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RESEARCH BRIEF

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How High School Computer Science Courses Affect College Majors and Early-Career Earnings

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Key Takeaways:

- The benefits of high-quality computer science (CS) coursework in Maryland high schools occur through *exposure* (being enrolled in a school where these courses are offered) as well as *course taking* (actually taking the courses).
- Exposure improves early-career labor market outcomes.
- CS course taking is lower among underrepresented students.
- Course taking raises CS Bachelor's degree receipt.
- Effects on CS Bachelor's degree receipt and earnings are similar or larger for students historically underrepresented in CS.

What We Studied

In response to rising demand for technology skills, many states are expanding K-12 computer science (CS) course offerings. Thirty states have adopted "CS for All" policies, which require all high schools to offer CS coursework, while eight require all students to take CS prior to high school graduation.

Maryland has rapidly expanded CS course offerings over the last decade. A 2018 law further requires all Maryland high schools to offer at least one "high-quality" CS course aligned with rigorous K-12 CS standards, including foundational courses such as Computer Science Essentials, Advanced Placement (AP) courses such as AP Computer Science Principles, and specialized programming courses.

Using rich longitudinal data from the Maryland Longitudinal Data System (MLDS) Center, we present the first causal evidence on how access to "high-quality" CS courses affects high school CS course-taking, college major choice, and early-career earnings.

How We Analyzed the Data

First, we looked at "exposure" to CS courses, defined as being enrolled in a Maryland high school when the school first offered CS courses. To do this, we examined the effects of the Maryland law that requires all Maryland high schools to offer at least one "high-quality" CS course by examining the effects of the availability of high-quality CS courses on all students in the school – not just those who took those courses. We estimated the effect on workforce outcomes: employment (i.e., visibility in the Maryland workforce) and earnings. Due to data limitations, we were unable to examine the effect of exposure to CS courses on college outcomes.

Second, we looked at "course taking," defined as being enrolled in a high-quality CS course. We looked at course-taking overall and by subgroup, and we were able to look at the effects of course taking on college outcomes.

Our research design exploits the fact that Maryland high schools adopted CS courses at different points in time. We compared cohorts of students exposed to CS to cohorts of students from the same high school that were not exposed to CS. To address concerns about students selectively sorting into high schools based on CS course offering, we leveraged quasi-random variation driven by *unexpected exposure* to CS. We compared students concurrently enrolled in high school when CS was first offered (unexpectedly exposed) to students who enrolled in high school before CS was offered (unexposed). Students who enrolled in high school after CS was offered were excluded from the analysis to mitigate concerns about sorting. Focusing on unexpected exposure enabled us to estimate causal impacts of both CS course offering and course-taking.

What We Discovered: Exposure to CS Courses

Exposure to CS courses improves early-career labor market outcomes.

Figure 1. Average effects of CS exposure on employment and earnings.

We found positive average impacts on employment and earnings at age 24. High schools offering CS courses raised students' likelihood of being employed by 2.6 percentage points and annual earnings by about 8% (see Figure 1). This is the average effect on all students in the school where CS courses were offered, not just those enrolled in CS courses.

Effects of exposure on earnings are similar or larger for students historically underrepresented in computer science.

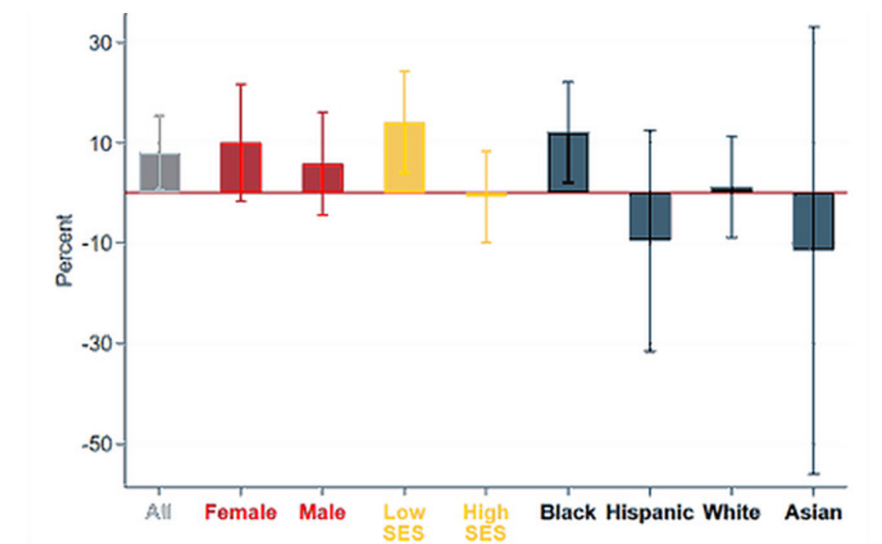

Figure 2. Effects of CS exposure on earnings, overall and by subgroup.

Digging deeper into those average effects, we found that effects were not necessarily the same for all groups (i.e., there is heterogeneity of effects). High schools offering CS coursework increased earnings at age 24 by 10 to 14% for students who are female, lower socioeconomic status (SES) (low SES), or Black. The benefits for these students are somewhat larger than the average effect of 8%.

What We Discovered: CS Course Taking

Computer science course taking is lower among underrepresented students.

Not all students ended up enrolling in the CS class when offered. On average, high schools offering CS courses raised the chance of students taking a CS course by about six percentage points for all students (see the gray bar in Figure 3). However, we found substantial differences by student demographic group in their likelihood of taking a CS course when their high school offered it, though we do not have enough power to say whether these differences between groups are more than random variation. Schools that offered CS courses increased CS course taking for Black and White students at similar rates while effects for Hispanic students were much smaller and effects for Asian students were much larger (see the black bars in Figure 3). Course taking increased slightly more for males and slightly less for females (see the red bars in Figure 3).

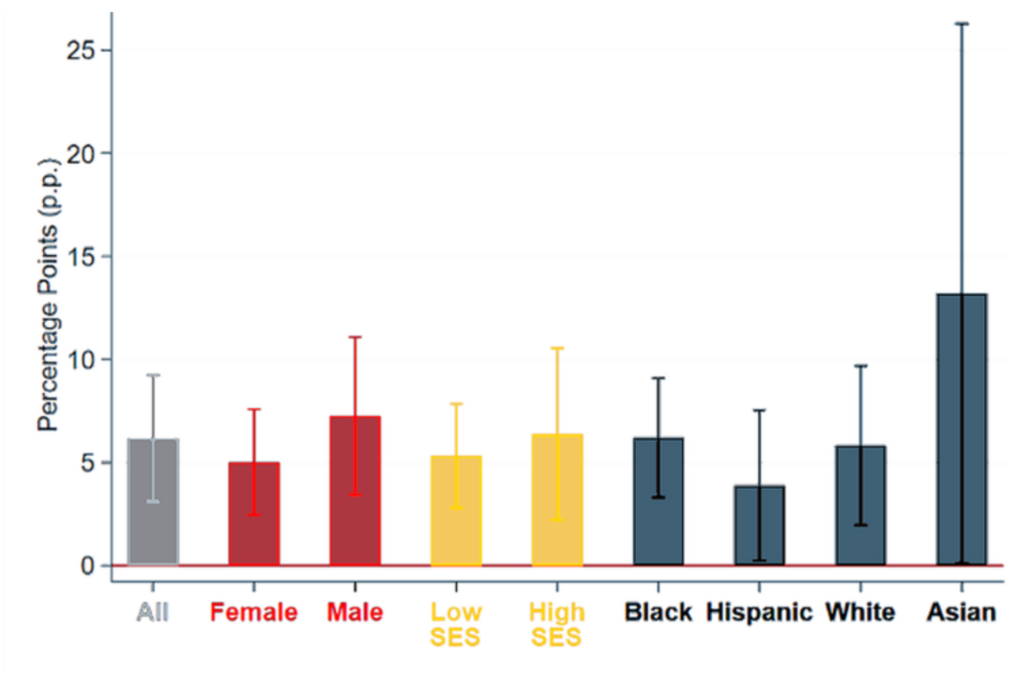

Figure 3. Effects of CS course offering on CS course taking, overall and by subgroup.

Taking a CS course raises computer science bachelor's degree receipt.

Taking a high school CS course led to a 5-percentage point increase, on average, in students' likelihood of earning a bachelor's degree in CS. Negative effects for other STEM fields, social sciences, and humanities suggest students may be switching from these fields to CS.

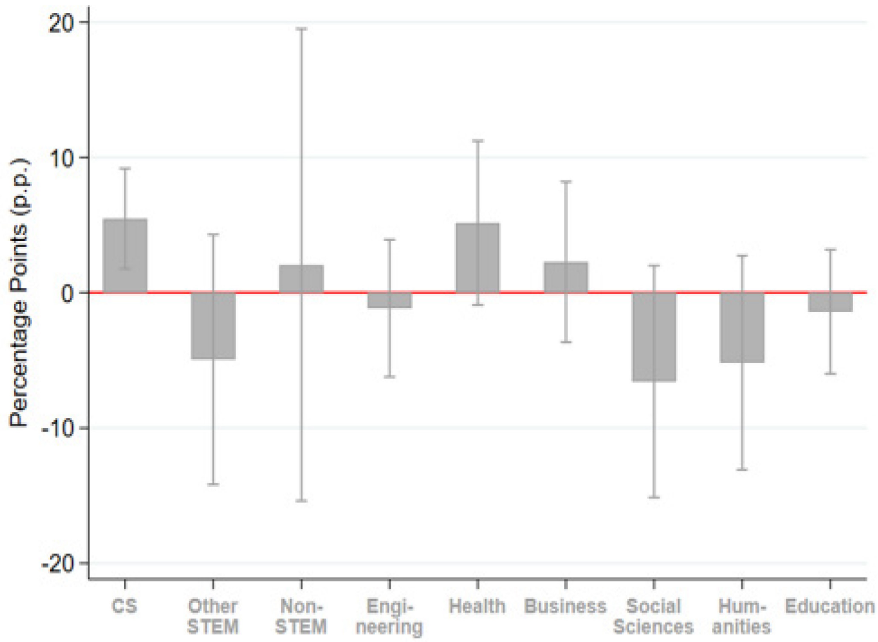

Figure 4. Effects of CS course taking on bachelor's degree receipt by field.

Effects of CS course taking on computer science bachelor's degree receipt were similar or larger for students historically underrepresented in computer science.

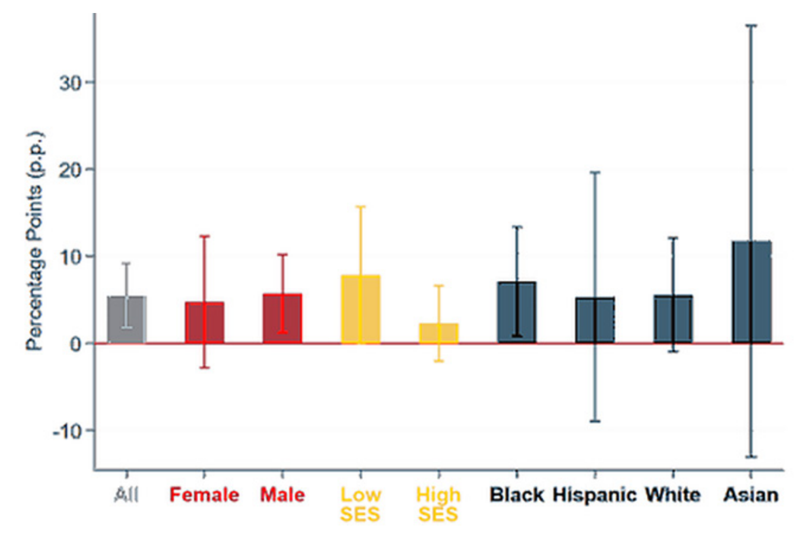

Figure 5. Effects of CS course taking on bachelor's degree receipt, overall and by subgroup.

High school CS course-taking had similar or larger effects for females, students from lower socioeconomic status (SES) backgrounds, and Black students relative to peer groups historically better represented in CS fields. Taking a CS course raised CS bachelor's receipt by nearly 8 percentage points for low-SES students and by 7 percentage points for Black students.

Together, these findings suggest that exposing students to CS coursework in high school could increase the supply of CS degree recipients and professionals in the labor market, particularly for historically underrepresented groups.

Policy and Practice Implications

Maryland's "Computer Science for All" policy is a promising approach.

The positive effects of CS course-taking—particularly for females, low-SES students, and Black students—are reasons for optimism about "CS for All" policies' potential to boost the supply of CS degree recipients and improve students' labor market outcomes. Other research has found that taking advanced secondary science coursework raises STEM degree receipt for male students by 6 percentage points[1] while taking advanced secondary mathematics coursework raises engineering degree receipt by 9 percentage points and earnings by almost 30% for females[2]. Thus, policies that expand high school STEM offerings can increase degree receipt in related fields, but how these policies are implemented plays a critical role in determining who takes courses and who benefits from course take-up.

Policymakers should focus on boosting computer science course participation for students who have been historically underrepresented in related fields.

Universal access to CS coursework is unlikely to eliminate demographic gaps in CS course participation because there is substantial variation in CS course taking across groups within schools. Our study found lower impact of CS course offerings on CS course taking for females relative to males. Similarly, prior research shows that female students in California are much less likely to take CS despite having similar access relative to male peers.[3] Similar patterns hold in national data, which show male students are more than twice as likely to take CS courses compared to females.

Maryland and other states may consider a few policies to eliminate gaps in CS participation. First, states could follow the lead of those that have adopted CS high school graduation requirements—South Carolina and Arkansas have graduation requirements and are much closer to having a representative share of females take CS. CS graduation requirements may show success similar to that demonstrated by high school math requirements, which increased Black students' completed math coursework and earnings.[4] The effect of CS graduation requirements is thus a fruitful area for future research.

Second, Maryland and other states should consider offering rigorous foundational CS courses and provide exposure to CS in elementary and middle school. More evidence is needed about the effects of different CS course types and whether early exposure to CS can boost CS participation in high school and college.

Third, Maryland and other states may consider offering financial incentives for students and teachers to increase CS participation and performance. Prior research has shown that providing financial incentives for passing scores on AP exams increases attainment and earnings, particularly for Hispanic students.[5]

Rapid expansion of computer science courses raises questions about capacity to fulfill new requirements.

The number of states requiring all high schools to offer CS coursework has increased from four in 2017 to thirty in 2023.[6] This rapid growth raises concerns about whether schools are prepared to implement new CS requirements and whether there is an adequate supply of teachers to meet growing demands for CS courses. Researchers should explore how schools are implementing new CS requirements and training CS teachers. To ensure students have access to effective CS instruction, states may also allocate funding to expand CS certification pathways. Offering professional development on CS content and pedagogy is another critical step to promote impactful CS instruction.

Additional Resources

Read the full paper, "Computer Science for All? The Impact of High School Computer Science Courses on College Majors and Earnings," located at EdWorkingPapers: https://edworkingpapers.com/sites/default/files/ai24-904.pdf.

A companion blog post published by the Brookings Brown Center Chalkboard can be found here: https://www.brookings.edu/articles/high-school-computer-science-impacts-colleg-majors-and-increases-earnings.

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How to Cite This Brief

Liu, J., Conrad, C., & Blazar, D. (2025). *How high school computer science courses affect college majors and early-career earnings.* Maryland Longitudinal Data System Center. https://mldscenter.maryland.gov/ResearchReports.html

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