Exploring the i-Ready Predictive Capability

Curriculum Associates' i-Ready is an adaptive diagnostic and individualized instructional tool that has been used in M-DCPS in the last few years. In addition, in 2016-2017, Curriculum Associates provided the District with results of their predictive model, which used the outcomes of the Fall and Winter i-Ready diagnostic testing to estimate the probabilities of a student scoring at every achievement level on the 2017 FSA ELA and Mathematics for students in grades 3-8. In this Brief, the results of the 2017 FSA are used to investigate the quality of the i-Ready's predictive results.

To enable a comparison of the i-Ready predictive results with the 2017 FSA observed results, the following procedure was used. The Winter i-Ready's reported probabilities of scoring in each of the achievement levels 3-5 on the 2017 FSA were added, and the results were converted into a dichotomous variable coded as 1 if the probability of scoring within achievement levels 3-5 was at least 0.5, and 0 otherwise. In addition, achievement level on the 2017 FSA was dichotomized and coded as 1 if a student scored within achievement levels 3-5, and 0 if the student scored within achievement levels 1-2.

The results of the comparison of the 2017 FSA ELA and the predicted Winter i-Ready results for Grade 3 students are shown below.

		i-Ready Prediction		
		0	1	Total
2017	0	8353	1512	9865
FSA ELA	1	2267	10757	13024
Total		10620	12269	22889

It can be seen that of the 10620 Grade 3 students who were predicted to score within achievement levels 1-2 on the 2017 FSA ELA, 8353 in fact scored that way. The corresponding cell in the table above is generally referred to as containing the True Negative (TN) results. Similarly, 10757 students who were predicted to score within achievement levels 3-5 in fact

scored that way. These are generally referred to as True Positive (TP) results.

One measure of predictive success is its *Accuracy*, defined as a percentage of correct predictions. For the table above, Accuracy$= \frac{Correct\ Predictions}{Total} = \frac{TN+TP}{Total} = \frac{8353+10757}{22889} = 83\%$

Because predicted and actual achievement levels may agree by chance, the accuracy results are generally accompanied by a statistical measure of agreement that corrects for a chance agreement. One such popular measure is Cohen's Kappa. It achieves a maximum value of 1 if the predicted and actual results are identical. Values of the Kappa in the 0.61 – 0.80 range are often interpreted as indicators of a substantial agreement, while the values in the 0.41 – 0.60 range as indicators of a moderate agreement.

Below are the results of an analysis of the capability of the Winter i-Ready diagnostic results to predict the 2017 FSA ELA and Mathematics results by grade level and subject area.

Grade	ELA		Mathematics	
	Accuracy	Kappa	Accuracy	Kappa
3	83%	0.67	83%	0.64
4	84%	0.67	84%	0.64
5	84%	0.68	83%	0.65
6	83%	0.67	84%	0.69
7	83%	0.67	84%	0.68
8	82%	0.63	79%	0.54
Total	83%	0.67	83%	0.66

Conclusion

It can be observed that the results displayed in the table above demonstrate a high accuracy of the Winter i-Ready results for predicting the 2017 FSA outcomes in both subjects and across all grade levels shown. In addition, they show a substantial agreement between the predicted and actual outcomes in both subjects and across all grade levels, except for Grade 8 in mathematics. In that one case, the value of the Cohen's Kappa falls within a moderate agreement range.

Additional Measures of Predictive Success

Predictive abilities of various tests are often reported using several additional measures. In the remainder of this brief, some of these measures are defined and presented.

Looking back at the table on the first page, one can see that 2267 students in Grade 3 were predicted to score within achievement levels 1-2, but scored instead within achievement levels 3-5 on the 2017 FSA ELA. These cases are referred to as False Negatives (FN). Similarly, 1512

students were predicted to score within achievement levels 3-5, but instead scored within achievement levels 1-2. These are referred to as False Positives (FP).

These are four additional measures of a predictive success of a test:

- *Sensitivity* is the percentage equivalent of the following fraction $\frac{TP}{TP+FN}$. In our context it answers the following question: of all students who scored within achievement levels 3-5, what percent were predicted to score that way?
- $Specificity = \frac{TN}{TN+FP}$ is the answer to the following question: of all students who scored within achievement levels 1-2, what percent were predicted to score that way?
- *Positive Predictive Value (PPV)* $= \frac{TP}{TP+FP}$ answers the question: of all students who were predicted to score within achievement levels 3-5, what percent scored that way?
- *Negative Predictive Value (NPV)* $= \frac{TN}{TN+FN}$ answers the question: of all students who were predicted to score within achievement levels 1-2, what percent scored that way?

The table below presents these additional indices.

Grade	ELA				Mathematics			
	Sensitivity	Specificity	PPV	NPV	Sensitivity	Specificity	PPV	NPV
3	83%	85%	88%	79%	87%	77%	87%	76%
4	88%	79%	84%	83%	86%	80%	90%	73%
5	86%	82%	85%	84%	80%	87%	90%	75%
6	86%	81%	82%	85%	84%	85%	85%	83%
7	85%	82%	83%	84%	84%	84%	82%	86%
8	91%	71%	79%	87%	73%	82%	68%	85%
Total	86%	80%	83%	83%	83%	83%	86%	80%

Using these indices, one can answer other questions of interest. For instance, if one is interested in a situation where a student was predicted to score within achievement levels 3-5, but instead scored within achievement levels 1-2, a question that can be asked is, "Of all students who were predicted to score within achievement levels 3-5, what percent scored below that?" The answer is 1-PPV. For Grade 3 students in ELA, the answer is 100% – 88% = 12%.

Summary

The results of the analyses presented above indicate that various indices of a test's predictive success are sufficiently high with a possible exception of the values of the Cohen's Kappa and PPV for Grade 8 students in mathematics. Therefore, the usage of the i-Ready diagnostic assessment as a predictive tool for the FSA outcomes in grades 3-8 is justified.