The Impact of Computational Thinking on Louisiana Students' STEM Outcomes

Findings from an Education Innovation and Research Early-Phase Grant

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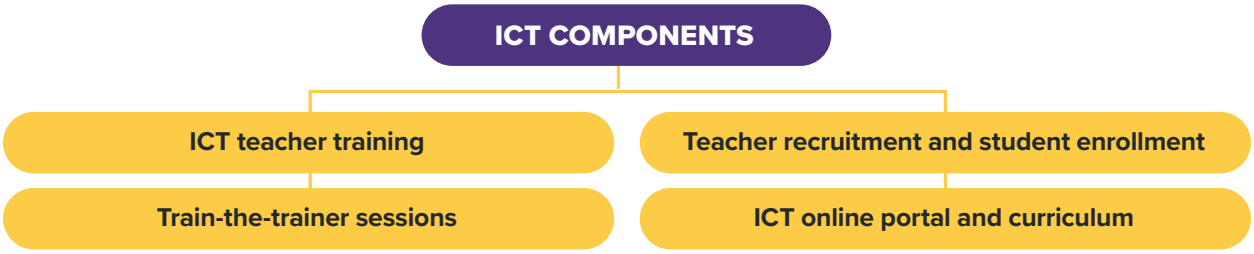
Introduction and Description of Intervention

Computational thinking encompasses proficiencies in computer science and general problem-solving and can support students' learning across subject areas and success in science, technology, engineering, and mathematics (STEM) education and career pathways. Louisiana State University received a federal Education Innovation and Research grant to develop and implement the Introduction to Computational Thinking (ICT) course. From fall 2020 through spring 2024, Education Northwest evaluated the implementation and impact of the ICT course across the East Baton Rouge Parish School System and high-need urban and rural high schools in Louisiana.

INTERVENTION

ICT is a yearlong course for students in grades 9 or 10 that develops students' problem-solving, programming, and mathematics skills, as well as prerequisite math skills that students don't always master in middle school. In pursuit of equity in computer science education, ICT is intentionally offered to schools with large percentages of students from low-income families and students of color. ICT has four key components:



Research Questions

What is the effect of enrolling in the ICT course on students' math and computer science achievement compared to students who do not enroll in ICT? Specifically, what is the effect on:

- **Scores on the Louisiana Algebra I and geometry state assessments**
- **Earning high school credit in Algebra II or higher math courses**
- **Earning high school credit in college-level math or computer science courses**

Evaluation Design

The treatment group consists of students in grades 9 and 10 who took ICT concurrently with Algebra I. The comparison group consists of students in grades 9 and 10 in the same schools who took Algebra I but not ICT. A student's cohort year is defined by the school year in which they took ICT concurrently with Algebra I or took Algebra I alone. The impact evaluation includes four cohorts of students in 2020–21, 2021–22, 2022–23 and 2023–24.

▲ *Comparison* ■ *Treatment*

Figure 1. Analytical sample in each condition by outcome

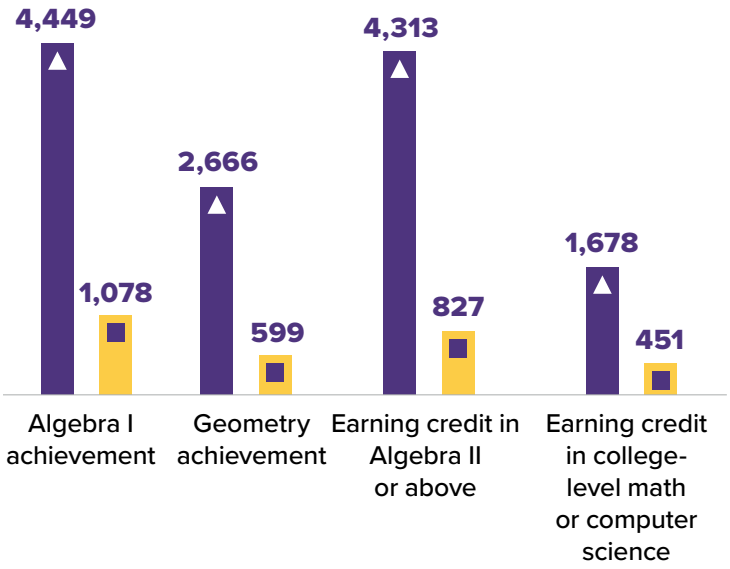
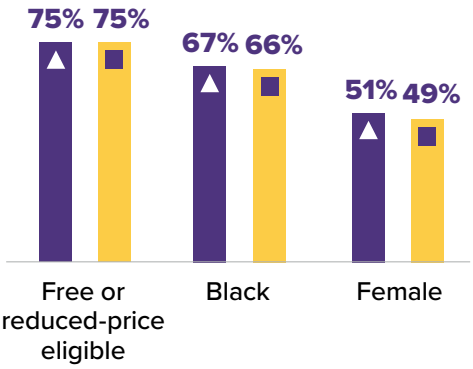
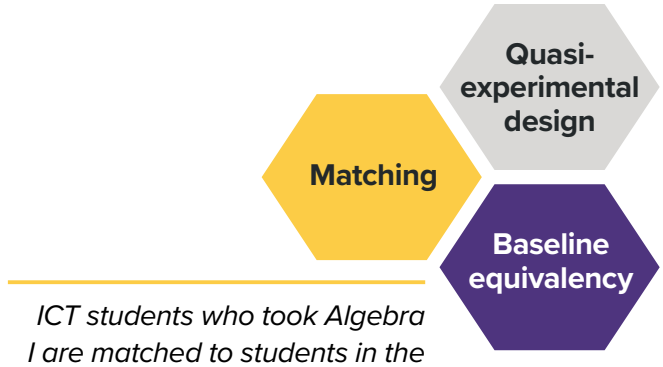


Figure 2. Student characteristics of analytical sample for outcome of Algebra I achievement on state assessment



DESIGN



Evaluation designed to meet What Works Clearinghouse standards with reservations

ICT students who took Algebra I are matched to students in the same school and grade who took Algebra I but did not take ICT

Established on socioeconomic status and baseline (grade 7 or 8) math state assessment scores

Program Effect

To assess program effects, we used a statistical approach that allowed us to compare similar groups of Algebra I-ready students within a high school while adjusting for differences between students who took ICT and those who did not. This method helped us better isolate the effect of ICT on student outcomes.

Table 1 presents the impact of ICT on the outcomes. In our analysis, we also accounted for grade level, gender, race and ethnicity, cohort, English learner status, special education status, and baseline middle school math scores.

Table 1. Regression results for examining the impact of ICT on outcomes

	Algebra I achievement on state assessment	Geometry achievement on state assessment	Earning credit in Algebra II or above	Earning credit in college-level math or computer science
Treatment	3.8* (1.8)	2.4 (1.5)	0.1*** (0.02)	0.002 (0.01)
Model N	5,527	3,265	5,160	2,129

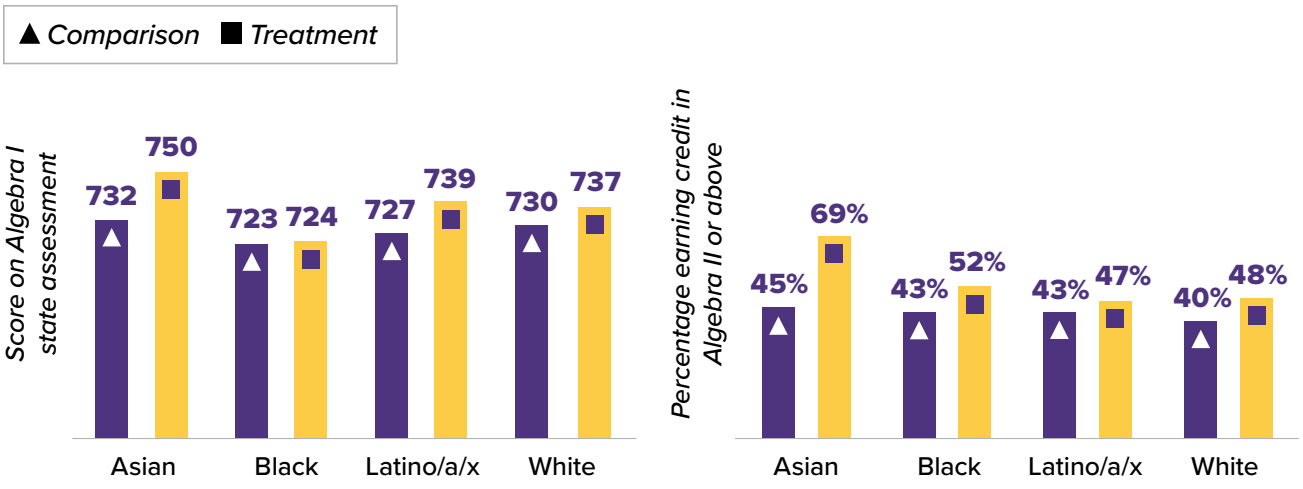
*** $p < 0.001$, * $p < 0.05$

Notes: Models use propensity score weighting. Regression results for the outcomes of earning credit in Algebra II or above and earning outcome in college-level math or computer science are presented as percentage points. Robust standard errors are shown in parentheses. Geometry and earning credit in Algebra II or above outcomes include students from the 2020–21, 2021–22, and 2022–23 cohorts. Earning credit in college-level math or computer science includes students from the 2020–21 and 2021–22 cohorts.

Source: Education Northwest

PROGRAM EFFECTS BY RACE/ETHNICITY

ICT's positive effect on algebra achievement varied by students' racial/ethnic identity. ICT helped improve algebra test score achievement more for Asian, White, and Latino/a/x students than for Black students. ICT also had a stronger effect on earning credit in Algebra II or above for Asian students compared to other student groups.



These figures show predicted outcomes from propensity score-weighted regression analyses.

Conclusion

Our analysis demonstrates:

Students who enrolled in ICT scored 3.8 points higher on the Algebra I state assessment than similar students who did not enroll in ICT. ***This finding is statistically significant.***

Students who enrolled in ICT were 10 percentage points more likely to earn credit in Algebra II or higher math courses than similar students who did not enroll in ICT. ***This finding is statistically significant.***

Students who enrolled in ICT scored higher on the geometry state assessment and were more likely to earn high school credit in college-level math or computer science than similar students who did not enroll in ICT. ***This finding is not statistically significant.***

Next Steps

Define adequate fidelity of implementation for ICT and identify which components of ICT have the greatest impact on students' math achievement and STEM outcomes

Better understand how ICT affects different groups of students and consider changes to the course design and delivery to ensure all students benefit equally from ICT

Scale and evaluate ICT through partnership between educators, researchers, and district leaders to support all students' computational thinking and broader STEM outcomes

FOR MORE INFORMATION

See the full evaluation report here: https://educationnorthwest.org/publications/impact-computational-thinking-louisiana-students-stem-outcomes

The ICT curriculum in this study is hosted at www.brbytes.org.

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