Pathways of Progress™ to Success on CCSS-Aligned Statewide Tests: A Tale of Two Tests

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Introduction

Progress monitoring decisions are a critical part of Response-to-Intervention models. DIBELS Next® is widely-used in elementary schools for screening and progress monitoring decisions. DIBELS Next Pathways of Progress™ offers a means of indexing student progress useful for evaluating the effectiveness of instruction, establishing meaningful, attainable, and ambitious goals, and providing feedback about progress. Pathways of Progress is based upon student growth percentiles using quantile regression (see Betebenner, 2011).

Pathways of Progress is based on an analysis of students across grades K–6 whose DIBELS Next scores were entered in DIBELSnet®, VPort®, or mCLASS® data systems (N ≈ 1.8 million students). The Pathways are calculated in a three-step process:

At each grade level, students were grouped by their beginning-of-year DIBELS Composite Score (BOY DCS) for scores of 1 through the score at the 99.5th percentile rank (scores of 0 were not included in the pathways analysis). For each unique beginning-of-year (BOY) DIBELS Composite Score (DCS), the 20th, 40th, 60th, and 80th quantiles were calculated for the end-of-year DIBELS Next measure or DCS.

1. A stiff spline quantile regression model was fit to each quantile using BOY DCS as the predictor (mean RMSE = .99 for all grades).

2. The predicted quantile scores from the regression model corresponding to each unique BOY DCS were rounded to the nearest whole number, forming the end-of-year pathway borders.

At the end-of-year benchmark administration, each student's score will fall into a single pathway based on the expectation of progress from their beginning-of-year score (Pathway 3 = Typical Progress).

Purpose

Previous research indicates that the probability of achieving the DIBELS Next Composite Score (DCS) benchmark is progressively higher for students achieving higher Pathways and that the Pathway of Progress explains an additional 5% to 35% of variance in spring DCS outcomes beyond the student's initial skills (Good, Powell-Smith, & Dewey, 2016).

This study examines the contribution of Pathways of Progress to outcomes on two CCSS-aligned statewide tests. The impact of initial skills and student progress are discussed with respect to practice and future directions for research.

Research Questions

1. What is the probability of meeting/exceeding the Smarter Balanced Assessment Consortium English Language Arts (SBAC ELA) standard associated with each level of initial skills and each Pathway of Progress?

2. What is the probability of earning a score in the proficient/highly proficient range on the Arizona's Measurement of Educational Readiness to Inform Teaching English Language Arts (AzMERIT ELA) standard associated with each level of initial skills and each Pathway of Progress?

3. What is the amount of additional variance accounted for by Pathway of Progress over and above initial skills when predicting CCSS-aligned test outcomes (i.e., SBAC and AzMERIT)?

Method

Participants

Participants were 1,422 third-grade students from 34 school sites from two districts in Arizona and Oregon representing southwest and northwest regions of the US. Select participant details are found in *Table 1*.

Table 1. Participating Sample Details by State

	Arizona	*Oregon*
Test	AzMERIT	SBAC
Data Year	2014–2015	2015–2016
# Schools	16	18
# Students	664	758

The participating Arizona district had greater diversity in its student population (e.g., about 54% Hispanic/Latino) than the participating Oregon district (e.g., 83% White) (see *Figure 1*).

Figure 1. Demographic Information for Participating Sites
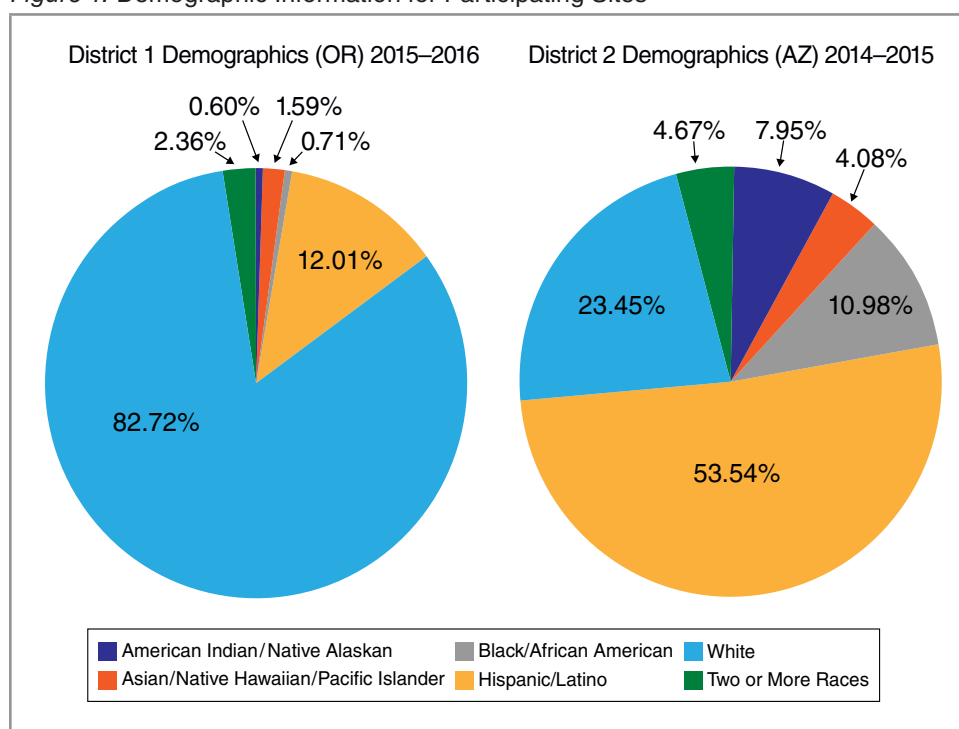
Measures

- DIBELS Next Composite Score (DCS; see Good, Kaminski, Dewey, Wallin, Powell-Smith, & Latimer, 2013).
- Arizona's Measurement of Educational Readiness to Inform Teaching English Language Arts Scale Score (AzMERIT ELA). There are four proficiency levels: Minimally Proficient (1), Partially Proficient (2), Proficient (3), Highly Proficient (4).
- Smarter Balanced Assessment Consortium English Language Arts (SBAC ELA). There are four proficiency levels: Does Not Meet (1), Nearly Meets (2), Meets (3), Exceeds (4).

Data Collection

The school districts were invited to participate in this study. Signed parental consent was obtained for each student participant. School personnel entered state assessment data for participants into a secure Excel spreadsheet and uploaded the spreadsheet to a secure upload site. The state assessment data were matched to DIBELS Next data. All data were de-identified prior to analysis.

Data Analysis

The independent variables were (a) the student's level of initial skill represented by the DCS at the beginning of the year and (b) an indicator variable for the student's individual Pathway of Progress over the course of the year. The dependent variables were the spring (a) AzMERIT and (b) SBAC ELA scores and achievement levels.

We evaluated the difference in the probability of meeting the SBAC or AzMERIT ELA achievement standard between each Pathway of Progress for each level of initial skills using logistic regression. The proportion of variance in the outcome (meeting spring SBAC or AzMERIT ELA achievement standard) that was explained by the student's BOY DCS score and their end-of-year Pathway of Progress was calculated from 2 logistic regression models at each grade level. The amount of additional variance explained by Pathways being added to the model beyond that explained by initial DCS alone was examined. Finally, two-way, between-subjects AOVs were conducted to examine the effects of BOY DCS benchmark status and Pathway on AzMERIT ELA and SBAC ELA scores.

Results

Descriptive Statistics

Descriptive statistics suggest that both samples of students were high-performing relative to their DIBELS Next scores. The AzMERIT ELA mean and standard deviation for our AZ sample is consistent with what was reported statewide for Arizona, as is the percent of students at or above proficient. However, the Oregon sample performed higher on the SBAC ELA than both their district overall and the state (see *Table 2*).

Table 2. Descriptive Statistics for Sample and Statewide by State

	Arizona	*Oregon*
% meeting standard on DIBELS Next (i.e., At or Above Benchmark) (sample)	70%–75%	76%–81%
% meeting the ELA standard on state assessment (i.e., Proficient/Highly Proficient on AZMERIT or Meets/Exceeds on SBAC) (sample)	42%	69%
% meeting the ELA standard on state assessment (i.e., Proficient/Highly Proficient on AZMERIT or Meets/Exceeds on SBAC) (statewide)	41%	47%

Logistic Regression Results

The results of the logistic regression analysis are summarized in *Figures 2* and *3*. The horizontal axis provides the level of student initial reading skills as measured by the beginning-of-year DIBELS Next Composite score. Vertical reference lines are provided for the DIBELS Next cut point for risk (CP), benchmark goal (BG), Above Benchmark level (AB, the 60th percentile on national norms), and the Well Above Benchmark level (WAB, the 80th percentile on national norms). The vertical axis provides the likelihood or probability of meeting or exceeding the state achievement standard. Horizontal reference lines are provided for .40 likelihood, below which students are unlikely to meet the state achievement standard, and for .60 likelihood, above which students are likely to meet the state achievement standard.

The graphed lines provide the likelihood of meeting the state standard for each Pathway of Progress and each level of initial skills. For example, if a student was performing at the Above Benchmark level at the beginning of the year and was making Typical Progress (light green line), their likelihood of meeting the AzMERIT standard was about .40 (*Figure 2*), while their likelihood of meeting the SBAC standard was about .72 (*Figure 3*). The student's Pathway of Progress explained a small but significant amount of additional variance in AzMERIT ELA outcomes (1.5%), and somewhat more in SBAC ELA outcomes (6.7%).

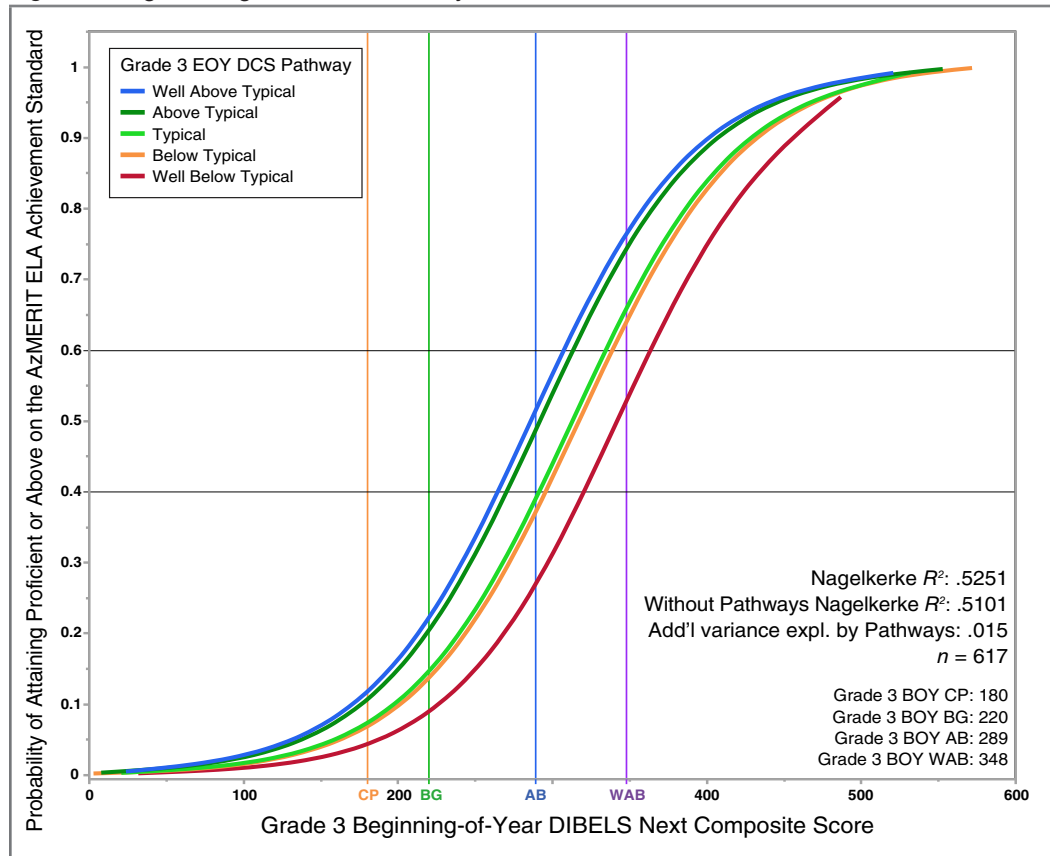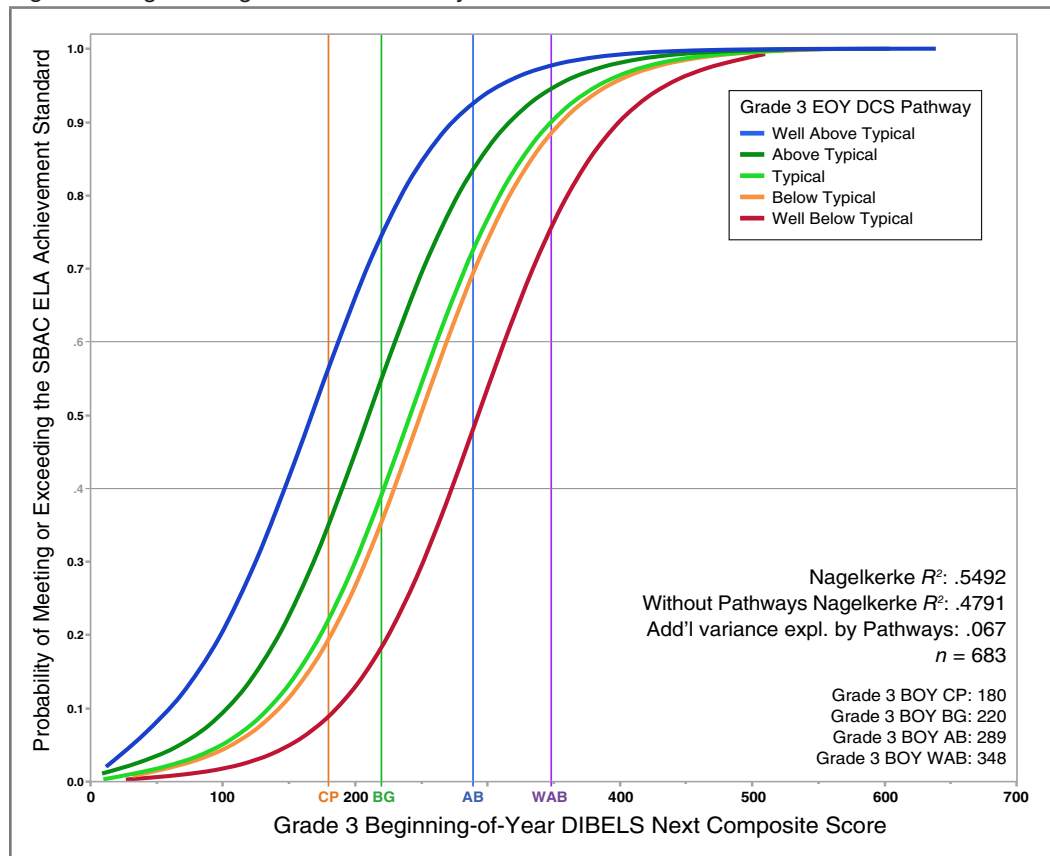*Figure 2.* Logistic Regression for Pathways and Grade 3 AzMERIT ELA

Grade 3 EOY DCS Pathway
— Well Above Typical
— Above Typical
— Typical
— Below Typical
— Well Below Typical

Nagelkerke R^2: .5251
Without Pathways Nagelkerke R^2: .5101
Add'l variance expl. by Pathways: .015
$n = 617$

Grade 3 BOY CP: 180
Grade 3 BOY BG: 220
Grade 3 BOY AB: 289
Grade 3 BOY WAB: 348

Y-axis: Probability of Attaining Proficient or Above on the AzMERIT ELA Achievement Standard
X-axis: Grade 3 Beginning-of-Year DIBELS Next Composite Score

Figure 3. Logistic Regression for Pathways and Grade 3 SBAC ELA

Grade 3 EOY DCS Pathway
— Well Above Typical
— Above Typical
— Typical
— Below Typical
— Well Below Typical

Nagelkerke R^2: .5492
Without Pathways Nagelkerke R^2: .4791
Add'l variance expl. by Pathways: .067
$n = 683$

Grade 3 BOY CP: 180
Grade 3 BOY BG: 220
Grade 3 BOY AB: 289
Grade 3 BOY WAB: 348

Y-axis: Probability of Meeting or Exceeding the SBAC ELA Achievement Standard
X-axis: Grade 3 Beginning-of-Year DIBELS Next Composite Score

On the AzMERIT, students are likely to meet the AzMERIT ELA standard if they were **Well Above Benchmark** at the beginning of the year. They were somewhat more likely to meet the standard if they made Above or Well Above Typical Progress and students making Well Below Typical Progress were less likely. The likelihood of meeting the AzMERIT ELA standard for each benchmark status for Grade 3 is provided in the Appendix (see *Table A1.*)

On the SBAC, students are likely to meet the SBAC ELA standard if they were almost **Above Benchmark** at the beginning of the year. They were somewhat more likely to meet the standard if they made Above or Well Above Typical Progress and students making Well Below Typical Progress were less likely. The likelihood of meeting the AzMERIT ELA standard for each benchmark status for Grade 3 is provided in the Appendix (see *Table A2.*)

AOV and Fitted Means
Two-way, between-subjects AOVs were conducted to examine the effects of BOY DCS benchmark status and BOY-EOY Pathway of Progress on AzMERIT ELA and SBAC ELA scores.

For both the AzMERIT and SBAC ELA, significant effects were found for initial benchmark status and for Pathway of Progress, and the interaction effect was not significant. A priori linear comparisons explained most of the effects in both benchmark status and Pathway of Progress. For benchmark status, there was also a significant non-linear component that was modeled in the fitted means in *Figures 4* and *5*.

For the AzMERIT only, there was a significant non-linear component of Pathway of Progress that seemed to indicate that Below and Well Below Typical Progress results were higher than the linear predicted pattern and that Typical, Above Typical and Well Above Typical Progress Pathways were lower than the linear predicted pattern. However, a post-hoc comparison representing that observed pattern was evaluated using the Sheffe' procedure and found to be non-significant. Consequently, the non-linear component of Pathways was not modeled in the fitted means.

Results are displayed in *Tables 3* and *4*. The fitted means for significant effects are illustrated in *Figures 4* and *5*. Similar results were seen for Grade 4 and are available in the Appendix.
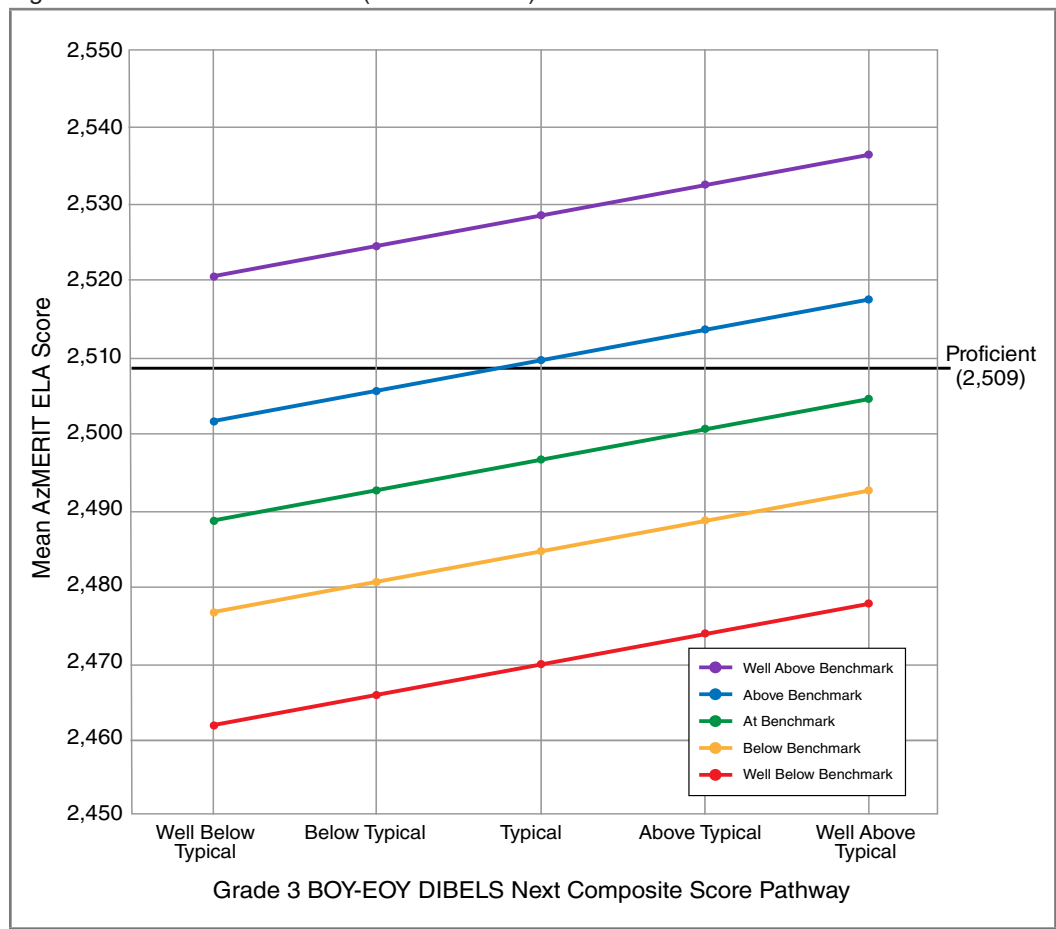
Figure 4. Grade 3 Fitted Means (AzMERIT ELA)

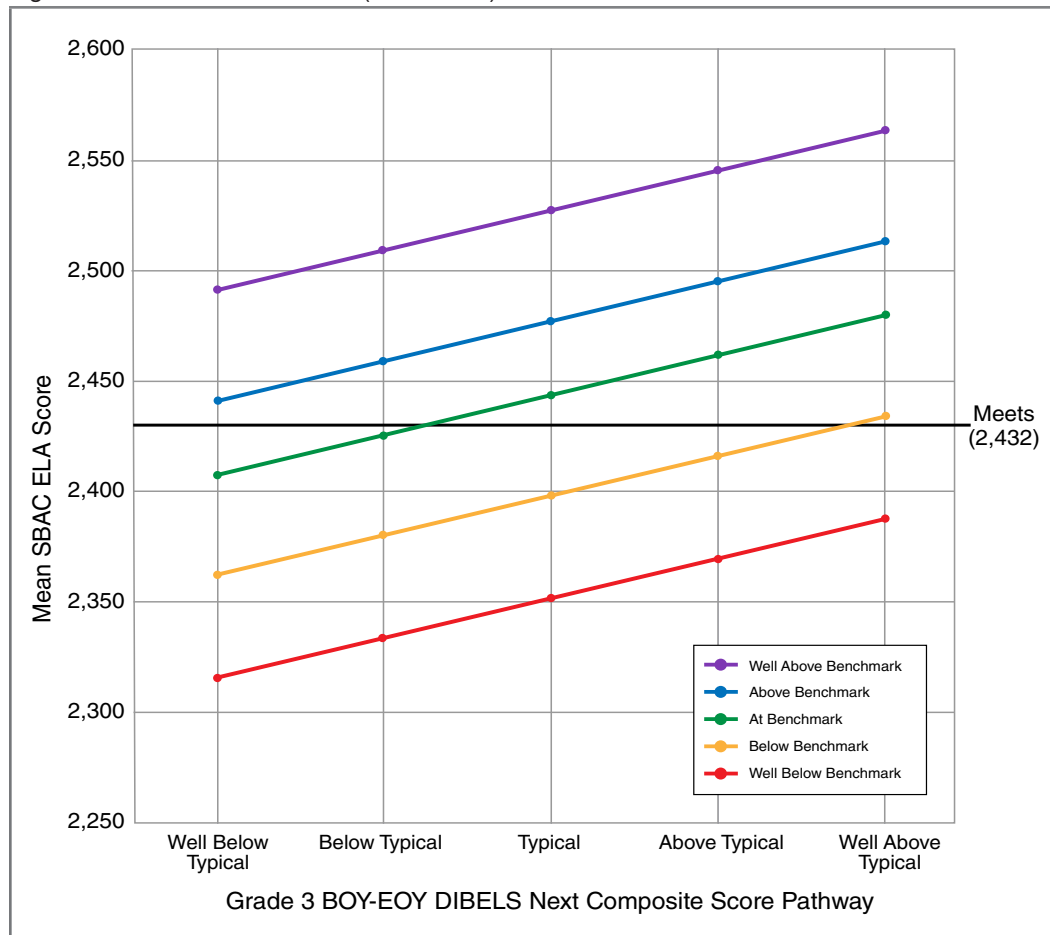*Figure 5.* Grade 3 Fitted Means (SBAC ELA)

Table 3. Two-Way, Between-Subjects Analysis of Variance Summary Table for the Effects of Beginning-of-Year DIBELS Next Composite Score Benchmark Status and Beginning-of-Year to End-of-Year DIBELS Next Composite Score Pathway on AzMERIT ELA Scores for Third-Grade Students

Source	df	SS	MS	F	p	Partial eta squared
Benchmark status	4	252,714.33	63,178.58	146.17	<.0001	.497
Linear	1	224,795.38	224,795.38	520.08	<.0001	.468
Non-linear	3	27,918.95	9,306.32	21.53	<.0001	.098
Pathway	4	19,555.51	4,888.88	11.31	<.0001	.071
Linear	1	14,668.44	14,668.44	33.94	<.0001	.054
WBT BT vs T AT WAT	1	3,273.79	3,273.79	7.57	.110*	.013
Other	2	1,613.28	806.64	1.87	.155	.006
Status by Pathway	16	6,158.13	384.88	0.89	.581	.024
Error	592	255,883.47	432.24			
Total	616	565,943.02				

*Scheffé p value
Note. WBT BT vs T AT WAT represents Well Below Typical and Below Typical being higher than linear only, and Typical, Above Typical, and Well Above Typical being lower than linear only, such that Below Typical and Typical were not different.

Table 4. Two-Way, Between-Subjects Analysis of Variance Summary Table for the Effects of Beginning-of-Year DIBELS Next Composite Score Benchmark Status and Beginning-of-Year to End-of-Year DIBELS Next Composite Score Pathway on SBAC ELA Scores for Third-Grade Students

Source	df	SS	MS	F	p	Partial eta squared
Benchmark status	4	2,119,617.80	529,904.50	173.57	<.0001	.518
Linear	1	1,919,709.45	1,919,709.45	628.81	<.0001	.494
Non-linear	3	199,908.35	66,636.12	21.83	<.0001	.092
Pathway	4	311,828.70	77,957.20	25.54	<.0001	.137
Linear	1	298,749.27	298,749.27	97.86	<.0001	.132
Non-linear	3	13,079.43	4,359.81	1.43	.233	.007
Status by Pathway	16	66,111.40	4,132.00	1.35	.159	.032
Error	645	1,969,144.10	3,053.00			
Total	669	4,613,432.40				

Discussion

Summary and Conclusion

Prior research has found that Pathways of Progress provides a reliable and valid basis for evaluating progress (see Good & Powell-Smith, 2015 & Good et. al. 2015). The current study expands this line of research with evidence of the predictive validity of DIBELS Next and Pathways of Progress for statewide CCSS-aligned ELA assessments.

Our results indicate that there is a strong association between DIBELS Next and statewide ELA outcomes. In addition, DIBELS Next Pathways of Progress contributes significantly to predictions of performance on statewide CCSS-aligned outcome assessments. The additional variance explained for each of these outcomes measures (AzMERIT ELA and SBAC ELA) is somewhat less than noted in previous research (e.g., Good, Powell-Smith, & Dewey, 2016).

The 800 pound gorilla in this discussion is the student's initial, beginning-of-year reading skills which accounted for 53% to 55% of the variance in likelihood of meeting the state standard. The amount of progress during the year add an additional 1.5% (AzMERIT) or 6.7% (SBAC) of variance explained.

Limitations

1. The DIBELS Next assessments were administered under uncontrolled conditions. Information on training of assessors and fidelity of assessment is not available. However, these data do represent the way DIBELS Next is used in practice.

2. We do not know the level of instructional support provided to the students or if there were changes in the level of support.

3. These data were collected in two school districts in two states, potentially limiting the generalizability of the results.

Implications

The purpose of DIBELS Next is to inform decisions about which students need instructional support to achieve important future reading outcomes and to monitor progress for students who are provided additional support. The DIBELS Next benchmark goals represent the lowest level of reading skill that puts the odds in a student's favor of reaching subsequent goals. The information from this study will assist schools using DIBELS Next to identify and provide instructional support to students at-risk of falling below the statewide assessment standards.

One practical implication drawn from the results of this study speaks to the importance of setting ambitious goals and monitoring progress toward them, in particular for students who score in the Well Below and Below Benchmark range at the beginning of the year.

The standards set by the SBAC and AzMERIT are rigorous. The increased rigor in these standards likely will require increases in Tier 1 instructional rigor as well.

Future Research

This study provides one of the very few examinations of the impact of DIBELS Next performance on performance on statewide CCSS-aligned assessments. Future research should replicate these results. Additionally, future research might examine these results for subgroups of students.

References

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Good, R. H., Kaminski, R. A., Dewey, E. N., Wallin, J., Powell-Smith, K. A., & Latimer, R. J. (2013). *DIBELS Next Technical Manual*. Eugene, OR: Dynamic Measurement Group. Available: http://DIBELS.org/next

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Appendix

Table A1. Likelihood of Meeting the AzMERIT ELA Standard by Benchmark Status

BOY DCS Benchmark Status	Likelihood of meeting the AzMERIT ELA standard
Below the Cutpoint for Risk (<CP)	**Very unlikely to meet the AzMERIT ELA standard.** Even Well Above Typical Progress is unlikely to change the prediction.
Below Benchmark (CP–BG)	**Unlikely to meet the AzMERIT ELA standard.** Even Well Above Typical Progress is unlikely to change the prediction.
At Benchmark (BG–AB)	**Unlikely to meet the AzMERIT ELA standard.** Students are somewhat more likely to meet the standard if they make Above or Well Above Typical Progress over the course of the year.
Above Benchmark (AB–WAB)	**Odds of meeting the AzMERIT ELA standard are about 50–50.** Students are somewhat more likely to meet the standard if they make Above or Well Above Typical Progress over the course of the year. Students making Well Below Typical Progress are less likely.
Well Above Benchmark (>WAB)	**Likely to meet the AzMERIT ELA standard.** Students are somewhat more likely to meet the standard if they make Above or Well Above Typical Progress over the course of the year. Students making Well Below Typical Progress are less likely.

Table A2. Likelihood of Meeting the SBAC ELA Standard by Benchmark Status

BOY DCS Benchmark Status	Likelihood of meeting the SBAC ELA standard
Below the Cutpoint for Risk (<CP)	**Unlikely to meet the SBAC ELA standard.** Students are more likely to meet the standard if they make Well Above Typical Progress.
Below Benchmark (CP–BG)	**Unlikely to meet the SBAC ELA standard.** The odds are about 50–50 for students making Above Typical Progress. Students are more likely to meet the standard if they make Well Above Typical Progress. Students making Well Below Typical Progress are substantially less likely to meet the standard.
At Benchmark (BG–AB)	**Likely to meet the SBAC ELA standard.** Students are more likely to meet the standard if they make Above or Well Above Typical Progress over the course of the year. Students making Well Below Typical Progress are substantially less likely to meet the standard.
Above Benchmark (AB–WAB)	**Likely to meet the SBAC ELA standard.** Students making Well Below Typical Progress are somewhat less likely to meet the standard.
Well Above Benchmark (>WAB)	**Likely to meet the SBAC ELA standard.**

Table A3. Two-Way, Between-Subjects Analysis of Variance Summary Table for the Effects of Beginning-of-Year DIBELS Next Composite Score Benchmark Status and Beginning-of-Year to End-of-Year DIBELS Next Composite Score Pathway on AzMERIT ELA Scores for Fourth-Grade Students

Source	df	SS	MS	F	p	Partial eta squared
Benchmark status	4	225,292.92	56,323.23	148.25	<.0001	.529
Linear	1	198,928.74	198,928.74	523.59	<.0001	.498
Non-linear	3	26,364.18	8,788.06	23.13	<.0001	.116
Pathway	4	25,639.53	6,409.88	16.87	<.0001	.113
Linear	1	22,429.28	22,429.28	59.04	<.0001	.101
WBT BT T vs AT WAT	1	1,971.21	1,971.21	5.19	.270*	.010
Other	2	1,239.04	619.52	1.63	.197	.006
Status by Pathway	16	5,234.91	327.18	0.86	.615	.025
Error	528	200,603.90	379.93			
Total	552	489,960.48				

*Scheffé p value
Note. WBT BT T vs AT WAT represents Well Below Typical, Below Typical, and Typical being higher than linear only and Above Typical and Well Above Typical being lower than linear only, such that Typical and Above Typical were not different.

Table A4. Two-Way, Between-Subjects Analysis of Variance Summary Table for the Effects of Beginning-of-Year DIBELS Next Composite Score Benchmark Status and Beginning-of-Year to End-of-Year DIBELS Next Composite Score Pathway on SBAC ELA Scores for Fourth-Grade Students

Source	df	SS	MS	F	p	Partial eta squared
Benchmark status	4	1,975,711.80	493,927.90	144.29	<.0001	.488
Linear	1	1,665,030.59	1,665,030.59	486.39	<.0001	.445
Non-linear	3	310,681.21	103,560.40	30.25	<.0001	.130
Pathway	4	129,192.40	32,298.10	9.43	<.0001	.059
Linear	1	115,859.77	115,859.77	33.84	<.0001	.053
Non-linear	3	13,332.63	4,444.21	1.30	.274	.006
Status by Pathway	16	44,043.60	2,752.70	0.80	.682	.021
Error	606	2,074,494.10	3,423.30			
Total	630	4,261,960.40				

Figure A1. Grade 4 Fitted Means (AzMERIT ELA)
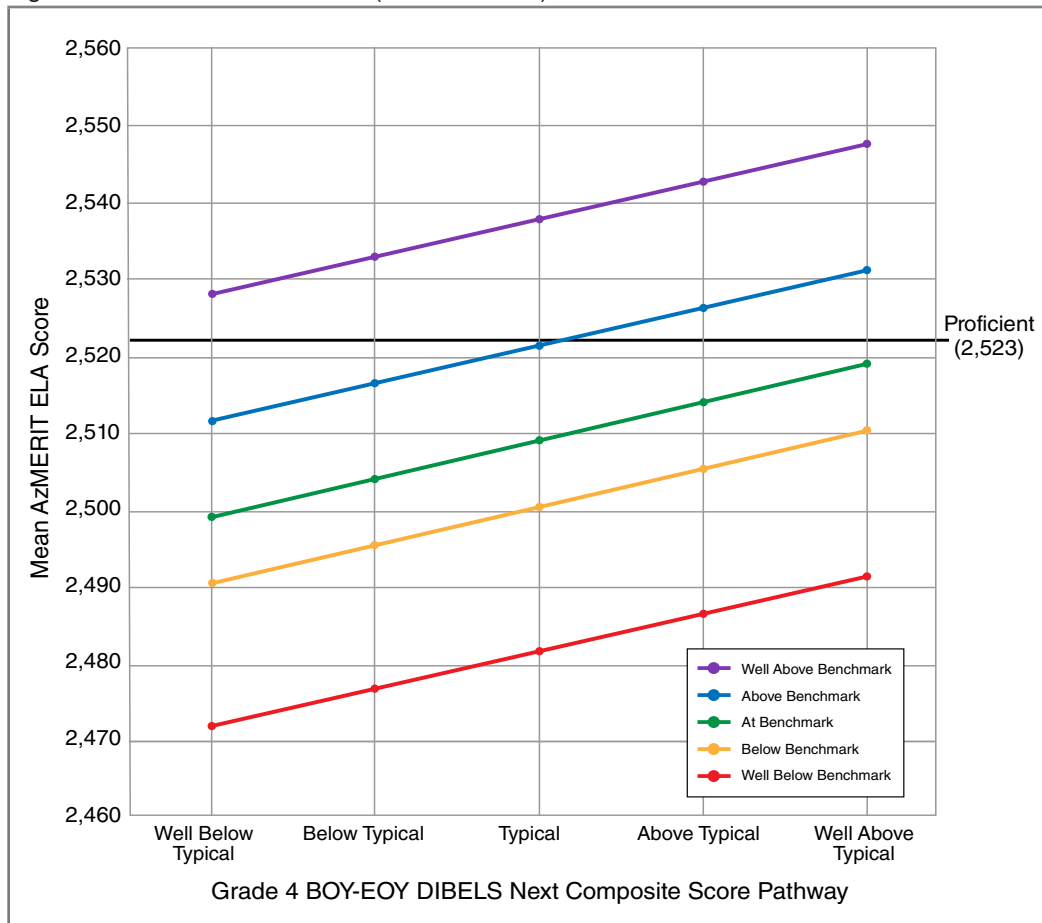
Figure A2. Grade 4 Fitted Means (SBAC ELA)

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