

Early Algebra & Inequality in Postsecondary Educational Outcomes



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Executive Summary

This report describes the association between enrolling in early (8th grade) algebra and postsecondary outcomes, including college attendance in general and bachelor's degree completion, among MMSD graduates who were in 3rd grade between 2006 and 2009. The report offers a general analytic approach to this question that distinguishes between student characteristics and experiences that may make them more or less likely to take 8th grade algebra, on the one hand, and the relationship between taking 8th grade algebra and postsecondary outcomes, on the other.

We find that, based on academic performance and behavioral patterns observed in 3rd grade, the kinds of students who would later enroll in 8th grade algebra between 2011 and 2014 were already more likely to enroll in and complete college than their peers. Beyond these initial differences, however, students in these cohorts who enrolled in 8th grade algebra were more likely to attend college and complete a bachelor's degree than would have been predicted based on their 3rd grade achievement and behavior alone. The association between enrollment in 8th grade algebra and postsecondary outcomes was stronger for Black and Hispanic students than it was for non-Hispanic White students and for students from low-income families relative to those not from low-income families, suggesting the equity-enhancing potential of offering algebra in the 8th grade.

The District's approach to mathematics instruction in terms of when algebra is introduced, what courses incorporate algebraic content, and what curricular materials support algebra instruction has changed over the past 10-15 years, compromising the extent to which these findings might translate to students entering middle school today. On the other hand, none of these features of policy and instructional practice ever static. Understanding how district practices influence students' trajectories beyond MMSD graduation requires grappling with interpreting differences in the school experiences of students in the past in the context of students coming up through the District today.





Introduction

This report examines how enrollment in algebra 1 during 8th grade is associated with students' postsecondary education outcomes. This study considers both average associations and how the associations might vary by racial, ethnic, and economic backgrounds of the students. This research report, taken on as part of the Madison Education Partnership, is designed to inform MMSD leaders about the potential associations so that they can consider implications for policy and practice.

We think of schools as places where teachers can intervene to reinforce or alter the paths students are already on based on students' prior personal and

educational experiences. We take 3rd grade as our initial point of observation due to the availability of both test scores and grades at that time and begin by asking what postsecondary outcomes we would expect based only on the academic achievement, behavioral, and personal information we observe up to that time. This approach is inspired by Alexander, Entwisle, and Horsey's (1997) research on high school dropout, which highlighted that later achievements are predicted surprisingly well by experiences and achievements from as young as first grade. Like Alexander and his colleagues, we find we can predict later outcomes fairly well based on these early-life observations.



We next compare the share of students we *predict* would experience an outcome (like college enrollment) based on things we observe in 3rd grade to the share of students *actually experiencing* the outcome conditional on different opportunities they have and choices they make. For example, we compare the share of students who enrolled in 8th grade algebra and went on to attend college to the share of such students we expected to attend college based on 3rd grade experiences, attributes, and achievements alone. The difference between these shares gives us a way of thinking about the association between 8th grade algebra enrollment and college enrollment. If enrollment in algebra in 8th grade leads students who would not otherwise have attended college to do so, then the share of 8th grade algebra enrollees we observe going on to college should be GREATER than the share we expected to attend. As we discuss below, this also gives us a way of thinking about who among those students we observed in 3rd grade actually enrolls in algebra in 8th grade. If students more predisposed to attending college are also more likely to enroll in 8th grade algebra, then the share of students we expect to attend college based on their 3rd grade outcomes should also be GREATER among such students than among students who enroll in algebra later, if at all. Such a difference might also lead the district to reflect on whether or not 8th grade algebra enrollment is reaching its intended audience.

In MMSD, policy and practice around middle school mathematics and course-taking sequences evolved substantially since the school years included in this report. Students in the 3rd grade cohorts comprising this analysis experienced 8th grade algebra in 2010-2013, prior to the full implementation and classroom integration of the Common Core State Standards. Instead, Algebra 1 curriculum during these years was aligned to the 1998 Wisconsin Model Academic Standards for Mathematics, and many of the skills and content covered in these standards have since been integrated into regular 8th grade math. The years included in this report also predate district efforts to expand access to algebra in middle school through “compacted math” course sequencing beginning in 2018-19. As a result of these changes, the population of students who take 8th grade algebra today may be substantially different from the population included in the analytic sample. These factors may limit the ability to extrapolate from this report to the district’s current context around early algebra.

The body of this report is organized as follows. The first section describes the prediction model of several postsecondary outcomes based on 3rd grade attributes, including details in model logic, measures, how well the model predicts postsecondary outcomes, and how different 3rd grade predictors are related to those outcomes. The second section provides a detailed examination of how enrolling in algebra 1 in 8th grade is associated with students’ postsecondary outcomes.



By comparing differences between predicted outcomes using 3rd grade data and observed outcomes later in life, we are able to evaluate how things that happened after elementary school might alter postsecondary trajectories.

Methods

Baseline Postsecondary Outcome Prediction Model

The logic behind our prediction model for postsecondary outcomes is rooted in Alexander, Entwisle, and Horsey’s (1997) study of early foundations of high school dropout. They found that much of what happens to students later in adolescence is deeply connected to earlier attributes. By comparing differences between predicted outcomes using 3rd grade data and observed outcomes later in life, we are able to evaluate how things that happened after elementary school (like patterns of course-taking and program participation) might alter postsecondary trajectories. We are also able to say something about the kinds of students who participated in such programs or enrolled in such courses in the first place.

We chose 3rd grade as the baseline for our analysis since it is the first year with standardized testing scores. 3rd grade is also early enough to observe student’s experiences outside of school and late enough that prediction of college enrollment is far from random. As shown in Table 1, we included students who were in 3rd grade in 2006, 2007, 2008, and 2009 and stayed with the Madison Metropolitan School District through 12th grade. We only included cohorts before 2009 since they are the most recent cohort that we have access to who should have enrolled and completed postsecondary education.

We constructed a prediction model using 3rd grade educational experiences and achievements to predict two distinct postsecondary educational outcomes: enrollment in 2-year or 4-year college (Any College Enrollment) and completion of a four-year degree regardless of initial kinds of enrollment (BA Completion). Academic achievement predictors in the model include 3rd grade WKCE (Wisconsin Knowledge and Concepts Examination) standardized test scores in reading and math, and 3rd grade overall GPA. Behavioral indicators include number of behavioral incidents (none, one, and two or above), number of unexcused absences (none and one or more), as well as an indicator for whether or not a student had an Individualized Education Plan (IEP) status. By adopting these measures, we aim to capture the key differences in achievement and engagement that already emerged and may predict a student’s postsecondary outcomes.



4,415
students tracked longitudinally
from 3rd through 12th grade.

Table 1: Distribution of Cohorts, by Year in Third Grade

Cohort Year	Count	Percent
2006	1,095	24.8%
2007	1,080	24.5%
2008	1,128	25.5%
2009	1,112	25.2%
Total	4,415	100%

This table shows share of all 3rd graders in each cohort year we observe through 12th grade.

Figure 1 illustrates our approach to understanding the association between enrolling in 8th grade algebra and enrolling in college. Based on their third grade attributes and experiences (the left side of the figure), some students are more likely to enroll in 8th grade algebra than others (the opportunity that is the focus of this report). However, in part independent of what led students to enroll in 8th grade algebra, students who do so may be more or less

likely to later enroll in college (the right side of Figure 1). Since the data we have are observational (rather than from an experiment), it's important to understand both entry into 8th grade algebra (the left side) and what happens after enrolling in 8th grade algebra (the right side) in order to get a sense of how 8th grade algebra may have altered trajectories for different types of students.

Figure 1: The Path from Third Grade to Algebra Enrollment to College



As shown in Table 2, among the 4,415 students included in our dataset, our model focused on 4,200 of them (95%) with complete test scores and behavioral records. Students with missing information on any of the predictors or outcomes were not included. The 5% reduction in sample size is driven primarily by missing data on records of standardized math and reading test scores. See Appendix 1 for the distribution of missingness across measures. 3rd Grade WKCE reading and math scores are standardized to have a mean of 0 and a standard deviation of about 1. The

average 3rd grade overall GPA among all cohorts is 3.05 with a standard deviation of 0.35. About 26% of students had at least 1 unexcused absence and 11% had an IEP in 3rd grade. The large majority of the students (98%) had no behavioral incidents recorded, and only a small share experienced 1 incident (1%) or at least 2 incidents (1%). Among students in the analytic sample, we predicted that 84% of the students continued to enroll in either a two-year or a four-year college degree and 47% of them completed a four-year degree.

Table 2: Summary of Descriptive Statistics

Coefficients	Count	Mean/%	Standard Deviation
Grade 3 WKCE Reading Test Score	4,200	0.02	0.98
Grade 3 WKCE Math Test Score	4,200	0.02	0.98
Grade 3 GPA	4,200	3.05	0.35
No Unexcused Absences	3,120	74%	
1+ Unexcused Absences	1,080	26%	
No IEP in Grade 3	3,750	89%	
Has an IEP in Grade 3	450	11%	
No Incidents	4,102	98%	
1 Incident	55	1%	
2+ Incidents	43	1%	
Outcomes			
Any College Enrollment	3,518	84%	
Baccalaureate College Completion	1,975	47%	
Observations	4,200		

This table shows means, percentages, and counts of predictors. Standard Deviation is only included for non-binary measures (test scores and GPA).

Results



Baseline Prediction Model

Table 3 shows that our model does a pretty good job of predicting postsecondary education outcomes. The predicted share of students experiencing each outcome is very close to the observed shares. For example, we predict 83.8% of students will attend college and observe only a slightly lower share—82.9%—do so.

Table 3: Comparison Between Predicted and Observed Shared, by Outcomes

Outcomes	Predicted Share	Observed Share
Any College enrollment	83.8%	82.9%
Baccalaureate College Completion	47.1%	45.6%

This table shows that our baseline model predicting each outcome as a function of 3rd grade academic and behavioral indicators is a pretty good fit.



Table 4 shows, all else equal, each standard deviation increase in 3rd grade reading test score is associated with a 2 percentage point increase in the probability of attending college and a 7.2 percentage point increase in the probability of completing a four-year degree. Each standard deviation increase in 3rd grade math test score is associated with a 1.6 percentage point increase in the probability of attending college and a 7.1 percentage point increase in the probability of completing a four-year degree. Holding constant 3rd grade test scores, behavioral incidents, IEP, and unexcused absences, each additional grade point (for example from an average B to an A) is associated with a 15.1 percentage point increase in the probability of attending college and a 50.5 percentage point increase of completing a four-year degree.

In contrast, students with one behavioral incident in 3rd grade are 9.3 percentage points *less likely* to go to college and 33.5 percentage points *less likely* to complete a four-year degree than students with no behavioral incidents. Any more behavioral incidents are also negatively associated with postsecondary outcomes; however, the association is not much different from that of a single incident. Students with one or more unexcused absences in 3rd grade are 7.3

percentage points less likely to attend college and 17.9 percentage points less likely to complete college than students with no unexcused absences.

These results should *not* be read as suggesting that, were students only to have avoided an unexcused absence or behavioral incident, they would have been appreciably more likely to attend college. Instead, that unexcused absences and behavioral incidents are indicative of different kinds of challenges students and families confront, differential access to various opportunities, and different choices about whether or not to take advantage of the opportunities available to them.¹ Regardless, these models are quite predictive of student outcomes and form a reasonable baseline against which we can assess the potential effects of different kinds of educational experiences.

Besides the common baseline prediction model, we also repeated the analysis separately for groups of students by race and family income (low versus not low), and parents' highest education level. Differences in estimates from these models were not large enough to merit separate analyses of the postsecondary outcomes experienced by MMSD students in our view.

Table 4: Baseline Prediction Model

Outcomes	Any College Enrollment	Baccalaureate College Completion
Grade 3 WKCE Reading Test Score	0.020*** (0.008)	0.072*** (0.016)
Grade 3 WKCE Math Test Score	0.016* (0.009)	0.071*** (0.015)
Grade 3 GPA	0.151*** (0.021)	0.505*** (0.042)
3rd Grade Behavioral Incidents (compared to no incidents)		
1 Incident	-0.093* (0.053)	-0.335*** (0.056)
2+ Incidents	-0.119* (0.062)	-0.088 (0.105)
1+ Unexcused Absences	-0.073*** (0.011)	-0.179*** (0.022)
Has an IEP in Grade 3	0.011 (0.016)	-0.017 (0.032)
Standard errors in parentheses		

Data include 3rd grade cohorts from 2006, 2007, 2008, and 2009 in the Madison Metro School District who continued with the MMSD through 12th grade and should have completed their postsecondary education if initially enrolled in one.

Findings



92%

Observed college enrollment rate for students who participated in 8th-grade algebra.

In Table 5, the rows labeled “observed” show students’ actual postsecondary education outcomes while those rows labeled “expected” show the predicted outcomes based on 3rd grade tests scores, GPA, and behavioral indicators. Columns distinguish between groups of students who did or did not participate in 8th grade algebra.

Comparisons between columns “No 8th Grade algebra” and “8th Grade algebra” in the “Expected” row help us understand **who enrolls in algebra in 8th grade**. Comparison between “Observed” and “Expected” in “Yes” columns for each outcome shows **how enrollment in 8th grade is associated with postsecondary outcomes**.

Based on 3rd grade achievements and behaviors, a greater share of students who enrolled in algebra in 8th grade were expected to attend college (90%) than the share of those who did not enroll (82%). In other words, based on 3rd grade outcomes alone, we would have expected 8th grade algebra enrollees to be 8 percentage points more likely to ultimately attend college than those who did not enroll. The magnitude of advantage is even greater (16%) if we compare the share of enrollees expected to complete four-year college (59%) to that of students who did not enroll in 8th grade algebra (43%).

Turning now to differences in observed postsecondary outcomes conditional on participating in 8th grade algebra (comparing within columns), we see that, among those who participate in 8th grade algebra, 2 percent more students attend college (92%) than we would have expected to attend based on their 3rd grade outcomes (90%). Among those who did not enroll in 8th grade algebra, we see 3 percent *less* students attending college (79%) as the share we predicted based on 3rd grade outcomes (82%). We can also see that, among algebra enrollees, 6 percent more completed a four-year degree (65%) than we had expected (59%). In contrast, among non-enrollees, we observed a rate of degree completion 4 percent lower (39%) than the share we predicted (43%).

Table 5: Average Associations: Enrolled in Eighth Grade Algebra

	No 8th Grade algebra	8th Grade algebra
Any College Enrollment		
Observed	79%	92%
Expected	82%	90%
Baccalaureate College Completion		
Observed	39%	65%
Expected	43%	59%

Differences among Groups of Students in Eighth Grade Algebra Participation and Postsecondary Outcomes

In this section, we consider whether students from different levels of family income or different racial or ethnic groups vary in (1) their proclivity to enroll in 8th grade algebra and (2) the association between enrollment in 8th grade algebra and postsecondary outcomes.

Any College Enrollment: Differences by Family Income

In Table 6, we compare observed and expected rates of any college enrollment for low-income and non-low-income students by whether they enrolled in 8th grade algebra. Based on 3rd grade achievement and behavior, 91% of non-low-income students who enrolled in 8th grade algebra were expected to attend college compared to 88% of their non-low-income peers who did not enroll in 8th grade algebra. Among low-income students, we expected higher chances (84%) for low-income algebra enrollees to attend college compared to their non-enrolling peers (73%).

Turning now to the observed outcomes, among non-low-income students, 4 percent more students who enrolled in 8th grade algebra went on to attend college (95%) than we would have expected to attend based on their third-grade outcomes (91%). For non-low-income students who did not attend algebra, we see about the same share attending college (89%) than what we expected (88%) based on 3rd grade outcomes.

Among low-income students, 2 percent more algebra attendees attend college (86%) than we expected based on third-grade outcomes (84%). In contrast, among low-income students who did NOT take algebra in 8th grade, 5 percent fewer attended college (68%) than we expected (73%) based on 3rd grade outcomes.

BA Completion: Differences by Family Income

In Table 7, we compare observed and expected rates of *four-year college completion* for low-income and non-low-income students by whether they enrolled in 8th grade algebra.

Table 6: Any College Enrollment and Eighth Grade Algebra, by Family Income

	No 8th Grade algebra	8th Grade algebra
Low-Income: No		
Observed	89%	95%
Expected	88%	91%
Low-Income: Yes		
Observed	68%	86%
Expected	73%	84%

Table 7: BA Degree Completion and 8th Grade algebra, by Family Income

	No 8th Grade algebra	8th Grade algebra
Low-Income: No		
Observed	58%	71%
Expected	55%	63%
Low-Income: Yes		
Observed	15%	44%
Expected	25%	48%

Based on third-grade achievement and behavior, a greater share of non-low-income students who enrolled in 8th grade algebra were expected to complete a four-year degree (63%) than their peers who did not enroll (55%), a difference of 8%. Among low-income students, the difference is triple that at 23%; we expected a higher share of algebra enrollees to complete a four-year degree (48%) compared to their non-enrolling peers (25%).

Turning now to the observed outcomes (comparing within income groups and columns), among non-low-income students, 8 percent more students who enrolled in 8th grade algebra went on to complete a four-year college degree (71%) than we would have expected to complete based on their third-grade outcomes (63%). For non-low-income students who did not attend algebra, 3 percent more completed a four-year degree than what we expected based on 3rd grade outcomes.

Among low-income students, 4 percent fewer algebra attendees completed a four year college degree (44%) than we expected based on 3rd grade outcomes (48%). Among low-income students who did NOT take algebra in 8th grade, 10 percent fewer completed a four-year degree than we expected based on 3rd grade outcomes. Enrollment in algebra in 8th grade may thus reduce the cumulative effects of living in a low-income family on college completion but does not eliminate those effects.

Any College Enrollment: Differences by Race

In Table 8, we compare observed and expected rates of college enrollment for students from different racial and ethnic backgrounds by whether they enrolled in 8th grade algebra.

Based on 3rd grade achievement and behavior, a greater share of Black students who enrolled in 8th grade algebra were expected to attend college (82%) than the share of their peers who did not enroll (71%). The same is true for Hispanic/Latino students (a 11% difference) and to a lesser extent non-Hispanic White students (4%).

Turning now to the observed outcomes (comparing within racial groups and columns), 4 percent more Black students (86%) , 4 percent more Hispanic (89%), and 3 percent more White (94%) students who completed algebra attended college than we would have expected. In contrast, among those not taking algebra in 8th grade, 5 percent fewer Black and 4 percent fewer Hispanic students attended college than we would have expected, while the same share of White students (87%) did so.

Table 8: Any College Enrollment and Eighth Grade Algebra, by Race

	No 8th Grade algebra	8th Grade algebra
Black		
Observed	66%	86%
Expected	71%	82%
Hispanic/Latino		
Observed	70%	89%
Expected	74%	85%
White		
Observed	87%	94%
Expected	87%	91%

BA Completion: Differences by Race

In Table 9, we compare observed and expected rates of four-year degree completion for students from different racial and ethnic backgrounds by whether they enrolled in 8th grade algebra.

Based on 3rd grade achievement and behavior, a greater share of Black students who enrolled in 8th grade algebra were expected to complete a four-year degree (47%) than their peers who did not enroll (21%), a difference of 26%. Similarly, the difference is 23 percent for Hispanic enrollees but appreciably less (9%) for White students.

In terms of observed outcomes (comparing within racial groups and columns), 5 percent fewer Black students (42%), 4 percent fewer Hispanic students (46%), and 7 percent more White students (70%) who enrolled in algebra in 8th grade completed a four-year degree than what we expected. In contrast, among those who did not take algebra in 8th grade, 7% fewer Black and 9% fewer Hispanic students completed a four-year degree while 1% more white students did so.

Table 9: BA Degree Completion and Eighth Grade Algebra, by Race

	No 8th Grade algebra	8th Grade algebra
Black		
Observed	14%	42%
Expected	21%	47%
Hispanic/Latino		
Observed	18%	46%
Expected	27%	50%
White		
Observed	55%	70%
Expected	54%	63%



3x

Black students who enrolled in 8th grade algebra were three times as like to complete a bachelor’s degree (42% completion rate) than their peers who did not enroll in 8th grade algebra (14% completion rate).



26pts

The gap in expected 4-year degree completion between Black students who took 8th-grade algebra (47%) and those who did not (21%).

Discussion

In this report, we examined participation in 8th grade algebra and how it is associated with postsecondary outcomes (any college enrollment and BA degree completion). We compared 1) observed shares of any college enrollment or BA degree completion to shares predicted from 3rd grade academic and behavioral indicators; 2) 8th grade algebra enrollees to non-enrollees; and 3) the association between 8th grade algebra enrollment and college outcomes among students from different racial, ethnic, and family income backgrounds.

Across all students in our sample, students who enroll in 8th grade algebra were more likely to attend college and earn a bachelor's degree based on 3rd grade academic and behavioral characteristics when compared to their peers who did not participate in 8th grade algebra. In other words, those already more likely to enjoy positive postsecondary outcomes were more likely to enroll in 8th grade algebra. This may be due in part to district practice at the time, in which selection into algebra was not guided by a formal district policy focused on expanding access to a broader population of students.

Beyond selection, those who enroll in 8th grade algebra experience higher probabilities of enrolling in any kind of college and completing a four-year degree than we would have expected based on 3rd grade achievements and behaviors alone.



Beyond selection, those who enroll in 8th grade algebra experience higher probabilities of enrolling in any kind of college and completing a four-year degree than we would have expected based on 3rd grade achievements and behaviors alone. 8th grade algebra enrollees often exceed predicted shares of both any college enrollment and BA degree completion, while non-enrollees generally meet their predicted possibilities.

By examining differences between observed and expected outcomes independently for enrollees and non-enrollees, we found that 8th grade algebra has a stronger association with postsecondary enrollment and completion for Black and Hispanic students than for White students. Among Black and Hispanic students, those who did not participate in 8th grade algebra experienced lower probabilities of college enrollment and four-year degree completion than what we would have expected based on their 3rd grade results. In contrast, their peers who enrolled in 8th grade algebra experienced increased probabilities for both outcomes. For White students, associations between 8th grade algebra participation and postsecondary outcomes are more modest, driven largely by the smaller differences among White non-enrollees between the share of students expected to attend college or complete a bachelor's degree and the share who actually do so.

Overall, these results suggest that participating in algebra in 8th grade is associated with higher probabilities of successful postsecondary outcomes than we would have predicted from 3rd grade achievements and behavioral records.

For White and non-low-income students, 8th grade algebra participation is associated with modestly increased probabilities of postsecondary outcomes, while students who did not participate experienced each outcome at rates close to what we would have predicted based on 3rd grade indicators. In contrast, for low-income, Black, and Hispanic students, we observed more of a divergence between enrollees and non-enrollees: students who enrolled in 8th grade algebra tend to meet or exceed enrollment and completion expectations based on 3rd grade attributes, while their non-enrolling peers are more likely to fall below what we would predict for both college enrollment and BA degree completion. This suggests that 8th grade algebra enrollment may be a more consequential turning point for less advantaged students in the district.

Due to changes in mathematics standards, the Algebra I experienced by cohorts in this report may differ from what students experience today, and the skills and content that were part of the 1998 standards are now integrated throughout regular middle school math instruction, limiting the comparability of both the intervention and counterfactual described in this report

to the current practice in MMSD. However, this analysis still provides several insights and implications for practitioners in MMSD to consider.

That the advantages of 8th grade algebra for students' postsecondary trajectories were derived from course enrollment alone, rather than course achievement, poses questions about the mechanism by which students gain this benefit. Is it the exposure to rigor -- practice with math concepts that aids in the formation of positive math identity and encourages further coursetaking in advanced mathematics? Is it the ability to carve out additional time in the high school schedule to enroll in higher-level math, due to participating in an accelerated middle school sequence? What is the role of learning experiences in peer groups with higher initial predicted rates of postsecondary enrollment?

In addition, the analytic approach employed in this report reminds us of the power and importance of schools and what they offer. Students' early life and schooling experiences can explain or predict a good deal of their longer-term outcomes, but what schools do throughout students' academic careers can meaningfully alter those trajectories, as Algebra I was shown to do in this report. This report provides a model of how MMSD could continue to think about its service offerings and delivery, and replicate these analyses to examine the longer-term outcomes of cohorts on a number of programs and policies.



Conclusion

Our study shows that 8th grade algebra may have potential as an equity-promoting strategy by narrowing gaps in postsecondary outcomes, especially college enrollment, between students from socially advantaged and disadvantaged groups. While those who took 8th grade algebra between 2010 and 2013 already showed stronger academic promise by 3rd grade, the rates of postsecondary enrollment and baccalaureate completion of those students often exceeded what we predicted with 3rd grade records alone, especially for low-income, Black, or Hispanic students. Enrollment in 8th grade algebra was thus simultaneously more common among students already on the path to postsecondary success in 3rd grade and a point of inflection in the college trajectory, potentially advantaging those who enrolled.

More specifically, our finding suggests that the association between 8th grade algebra and postsecondary outcomes varies across student groups. For Black and Hispanic students and students from low-income households, the divergence between the postsecondary outcomes of enrollees and non-enrollees was larger than that for White or non-low-income students. Among Black, Hispanic, and low-income students who enrolled in 8th grade algebra, their probabilities of postsecondary enrollment and four-year degree completion were often higher than what we predicted. In comparison, their peers from similar backgrounds but did not participate in 8th grade algebra were more likely to fall below predictions while White and non-low-income non-enrollees generally meet the predicted probabilities. This pattern suggests that 8th grade algebra may reduce disparities in college enrollment and completion by allowing academically prepared students from disadvantaged backgrounds to capitalize on the opportunity afforded by their early academic promise and those who enroll in 8th grade algebra tend to exhibit higher chances of postsecondary enrollment.

The potentially equity-promoting role of 8th grade algebra is less clear for the completion of a four-year degree. While participation in the course is associated with higher chances of completion among non-low-income and White students, gains beyond expectations are smaller



for low-income and Black students. One explanation for this pattern may be the different trajectories a student may choose after getting into a postsecondary institution. Those who chose to enroll in a two-year degree may not have the intention of earning a bachelor's degree. As a result, differences in the completion of a four-year degree likely reflect factors beyond 8th grade algebra participation alone.

At the same time, our models highlight 8th grade algebra's potential role in selection into opportunity. Students who participated in algebra in 8th grade were already more academically prepared in 3rd grade when compared to their peers, especially those from disadvantaged backgrounds. This pattern indicates that 8th grade algebra may be particularly beneficial for high-achieving students from disadvantaged backgrounds to realize their potential and reduce the gap to more socially benefited students.

Nonetheless, our findings suggest that enrolling in algebra in 8th grade could potentially help academically prepared students from low-income households and Black or Hispanic backgrounds translate early achievements into improved chances of postsecondary success. Because participation in algebra in 8th grade is influenced by differences in early 3rd grade academic achievements, the equity implications of enrollment in algebra in 8th grade are limited to those who had the opportunity instead of reflecting an expansion of opportunity and access to a broader student population.

Endnotes, References, & Appendix



Endnotes

1 For examples, see MEP's previous work on [middle school attendance](#) (2019) and [elementary school attendance](#) (2018).

References

Alexander, Karl L., Doris R. Entwisle and Carrie S. Horsey. 1997. "From First Grade Forward: Early Foundations of High School Dropout." *Sociology of Education* 70(2):87-107.

Appendix 1: Summary of Descriptive Statistics with Missingness

Coefficients	N: Full Sample	N: Missing	%Missing
Grade 3 WKCE Reading Test Score	4415	194	4%
Grade 3 WKCE Math Test Score	4415	176	4%
Grade 3 GPA	4415	12	<1%
Incidents of Unexcused Absences	4415	0	0%
IEP in Grade 3	4415	0	0%
Behavioral Incidents	4415	0	0%
Outcomes			
Any College Enrollment	4415	20	<1%
Baccalaureate College Completion	4415	20	<1%

This table shows the distribution of missing data across predictors and outcomes.

MEP brings together the Madison Metropolitan School District (MMSD) and the Wisconsin Center for Education Research (WCER) at the University of Wisconsin-Madison in a locally based, nationally relevant, research-practice partnership. MEP joins research and practice by engaging in mutually defined, high-quality, problem-based research that contributes to policy, builds capacity, and strengthens practice.

Collaborating on MEP are UW Madison researchers and faculty; MMSD administration, teachers and staff; and stakeholders from the broader Madison community. The partnership enables research to be conducted more quickly and results released more efficiently—to advance strategies that benefit Madison students, families, and schools.

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