoring.
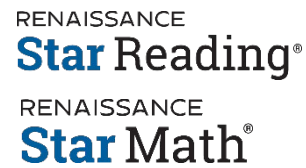
Star Reading and Star Math are highly rated for academic screening and academic progress monitoring by the National Center on Intensive Intervention.

Appendix B: MCA achievement levels

Table B1. MCA achievement level score ranges

MCA achievement level score ranges: Reading			
Grade	Does Not Meet	Partially Meets	Meets	Exceeds
3	301 − 339	340 − 349	350 − 373	374 − 399
4	401 − 439	440 − 449	450 − 465	466 − 499
5	501 − 539	540 − 549	550 − 566	567 − 599
6	601 − 639	640 − 649	650 − 666	667 − 699
7	701 − 739	740 − 749	750 − 766	767 − 799
8	801 − 839	840 − 849	850 − 866	867 − 899

MCA achievement level score ranges: Mathematics			
Grade	Does Not Meet	Partially Meets	Meets	Exceeds
3	301 − 339	340 − 349	350 − 365	366 − 399
4	401 − 439	440 − 449	450 − 465	466 − 499
5	501 − 539	540 − 549	550 − 562	563 − 599
6	601 − 639	640 − 649	650 − 661	662 − 699
7	701 − 739	740 − 749	750 − 759	760 − 799
8	801 − 839	840 − 849	850 − 860	861 − 899

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