



Research Brief

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Office of Shared Accountability

An Updated Model Predicting High School Students' Attainment of Core Credits in Grade 9

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Executive Summary

The Office of Shared Accountability (OSA) in Montgomery County Public Schools (MCPS) has provided Grade 9 course prediction information to high school administrators and teachers to help them identify students who are at risk of failing to earn four or more core credits in Grade 9. The Grade 9 course prediction model was initiated several years ago to help fulfill the district's mission to ensure success for all students through additional support provided for those in need so that more students can stay on track toward college and career readiness in their first year of high school. Recently, a significant model update was required to accommodate the departure from the Maryland School Assessment (MSA) and the recent data summary for achievement milestone establishment in MCPS. This research brief examines whether the updated model works effectively in predicting Grade 9 course attainment and highlights changes in predictor data between current and prior models.

The updated Grade 9 course prediction model now includes scores from Measures of Academic Progress (MAP) that students obtain in Grade 8 as the only standardized assessment predictor in the model. In addition, the updated model integrates Grade 8 student academic and behavioral data as predictors in the second semester or the whole school year instead of data from the first semester of Grade 8 for the previous model. Serving as a cross-validation study, the updated Grade 9 course prediction model demonstrates a prediction accuracy of 92.2 percent, more than two percentage points higher than the accuracy for the previous model established by Rethinam and Von Secker (2011). The increase of prediction accuracy is consistently observed across all racial/ethnic and service groups, with greater improvement for Black or African American and Hispanic/Latino students and those receiving Free and Reduced-price Meals System (FARMS) services than for Asian and White students.

The predicted Grade 9 core credits completion data computed with the updated model for the 2016–2017 school year now are available for use by high schools in MCPS. The data continue to provide high school administrators and teachers with information necessary to identify students who might be at risk of course failure in Grade 9 and inform instructional decisions for those students at an earlier time.

Recommendations are as follows:

- School administrators and teachers who design academic interventions for Grade 9 students should consider all available student information.
 - Use Grade 9 course predictions in conjunction with the recent MCPS milestone student-level data; and
 - Take into account data obtained during Grade 9 such as students' performance, teachers' classroom observations, teachers' interactions with students, etc.
- OSA will continue to use MAP and other updated predictor data to provide high schools with Grade 9 course attainment information.
- OSA will provide high schools with Grade 9 course predictions twice a year, in March and August, for rising Grade 9 students.
- OSA will conduct cross-validation studies for the current Grade 9 course prediction model when needed to accommodate changes in high school courses, instructional practices, and assessments over time.

Background

OSA initiated the Grade 9 course prediction model in the 2009–2010 school year to help fulfill the district's mission to ensure success for all students. Research has shown that Grade 9 students who fail two or more core courses are at higher risk of dropping out or failing to graduate within four years (Lloyd, 2007; Roderick & Camburn, 1999; Wheelock & Miao, 2005). OSA has made available the prediction information to school administrators and teachers to meet the need for more emphasis on successful course completion in Grade 9, specifically, the need for early identification of students who are at risk of course failure in their first year of high school. Having predicted Grade 9 course attainment information prior to or in the beginning of the school year can provide high schools with guidance for instruction/intervention planning so that more students can stay on track toward college and career readiness.

According to MCPS Regulation JEB-RA, *Placement, Promotion, Acceleration, and Retention of Students*, high school students, including those in Grade 9, are required to earn five credits each year in order to be promoted. For Grade 9, four of those five courses should be in core areas of English, mathematics, science, and social studies. For the purposes of building the Grade 9 course prediction model, world language also is considered a core course given that earning credits in world language is one of the options to satisfy MCPS graduation requirements.

The Grade 9 course prediction model originally was established based on Grade 7 MSA reading and mathematics scores as well as middle school academic and behavioral data obtained from Grade 7 or the first semester of Grade 8 (Rethinam & Von Secker, 2011). With the recent shift in assessments in the state of Maryland to the Common Core Consortia Partnership for Assessment of Readiness for College and Careers (PARCC) assessments, MSA no longer is administered. Therefore, the absence of MSA scores and the district's recent effort on achievement milestones based on end-of-year performance data made it necessary to update the predictor data in the existing Grade 9 course prediction model.

Most importantly, a reliable standardized assessment was needed to replace the MSA in the Grade 9 course prediction model. MCPS has been administering MAP-Reading (MAP-R) in Grades 3 to 8 for many years. In 2014–2015, the district expanded MAP-Mathematics (MAP-M) to all students in Grades 5 and 8. A recent validity study conducted by OSA researchers (Wang, Zhao, & Addison, 2016) shows strong predictive and concurrent validity evidence between MAP data and data from the new state accountability assessment, PARCC; this demonstrates MAP a reliable and compatible assessment for the district’s accountability system. In fact, the updated Grade 9 course prediction model reflects its shift from MSA to MAP and from Grade 7 and Grade 8 semester 1 data to semester 2 and yearly data in Grade 8.

In response to the changes in predictor data and serving as a cross-validation study of the previous Grade 9 course prediction model, this brief addresses two questions as follows:

1. Can the updated Grade 9 course prediction model with MAP data and specified Grade 8 academic and behavioral variables effectively predict the number of core credits that students are likely to earn at the end of Grade 9?
2. Can the updated Grade 9 course prediction model preserve the integrity of the previous model in terms of prediction accuracy on whether or not students will earn four or more core credits at the end of Grade 9 among student racial/ethnic and service groups?

Methodology

The Grade 9 course prediction model was updated based on data from 9,024 students who were enrolled as first-time ninth graders in the school year of 2015–2016 and had complete predictor data provided through official middle school report cards and other student system data files in MCPS. Students’ demographic information on gender, race/ethnicity, and receipt of special services (i.e., FARMS, special education, and Limited English Proficiency) were obtained from MCPS records at the end of 2015–2016 school year.

As in the previous prediction model, the predictor data in the current model included three research-based constructs represented by seven updated variables as shown below:

1. Prior performance on the Measures of Academic Progress (MAP) standardized assessments
 - Fall Grade 8 MAP-Reading (MAP-R) Rasch Unit (RIT) score
 - Fall Grade 8 MAP-Mathematics (MAP-M) RIT score
2. Rigor of middle school courses
 - High school mathematics courses passed with a C or higher in the second semester of Grade 8
 - Enrolled in English language learning or supportive reading class in Grade 8
3. Middle school academic engagement
 - Mean Marking Period Average (MPA) in Grade 8
 - Grade 8 attendance rate
 - Any ineligibility during the four marking periods of Grade 8

As mentioned previously, the number of core credits earned in Grade 9 was computed based on course information in core areas of English, mathematics, science, social studies, and world languages. Exploratory multiple regression procedures were used to find whether the selected predictors were significantly associated with the number of attained core credits in Grade 9, and to help remove outlier cases from the prediction model. Each of the continuous predictor variables (i.e., MAP-R RIT score, MAP-M RIT score, mean MPA, attendance rate) was centered toward the median in order to normalize the data. Then, the generalized estimating equations (GEE) procedure, a regression-based technique that accounts for variation for both categorical and continuous variables was performed to obtain intercept and regression coefficients for the seven variables specified in the model in order to predict the number of core credits earned in Grade 9.

Prediction accuracy was examined on the category of whether or not students earned four or more core credits at the end of Grade 9, in terms of the percentage of first-time Grade 9 students whose predicted and actual core credits attainment agreed to each other or not. Rates of accurate estimation (performed as predicted) and error estimation such as overestimation (performed not as good as predicted) and underestimation (performed better than predicted) were compared between current and previous prediction models.

Results

Model effectiveness

The analytical results show that Grade 8 fall MAP-R RIT scores and MAP-M RIT scores are significantly associated with the number of core credits earned in Grade 9 ($p < .001$). Other selected variables in the updated Grade 9 course prediction model are also significant predictors for the expected outcome ($p < .001$). In general, the current model can predict how many core credits students are likely to attain at the end of Grade 9.

Prediction accuracy

The examination of model accuracy shows that the updated Grade 9 course prediction model correctly predicts 92.2 percent of first-time Grade 9 students included in this study regarding their attainment of four or more core credits. There is a 2.2 percentage point increase in accurate estimation between current (92.2%, see Table 1) and previous models (90.0%) (Rethinam & Von Secker, 2011). The improvement in prediction accuracy is consistently observed across all racial/ethnic and service groups. Prediction accuracy provided by the current model is highest among Asian (98.1%) and White (97.3%) students, with an increase less than 3.5 percentage points compared with the previous accuracy. The current prediction accuracy is also high for Black or African American (89.1%) and Hispanic/Latino (84.9) students and for students receiving FARMS services (84.5%) with an increase of 6.3, 5.0, and 4.0 percentage points from the previous accuracy for these groups, respectively.

Table 1
Accurate and Error Estimations on Whether or not Earning Four or More Core Credits in Grade 9 Predicted by the Updated Grade 9 Course Prediction

Student group	N Total students	% Accurate estimation	% Overestimation	% Underestimation
All students	9,024	92.2	2.4	5.4
Black or African American	1,831	89.1	3.9	7.1
Asian	1,438	98.1	1.1	0.8
Hispanic/Latino	2,207	84.9	3.4	11.8
White	3,118	97.3	0.9	1.7
Two or more races	419	93.9	3.6	2.5
FARMS	2,501	84.5	4.3	11.2
Special education	805	79.6	6.1	14.2
LEP	881	79.5	3.4	17.1

Notes. Estimations are based data from first-time Grade 9 students in 2015–2016 with complete predictor information. FARMS= Free and Reduced-price Meals System; LEP = Limited English Proficient.

In addition to the improved prediction accuracy, the current Grade 9 course prediction model also shows a lower overestimation rate (2.4% vs. 5.1%) and a slightly higher underestimation rate (5.4% vs. 4.8%) compared with the previous model. The declined overestimation rate is observed across all racial/ethnic and service groups, while the increased underestimation rate is also found for most of the student groups. With the current model, Black or African American, Hispanic/Latino, and all the service groups are more likely to be underestimated (7.1% to 17.1%) than overestimated (3.4% to 6.1%). For Asian and White students, the error estimation (overestimation or underestimation) is represented by less than two percent of them.

Summary

The updated Grade 9 course prediction model validates the effectiveness of the previous model and appears to work better in distinguishing between students earning four or more core credits versus students earning less than four core credits in Grade 9. First, the prediction accuracy is improved among all student groups. Second, the current model demonstrates a greater improvement in prediction accuracy for Black or African American and Hispanic/Latino students and students receiving FARMS than for Asian and White students. Third, students are more likely to be underestimated than overestimated with the current model, while students tended to be more equally underestimated and overestimated with the previous model. Especially, underserved students tend to perform better than predicted if being predicted incorrectly, given their high underestimation rates relatively to their overestimation rates in the updated model. These findings suggest that the current Grade 9 course prediction model continues to provide school administrators and teachers with an effective course prediction tool to guide instructional practice. Indeed, the current tool can help more accurately identify students, especially underserved students, who might be at risk of course failure in Grade 9 and therefore reduce the chance that underserved students are overlooked by the predictions.

The improvement in prediction accuracy between the previous and current Grade 9 course prediction models may be largely explained by the replacement of MSA reading and mathematics with MAP-R and MAP-M as the standardized test predictors. The updated model

demonstrates that MAP-R and MAP-M are reliable assessments in informing student achievement, which confirms the findings from the recent validity study for MAP and PARCC in MCPS (Wang, Zhao, Addison, 2016).

Although the accuracy of the updated prediction model is high by statistical standards (92.2%), error estimations (overestimation or underestimation) may still happen to about eight percent of first-time Grade 9 students. The error estimations occur when other influential factors are not taken into account in the establishment of the current prediction model due to the limitation of data availability and the scope of the study. Additionally, students with missing data on any of the predictors, those repeating their ninth grade, and those entering MCPS after the 2015–2016 school year do not have a predicted course outcome in Grade 9.

Recommendations

- As discussed previously, other unspecified factors might affect students' attainment of core credits in Grade 9. In addition, the course prediction is based on data prior to students entering Grade 9. Therefore, when using Grade 9 course prediction information to assess individual students' instructional needs, school administrators and teachers who design academic interventions for Grade 9 students should consider all available student information.
 - Use Grade 9 course predictions in conjunction with the recent MCPS milestone student-level data; and
 - Take into account data obtained during Grade 9 such as students' performance, teachers' classroom observations, teachers' interactions with students, etc.
- Given the high and improved prediction accuracy of the current model, OSA will continue to use MAP and other updated predictor data to provide high schools with Grade 9 course attainment predictions.
- Considering that high schools need to receive course prediction information at an earlier time to plan Grade 9 instruction, OSA will provide the information twice a year, in March and August, for rising Grade 9 students.
- Due to differences between student cohorts in high school courses, instructional practices, and assessments, OSA will conduct cross-validation studies for the current Grade 9 course prediction model when needed in order to accommodate the changes over time.

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