Skills That Pay: Subject-Specific Test Scores and Long-Run Outcomes

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Key Takeaways:

- Math and English Language Arts (ELA) test scores both predict high school and college graduation, but math scores are especially predictive of STEM degree attainment and earnings.
- Roughly half of the math-earnings association is not explained by educational attainment or degree field, which suggests a more direct link between math skills and earnings. In contrast, the ELA-earnings association appears to operate largely through differences in educational attainment.
- Math scores are more predictive of earnings for all students, but the association is weaker for low-income (FARMS-eligible) students and for those in the bottom third of the achievement distribution. For these groups, ELA scores have a relatively stronger association with earnings than they do for non-FARMS and higher-achieving students.

What We Studied

Students develop many skills in school, but not all are equally linked to later outcomes. Standardized test scores proxy for skills and play a central role in K-12 accountability and college admissions,[1] raising the question: how well do they predict educational attainment and earnings?

Using longitudinal data from Maryland, we estimated descriptive correlations and leveraged differences in teacher effectiveness to assess causal effects. Our findings suggest that policies aimed at promoting economic mobility should account for differences in the returns to skills across subjects and student subgroups.

How We Analyzed the Data

Our study examined how proxies for student skill relate to and influence long-term outcomes. Specifically, we addressed the following questions:

1) What is the relationship between state standardized test scores in math and ELA with educational and economic outcomes?

2) What is the causal effect of being assigned to a teacher who is more effective at improving test scores on these outcomes?

3) To what degree do educational attainment and degree field explain the relationship between test scores and earnings?

4) How does the test score-earnings relationship vary by eligibility for Free and Reduced-Price Meals (FARMS) and student achievement?

To answer these questions, we used data from the Maryland Longitudinal Data System (MLDS) Center, which enabled linking K-12 standardized test scores to postsecondary and earnings outcomes. Our sample included Maryland public school students in grades 3-8 from 2008-2019.[1] Two testing regimes were administered during this period: the Maryland School Assessments (MSA) from 2008-2014 and the Partnership for Assessment of Readiness for College and Careers (PARCC) assessments from 2015-2019. Math and ELA test scores were standardized within subject, grade, and year to have a mean of zero and a standard deviation of one, accounting for differences in assessment content and testing regimes over time and facilitating comparability across cohorts. For analyses of teachers' causal effects, we linked test score and outcome data to course records connecting teachers to their students from 2013-2019.

We used two complementary approaches. First, we used descriptive regressions to examine how test scores are associated with long-term outcomes. Specifically, we estimated the relationship between a student's score in one subject and outcomes, controlling for the score in the other subject and demographic characteristics. These estimates reflect associations across student-year observations and should not be interpreted as causal effects. This approach ensured we compared students with similar achievement in the other subject and isolated the independent association of each subject score with outcomes. Second, we leveraged variation in students' assignments to more- or less-effective teachers to estimate the causal effect of

[1] This period begins with the availability of linked administrative data through the MLDS Center and ends prior to COVID-19-related disruptions to testing schedules, which allowed us sufficient time to observe longer-term outcomes.

teacher-driven differences in test scores on these outcomes. As in the descriptive analysis, we estimated how being assigned to a teacher with value-added (TVA) that is higher in one subject affected student outcomes, holding TVA in the other subject and student demographics constant.

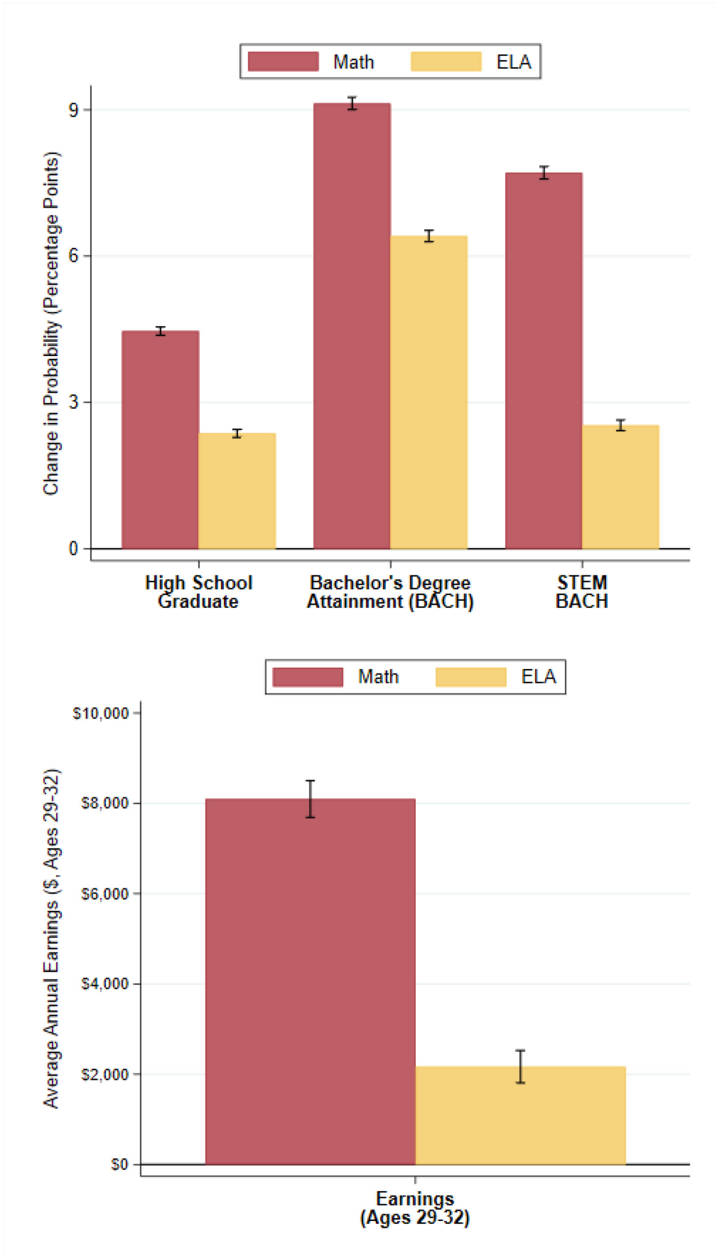
What We Discovered

Key Takeaway #1: Math scores more strongly predict STEM degree attainment and earnings than ELA scores.

Figure 1 highlights how test scores in math and English Language Arts (ELA) relate to students' long-term outcomes. Both subjects are similarly linked to milestones like high school graduation and attaining a bachelor's degree (BACH), with math only slightly stronger. But when it comes to STEM BACH receipt or future earnings, math stands out much more. Holding other test scores and demographic characteristics constant, a one standard deviation difference in math scores across students is associated with $8,100 higher average annual earnings (17 percent) at ages 29-32, compared to about $2,200 (4.5 percent) for ELA.

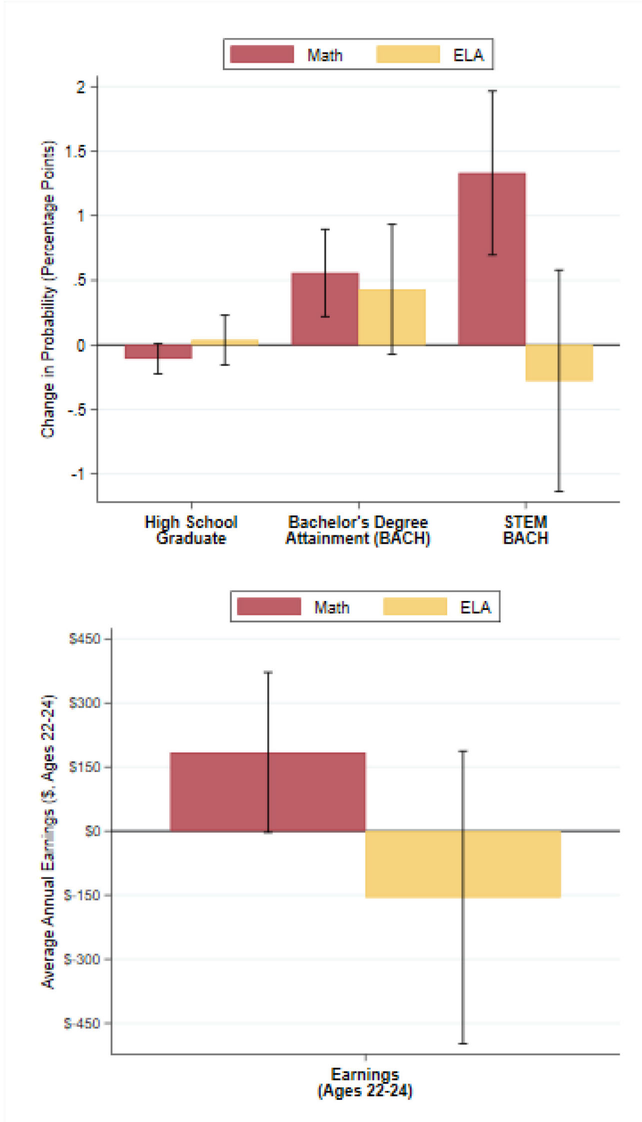
We found similar patterns when examining the effects of more effective teachers in math versus ELA. Figure 2 shows that, holding TVA in the other subject and student demographic characteristics constant, students assigned to a teacher with one standard deviation higher TVA in either subject are about 0.5 percentage points more likely to complete a BACH degree. However, math teacher effectiveness has a larger impact on STEM BACH attainment and early-career earnings. Students assigned to a math teacher with one standard deviation higher TVA are 1.3 percentage points more likely to earn a STEM BACH degree, and their average annual earnings at ages 22-24 are about $180 higher (0.8 percent). In contrast, estimates for ELA teacher effectiveness are negative and not statistically distinguishable from zero for these outcomes.

Figure 1: Relationship Between a One Standard Deviation Increase in Test Scores and Student Outcomes



Notes: Bars show the estimated change in the likelihood of high school graduation, bachelor's degree (BACH) attainment, STEM BACH attainment, and average annual earnings (ages 29-32) associated with a one standard deviation increase in test scores across students, controlling for the other subject score and student demographics. Error bars indicate 95 percent confidence intervals.

Figure 2: Effects of a One Standard Deviation Increase in Teacher Quality on Student Outcomes

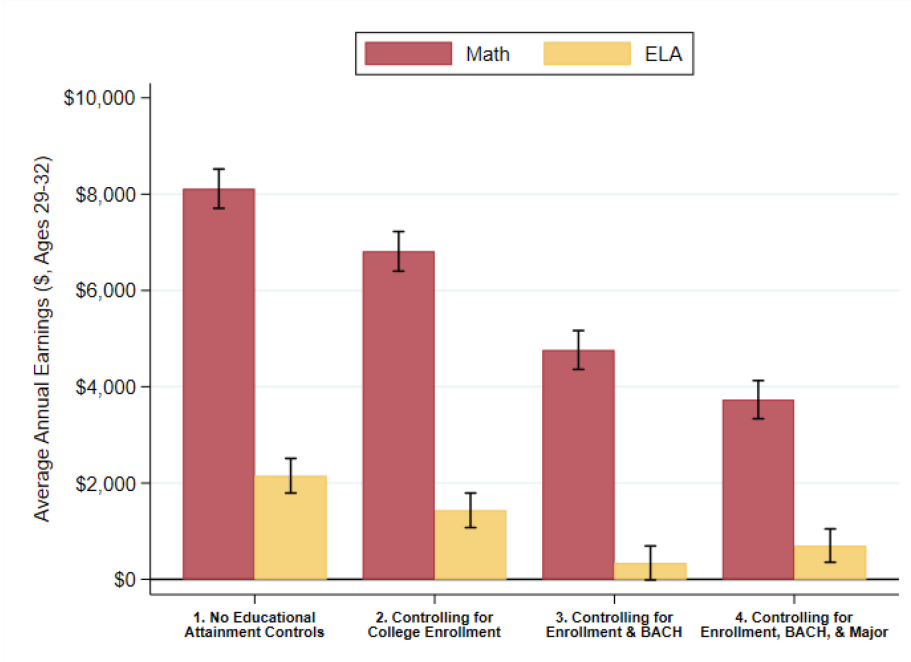


Notes: Bars show the estimated change in the likelihood of high school graduation, bachelor's degree (BACH) attainment, STEM BACH attainment, and average annual earnings (ages 22-24) associated with a one standard deviation increase in teacher value-added (TVA) for test scores, controlling for TVA in the other subject and student demographics. Error bars indicate 95 percent confidence intervals. Estimates for earnings are limited to ages 22-24 due to linked teacher-student data availability beginning in 2013.

Key Takeaway #2: The math score-earnings association remains strong even after controlling for educational attainment.

Next, we examined why test scores are associated with later earnings (Figure 3). The first column reproduces our baseline results from Figure 1, showing that math scores are more strongly associated with earnings than ELA scores.

Figure 3: Test Scores-Earnings Relationship Without and With Controls for Educational Attainment



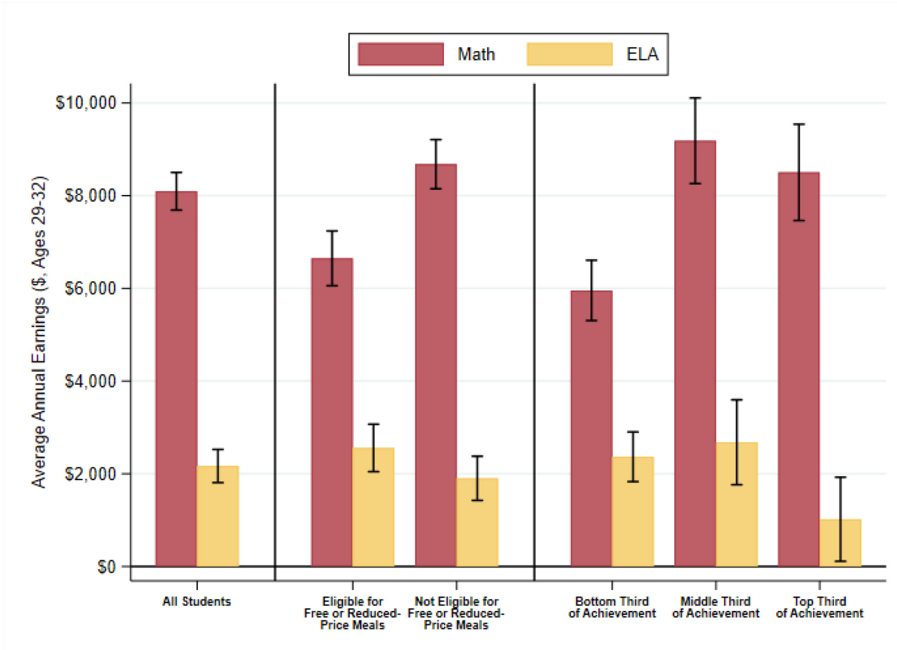
Notes: Bars show the estimated change in average annual earnings (ages 29-32) associated with a one standard deviation increase in test scores, shown without and with controls for educational attainment. Error bars indicate 95 percent confidence intervals.

As we sequentially added controls for educational attainment, the estimates changed. Adding a control for college enrollment modestly reduced both associations. Including BACH degree completion as a control in the model led to a larger decline, especially for ELA. After controlling for enrollment, BACH completion, and BACH major, the math-earnings association remained just under $4,000 (roughly half of the baseline estimate), while the ELA association was substantially smaller.

These patterns suggest that much of the ELA-earnings relationship operates through educational attainment, whereas a substantial portion of the math-earnings relationship remains even after controlling for differences in college enrollment, BACH completion, and BACH major. Although these estimates are descriptive and do not establish causality, they indicate that math achievement is more strongly associated with earnings through channels beyond educational attainment.

Key Takeaway #3: Math scores are more predictive of earnings than ELA scores across all groups, but the strength of these relationships varies by student subgroup.

Figure 4: Relationship Between a One Standard Deviation Increase in Test Scores and Earnings by Subgroup



Notes: Bars show the estimated change in average annual earnings (ages 29-32) associated with a one standard deviation increase in test scores by Free and Reduced-Price Meals (FARMS) status and thirds of the achievement distribution. Error bars indicate 95 percent confidence intervals.

Figure 4 shows how the test scores-earnings association differs by Free and Reduced-Price Meals (FARMS) status and relative student achievement. [2] The statistical model mirrors our main specification, controlling for the other subject test score and demographic characteristics, but excluding the educational attainment controls used in Figure 3. The first column reproduces our baseline results for all students, while subsequent columns show estimates by subgroup.

Although math scores are more strongly associated with higher earnings than ELA scores for all groups, the math-earnings relationship is weaker for FARMS students and for students in the bottom third of the achievement distribution. For these groups, ELA scores have a relatively stronger association with higher earnings compared with non-FARMS students and students in the top third of the achievement distribution.

The differences are particularly pronounced across achievement levels. A one standard deviation higher math score is associated with about $6,000 higher average annual earnings (ages 29-32) for students in the bottom third of the achievement distribution, compared with

[2] Achievement subgroups are defined by averaging students' standardized math and ELA scores and classifying students into the bottom, middle, and top thirds of the resulting achievement distribution.

roughly $8,500 for students in the top third. In contrast, ELA scores are more strongly associated with higher earnings among lower-achieving students ($2,400) than among higher-achieving students ($1,000).

A similar pattern emerges by FARMS status. The math-earnings association is smaller for FARMS students ($6,600) than for non-FARMS students ($8,700), while the ELA-earnings association is modestly larger for FARMS students ($2,600) than for non-FARMS students ($1,900).

Policy and Practice Implications

Implication #1: Prioritize math skill development.

Math scores strongly predict STEM degree attainment and adult earnings, both directly and through educational attainment. Research suggests that strengthening math skills in K-12 can yield long-term benefits for both students and the broader economy.[2] A workforce with strong math and STEM competencies is critical for innovation, technological advancement, and competitiveness in an AI-driven future.[3] Evidence suggests that policies focused on raising minimum math requirements,[4] expanding access to rigorous coursework,[5] and providing intensive tutoring interventions can boost math learning[6] and prepare students to succeed in high-demand, innovation-focused sectors.

Implication #2: Tailor support for disadvantaged and lower-achieving students.

The link between math scores and earnings is weaker for FARMS and lower-achieving students, while the ELA-earnings link is relatively stronger for these groups. This indicates that a one-size-fits-all approach may miss key equity gaps. Research shows that interventions should combine supports in math and ELA and include differentiated instruction and tutoring.[7] Additional scaffolding may be needed to ensure that math gains translate into earnings gains. Recognizing these differences can help inform the design of policies that promote both educational and economic equity.

Implication #3: Leverage teacher quality strategically.

Teacher effectiveness in math causally affects STEM attainment and earnings, highlighting the long-term impact of high-quality instruction. Teacher shortages are often more severe in math and STEM subjects, particularly in high-poverty schools,[8] underscoring the need to recruit, develop, and retain effective teachers in these areas.[9] Efforts may include incentives to teach in high-need schools[10] and professional development focused on frequent teacher feedback and data-driven instruction.[11] Focusing resources on subjects and teachers with the largest impact can maximize educational investments and improve students' long-term outcomes.

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How to Cite this Brief

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