

## Pathway to Proficiency: Linking Star Reading® and Star Math® Scales with Performance Levels on the Kentucky Performance Rating for Educational Progress (K-PREP) Tests



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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,<sup>1</sup> indicate which students are on track to meet later expectations (Perie, Marion, Gong, & Wurtzel, 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 Kentucky Performance Rating for Educational Progress (K-PREP) tests in Reading and Mathematics in grades 3 through 8.<sup>2</sup>

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## Kentucky Findings

Results from the linking analysis revealed that Star Reading and Star Math are accurate predictors of the K-PREP 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 K-PREP 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 K-PREP tests in Reading and Mathematics, we began by linking the score scales for each assessment.

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<sup>1</sup> **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.

<sup>2</sup> Technical manuals are available for Star Reading and Star Math by request to [research@renaissance.com](mailto:research@renaissance.com).

## School-Level Data collection

To find a sample of students who were assessed by both the K-PREP and Star Assessments, we began by gathering all Star Reading and Star Math test records from 2011–2012 for Kentucky. Then, each school's Star Reading and Star Math data were aggregated by grade and subject area. The next step was to match Star data with the K-PREP data from the same school year by district and school name. To do this, performance level distribution data from the K-PREP was obtained from the Kentucky Department of Education website. The file included the number of students tested in each grade and the percentage of students who were *Novice*, *Apprentice*, *Proficient*, or *Distinguished*.

## Sample characteristics

Once we determined how many students in each grade at a school were tested on the K-PREP 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 K-PREP 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 K-PREP 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 23,281 Star Reading students from 291 schools. The math sample included 8,691 Star Math students from 94 schools. Table 1 displays by-grade test summaries for the reading and math samples. It also includes percentages of students in the *Novice*, *Apprentice*, *Proficient*, and *Distinguished* 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	K-PREP reading students	Novice		Apprentice		Proficient		Distinguished	
			sample	state	sample	state	sample	state	sample	state
3	2,915	2,876	21%	25%	24%	26%	35%	32%	20%	17%
4	4,631	4,556	21%	25%	28%	28%	33%	31%	18%	16%
5	4,925	4,853	26%	29%	22%	23%	33%	31%	19%	17%
6	3,995	3,933	28%	31%	23%	23%	33%	29%	16%	17%
7	3,528	3,507	24%	27%	25%	25%	34%	31%	17%	17%
8	3,287	3,224	26%	29%	24%	25%	32%	30%	18%	17%
Star Math® sample performance										
Grade	Star Math® students	K-PREP math students	Novice		Apprentice		Proficient		Distinguished	
			sample	state	sample	state	sample	state	sample	state
3	1,180	1,162	19%	22%	34%	35%	38%	35%	9%	8%
4	2,073	2,040	16%	22%	38%	39%	34%	29%	12%	10%
5	1,567	1,537	13%	20%	41%	41%	31%	28%	15%	11%
6	1,040	1,044	21%	20%	42%	38%	32%	32%	6%	10%
7	1,160	1,158	22%	22%	41%	39%	28%	29%	9%	10%
8	1,671	1,638	23%	21%	41%	38%	29%	32%	7%	9%

## Scale linkage

Renaissance linked the Star test scale to the K-PREP by applying equipercentile linking analysis (Kolen & Brennan, 2004). First, we aggregated the sample of schools to calculate the percentage of students performing *Novice*, *Apprentice*, *Proficient*, and *Distinguished* for each subject and grade. Then we analyzed the distribution of Star scores to determine the scaled score corresponding to the same percentile as a specific K-PREP level. For example, as shown in Table 1, 21% of students in the third-grade reading sample were classified as *Novice*, 24% were classified as *Apprentice*, 35% were classified as *Proficient*, and 20% were classified as *Distinguished*. Therefore, the cut score was at the 21<sup>st</sup> percentile for *Apprentice*, the 45<sup>th</sup> percentile for *Proficient*, and the 80<sup>th</sup> percentile for *Distinguished*.

## K-PREP cut scores and corresponding Star score equivalents

K-PREP results are reported in scaled scores that are split into five achievement levels: *Novice*, *Apprentice*, *Proficient*, and *Distinguished*. The main purpose in linking Star Reading and Star Math to the K-PREP was to identify Star scores at the time of the state test that are approximately equivalent to the cut-off scores that separate the K-PREP levels. Table 2 displays these equivalent Star scores at the time of the state test for grades 3–8<sup>3</sup>. The corresponding K-PREP cut scores can be found in Appendix B.

Table 2. Star Reading® and Star Math® score equivalents at time of state test for each K-PREP achievement level range

Star Reading® cut-score equivalents				
Grade	Novice	Apprentice	Proficient	Distinguished
	Cut score	Cut score	Cut score	Cut score
3	< 337	337 – 433	434 – 552	≥ 553
4	< 422	422 – 530	531 – 680	≥ 681
5	< 511	511 – 600	601 – 804	≥ 805
6	< 563	563 – 682	683 – 939	≥ 940
7	< 604	604 – 778	779 – 1068	≥ 1069
8	< 686	686 – 890	891 – 1186	≥ 1187
Star Math® cut-score equivalents				
Grade	Novice	Apprentice	Proficient	Distinguished
	Cut score	Cut score	Cut score	Cut score
3	< 569	569 – 649	650 – 723	≥ 724
4	< 624	624 – 719	720 – 787	≥ 788
5	< 647	647 – 769	770 – 839	≥ 840
6	< 674	674 – 781	782 – 871	≥ 872
7	< 705	705 – 812	813 – 888	≥ 889
8	< 726	726 – 828	829 – 908	≥ 909

<sup>3</sup> 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.

# Results

## Accuracy of scale linkage confirmed

Three Kentucky districts shared student level K-PREP scores to explore the accuracy of using Star Reading and Star Math for forecasting K-PREP performance. The Star Reading sample consisted of 2,086 students and the Star Math sample consisted of 2,062 students. We took students' Star scores and used national growth norms (Renaissance Learning, 2016a, 2016b) to project what their Star scores would be at the date of the K-PREP 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 K-PREP administration) to examine the accuracy of the linkage to the K-PREP scale.

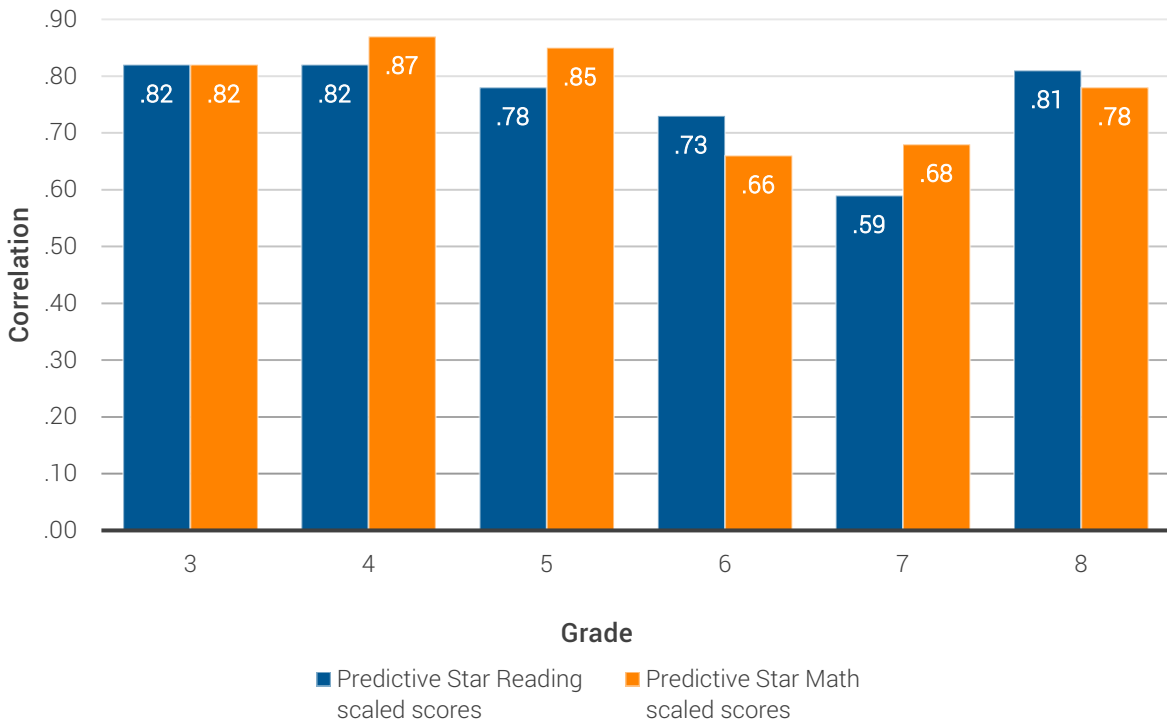
Classification diagnostics were derived from counts of correct and incorrect classifications when using Star scores to predict whether a student would achieve proficiency on the K-PREP. The results indicate that Star Assessments provide an effective means of estimating end-of-year achievement on the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

## Predictive Star scores correlate highly with actual K-PREP scores

To summarize the predictive power of Star Reading and Star Math, we calculated correlations between observed K-PREP scores and projected Star scores. As seen in Figure 1, the correlations were strong, averaging .76 and .78 between K-PREP and Star Reading and Star Math, respectively.

Star scores have a strong relationship with end-of-year K-PREP scores.

Figure 1. Star Reading® and Star Math® scores highly correlate with K-PREP scores



## Star scores discriminate well between students who score proficient or not

We compared actual K-PREP performance to students' estimated K-PREP 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 K-PREP using projected Star scores. On average, students were correctly classified (i.e., overall classification accuracy) 81% of the time by Star Reading and 83% of the time by Star Math.

For Area Under the ROC Curve (AUC), a summary measure of diagnostic accuracy, Star Reading averaged .92 and Star Math averaged .91 (also displayed in table 3). The AUCs generally met or exceeded the .85 standard set by the National Center on Response to Intervention to indicate convincing evidence that an assessment can accurately predict another assessment result or outcome.

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

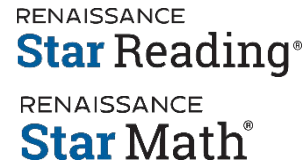
Star Reading®						
Measure	Grade					
	3	4	5	6	7	8
Overall classification accuracy (percentage of correct classifications)	82%	85%	80%	85%	76%	80%
Area Under the ROC Curve	.92	.94	.88	1.00	.89	.90
Star Math®						
Measure	Grade					
	3	4	5	6	7	8
Overall classification accuracy (percentage of correct classifications)	82%	87%	86%	82%	79%	79%
Area Under the ROC Curve	.93	.94	.93	.97	.81	.89

Other diagnostic accuracy measures studied:

- ✓ **Sensitivity** represents the percentage of proficient students that were correctly forecasted, which for Star Reading averaged 89% and for Star Math averaged 75%.
- ✓ **Specificity** represents the percentage of not-proficient students that were correctly forecasted, which for Star Reading averaged 72% and for Star Math averaged 84%.
- ✓ **Positive predictive values**, which indicate that when Star scores forecasted students to be proficient, they actually were proficient, were 71% for Star Reading and 85% for Star Math.
- ✓ **Negative predictive values**, which indicate that when Star scores forecasted students to miss proficiency, they actually weren't proficient, were 88% for reading and 84% 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 7% and Star Math averaged -1% (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.

National Center on  
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## Appendix B: K-PREP achievement levels

Table B1. K-PREP achievement level score ranges

K-PREP achievement level score ranges: Reading				
Grade	Novice	Apprentice	Proficient	Distinguished
3	100 – 197	198 – 209	210 – 225	226 – 300
4	100 – 196	197 – 209	210 – 226	227 – 300
5	100 – 197	198 – 209	210 – 225	226 – 300
6	100 – 198	199 – 209	210 – 226	227 – 300
7	100 – 198	199 – 209	210 – 225	226 – 300
8	100 – 198	199 – 209	210 – 224	225 – 300
K-PREP achievement level score ranges: Mathematics				
Grade	Novice	Apprentice	Proficient	Distinguished
3	100 – 191	192 – 209	210 – 233	234 – 300
4	100 – 193	194 – 209	210 – 228	229 – 300
5	100 – 191	192 – 209	210 – 228	229 – 300
6	100 – 190	191 – 209	210 – 230	231 – 300
7	100 – 191	192 – 209	210 – 230	231 – 300
8	100 – 191	192 – 209	210 – 231	232 – 300



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