

Intensive Math Instruction and Educational Attainment: Long-Run Impacts of Double-Dose Algebra

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Itau Conference

Note: This research was funded by IES award R305A120466.



Motivation

Why do large numbers of students fail to finish high school?

- One potential explanation is poor academic preparation.

Low skills may explain high failure rates in 9th grade coursework.

- Particularly in algebra and other math classes.

Students who fail courses early are very likely to drop out of school.

- Early failures stop students from taking advanced coursework and from earning credits needed to graduate.

In Chicago (CPS), half of 9th graders fail at least one course.

- The highest failure rates were in math.

Double-Dose Algebra and Instructional Time

CPS' use of remedial math classes in middle school had failed.

- Common pattern: having students repeat lower level classes does not lead to later success.

CPS implemented a “double-dose” algebra policy starting fall of 2003.

- In 8th grade, students took a math test.
- Students scoring below the 50th percentile were then assigned in 9th grade to two periods of algebra instead of one.
- A regular algebra class plus an algebra support class.

Instructional time in algebra doubled.

Peers and Teaching Also Changed

This intervention did not just increase instructional time.

Peers changed

CPS told schools that the two periods should be consecutive, with the same teacher and same classmates.

Double-dosed students were in class with other double-dosed students.

More segregation of students by academic skill (tracking).

Teaching changed

Double-dose algebra teachers were given specific curricula, lesson plans, and professional development workshops.

Double-dosed students reported more frequently writing about and verbally discussing math problems.

Summary of The Intervention

Potentially positive: Double-dosed students had

- Twice as much math instructional time (90 vs. 45 minutes)
- Teachers with additional training and focus on verbal work
- Classmates with more homogeneous math skills

Potentially negative: Double-dosed students had

- Classmates with lower average math skills
- Fewer classes in art, music, foreign language, vocational ed.

Not clear ahead of time if intervention would be effective.

The Impact of Double-Dose Algebra

How to measure impact of this intervention?

Great data from CPS tracks students for nearly a decade after they finish 8th grade (in 2003 and 2004).

- demographic information
- detailed high school transcripts
- standardized test scores
- high school graduation status
- college enrollment status

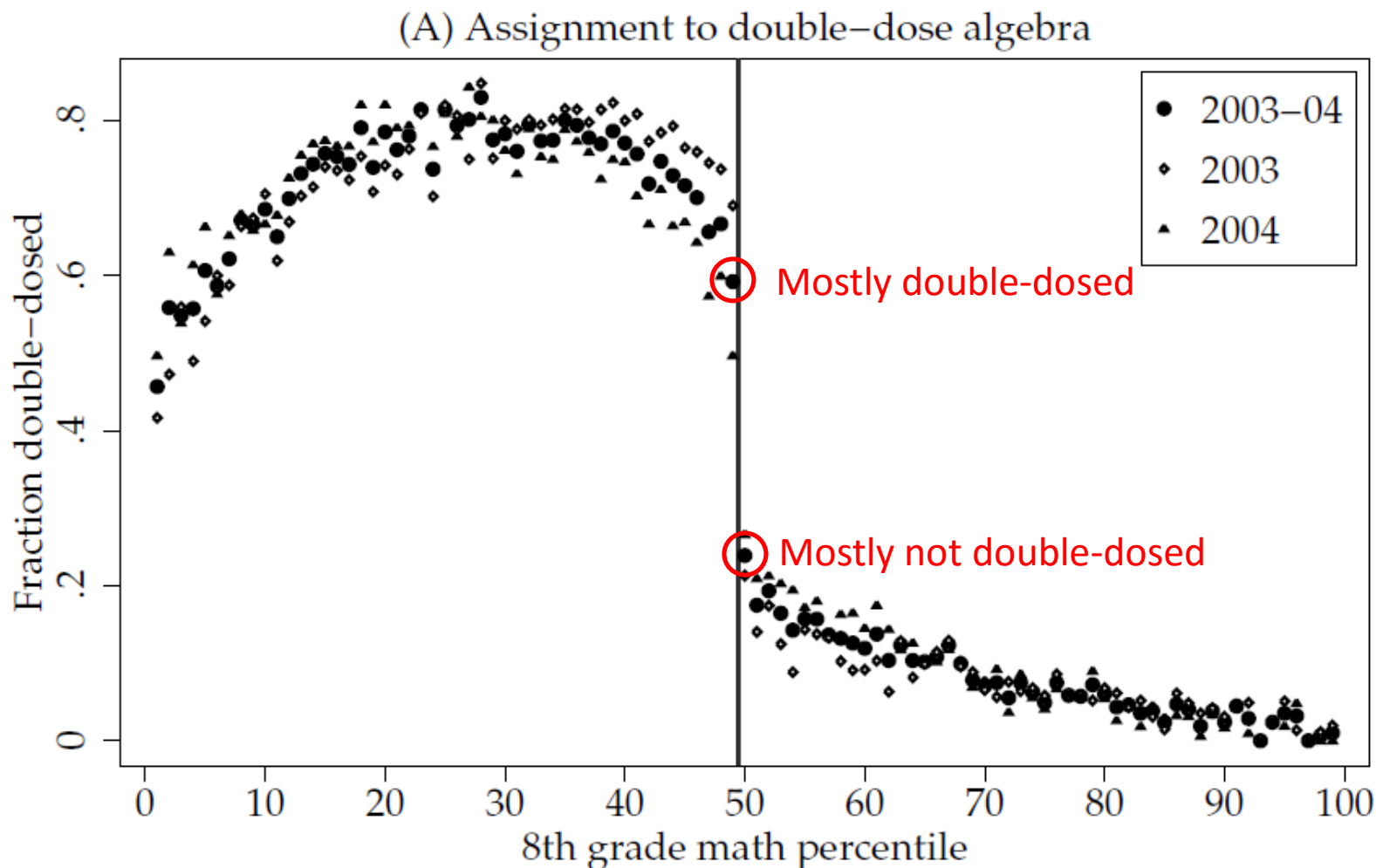
To estimate impact of policy, we can't just compare double-dosed students to others because of big differences in academic skills.

We compare students on either side of the 8th grade test score threshold who are quite similar except for differences in double-dose algebra.

Comparing Similar Students

49th %ile students more likely to be double-dosed than 50th %ile students

Other than double-dosing, those students are similar in all other ways.



Course Grades and Test Scores

9th grade algebra grades improved

Fraction earning a B or better rises (11 percentage points)

Fraction passing rises (8 percentage points)

Grades in other courses do not suffer

10th grade geometry grades improved

Fraction passing rises (11 percentage points)

Partly because of higher rate of taking geometry

Earn more credits overall in 10th grade

Not much clear impact on 11th / 12th grade coursework

Small improvement in test scores (0.1 sd)

Impacts are particularly strong for those with low reading skills

Not much other heterogeneity (gender, race, income)

Educational Attainment

Fraction of students graduating high school increases

10 percentage point increase

Driven entirely by impact on low-skilled readers

Fraction of students enrolling in college increases

8 percentage point increase

Largely from part-time enrollment in two-year colleges

Comes from both low- and high-skilled readers

Data ended too soon to measure college completion.

Math Interventions

Double-dose algebra in 9th grade improved course performance, test scores and, most importantly, educational attainment.

Not true of all math interventions.

Miami, FL tried a **middle school double-dose math** policy.

- Raised test scores but had no visible long-run impacts.

Some states and districts have tried **universal algebra**.

- Often lowers achievement when struggling students fail.

Wake County, NC is trying **targeted acceleration** in middle school.

- Raised test scores but had no visible long-run impacts.

Policy Lessons

Instructional time increases should be coupled with training.

Double-dose teachers were trained about how to use extra time.

More time with low quality instruction makes little difference.

Interventions should carefully target students based on their skills.

Double-dose algebra helped students with mediocre math skills but low reading skills.

It did not help those with very low math skills.

Interventions should target critical points in educational pathways.

Ninth grade algebra was known to have high failure rates.

Test scores are not the only measure of success.