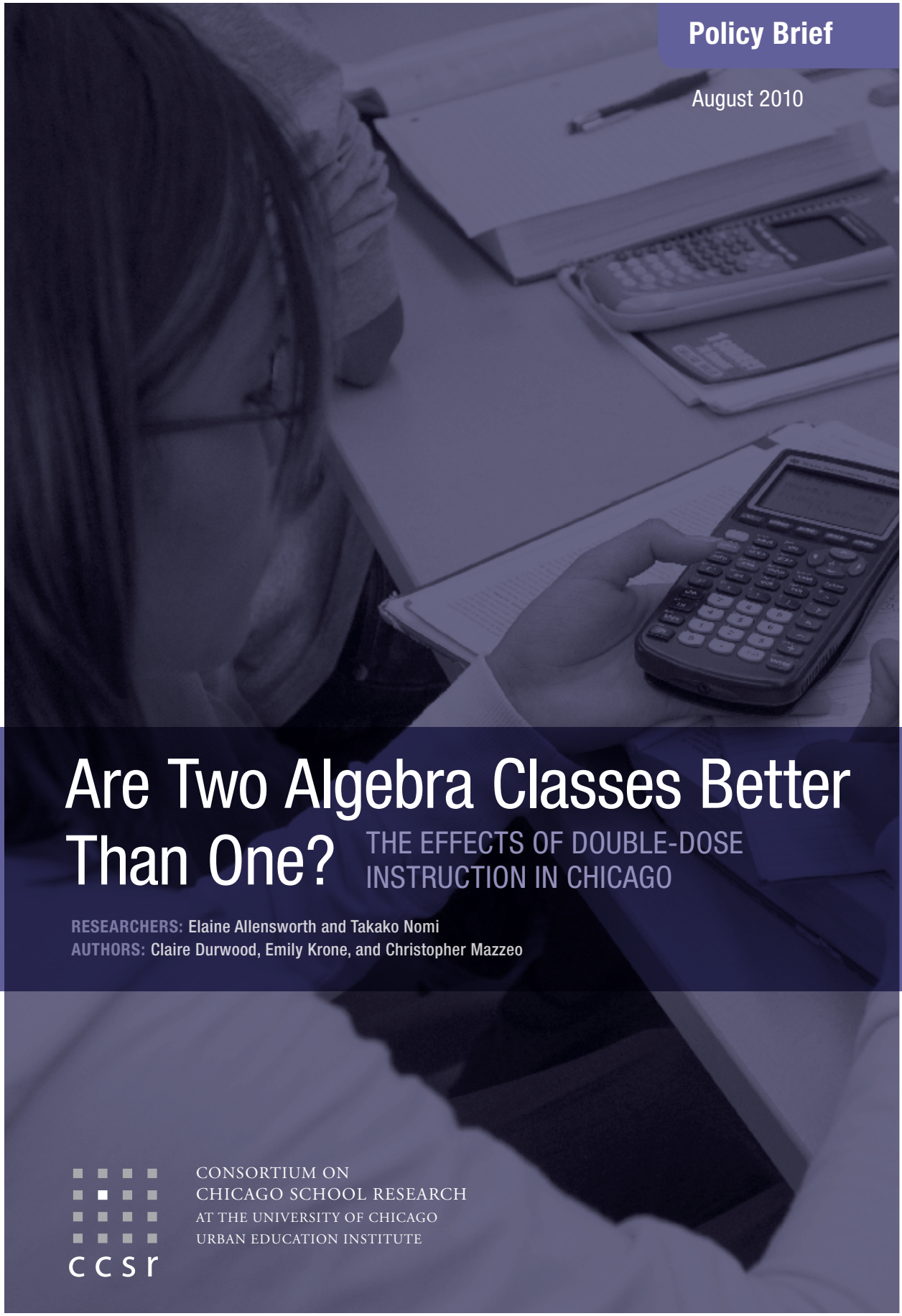

Policy Brief

August 2010

Are Two Algebra Classes Better Than One?

THE EFFECTS OF DOUBLE-DOSE INSTRUCTION IN CHICAGO

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CONSORTIUM ON
CHICAGO SCHOOL RESEARCH
AT THE UNIVERSITY OF CHICAGO
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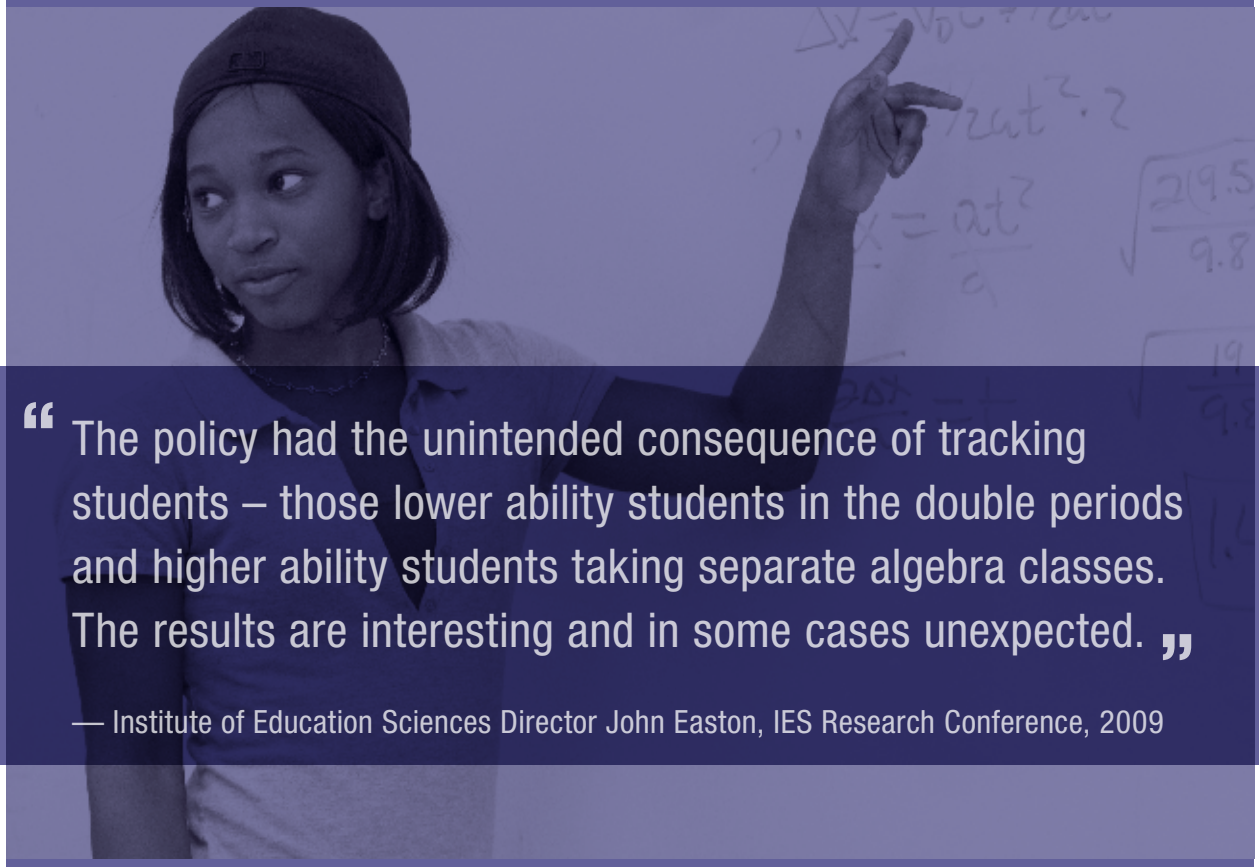


> “The policy had the unintended consequence of tracking students – those lower ability students in the double periods and higher ability students taking separate algebra classes. The results are interesting and in some cases unexpected.”
>
> — Institute of Education Sciences Director John Easton, IES Research Conference, 2009

Summary

A diverse set of reformers and policymakers argue that growing numbers of students are leaving high school lacking the math skills necessary to succeed in college and careers. Consequently, states and districts have sought to increase the rigor of math coursework both in the middle grades and in high school. Despite these efforts, many students are still entering high school unprepared for Algebra I, the gateway course for more advanced math. In response to the problem of weak math preparation, districts and schools around the country are developing curricular supports for struggling high school students. "Double-dose" algebra—in which less-skilled students take two periods of algebra in one year—is one such support strategy that is growing in popularity.

In 2003, Chicago Public Schools (CPS) became an early adopter of the double-dose algebra strategy, requiring all ninth-graders with low entering test scores to take two periods of algebra. To inform double-dose efforts in Chicago and nationally, researchers at the Consortium on Chicago School Research (CCSR) at the University of Chicago have spent the last two-and-a-half years studying the implementation of the double-dose algebra policy in Chicago. They found that the double-dose algebra strategy, when accompanied by additional supports for teachers, has significant promise for improving the academic skills of all students. One reason for this impact is that Chicago's double-dose policy was accompanied unintentionally by a form of ability grouping, as schools split students into different algebra classes based on their incoming skills. This ability grouping seemed to benefit all students: lower-skilled students gained from the extra instructional time and teacher support in the double-dose classes, while higher-skilled students benefited from stronger classroom environments with less time spent on in-class remediation.

Yet, while Chicago's double-dose policy improved students' math test scores, it also led to higher failure rates and lower grades among students enrolled in regular single-period algebra courses. This is a substantial concern because grades and course failures are strong predictors of important outcomes like high school and college graduation. Thus, even successful reform efforts like double-dose algebra may not lead to sustained improvements in later student outcomes without a set of complementary efforts to improve students' effort and grades. Furthermore,

Double-Dose Algebra

The strategy of requiring lower-skilled math students to take twice as much algebra as higher-skilled students

students with the weakest entering skills, most of whom were receiving special education services, benefited least from the double-dose policy.

The Need for Double-Dose Instruction in Algebra

Nationwide there is growing concern about Americans' mathematical literacy.[1] As economic conditions shift within the United States, schools have come under increasing criticism for insufficiently preparing students for the rigorous demands of college math courses and careers requiring high-level math skills.[2] In 2009, only 34 percent of eighth-graders scored at or above proficient levels in math on the National Assessment of Educational Progress (NAEP).[3] Additionally, more than one-quarter of college freshmen must take remedial math courses because they lack sufficient knowledge to enroll in college-level math courses.[4] Clearly there is a gap between the math skills students gain in high school and the requirements they face once they leave.

Across the country, states are responding to the need to equip young adults with higher-level math skills. By 2010, 20 states and the District of Columbia had adopted college- and career-ready graduation requirements. These requirements include four years of "challenging" mathematics, defined as content that, at a minimum, reaches the level of that which is typically taught in Algebra II courses.[5] This more rigorous coursework begins with Algebra I, the "gatekeeper course," which students must pass to continue taking subsequent advanced math courses.[6]

However, as states and districts raise standards in high school, many have voiced concerns that this will increase course failures and dropouts.[7] Particularly in urban schools, many students already begin ninth grade lacking a mastery of the skills necessary to successfully complete higher-level math coursework. In America's largest urban public school districts, 55 percent of freshmen are performing below grade level in math when they enter high school.[8]

Requiring all students to take rigorous classes also poses a new challenge for teachers. High school math teachers may be unprepared to teach classes in which students have a wide range of skills. Teachers must strive

BY THE NUMBERS

34%

of eighth-graders nationwide scored at or above proficient in math on the 2009 National Assessment of Educational Progress.

Source: U.S. Department of Education (2009).

1 U.S. Department of Education (2008).
2 Brown (2009).
3 U.S. Department of Education (2009).
4 Parsad and Greene (2003).
5 Achieve, Inc. (2010).
6 Paul (2005).
7 Grubb and Oakes (2007); Perna and Thomas (2008).
8 Council of the Great City Schools (2009).

Double-Dose in Practice Elsewhere

Schools and districts in a number of states employ double-dose instruction as a student support strategy, and some have seen higher test scores among students who take it. Some schools offer one instructional period followed by a second "shadow" or "support" period, while others utilize block scheduling that changes the length of one class to two periods.[9] For example, in Maryland more than half of all high schools offer extended instruction time or double-dose class periods to ninth-graders,[10] and a study of students in Baltimore reported that those in double-dose classes scored a half year higher on standardized tests.[11] Many Catholic schools have traditionally enrolled struggling students in two periods of a subject when they seem unprepared for high school curriculum, and their test scores have been higher than those of public schools.[12]

Another example of double-dose instruction occurs within the Talent Development High School Model, a comprehensive reform model being implemented in 15 states and the District of Columbia. The model high schools offer double-dose instruction as one of several supports that have produced positive effects on student achievement in Baltimore and Philadelphia.[13] Surveys revealed that 75 percent of students in Talent Development High Schools felt they understood math better because of their specific class, compared with 53 percent of students in other schools with similar characteristics. A 2005 study found students in Talent Development schools showed improved attendance rates, course completion, and promotion rates; however, evaluations of Talent Development schools have not examined the effectiveness of the double-dose strategy on its own without the other instructional supports.

9 Chait et al. (2007).

10 Legters and Kerr (2001).

11 Balfanz et al. (2004).

12 Bryk et al. (1993).

13 Balfanz et al. (2004).

FACT:

Nearly half of large urban districts report double-period math instruction as the most common form of support for students with lower skills.

Source: Council of the Great City Schools (2009).

to engage all students and to meet the needs of both higher- and lower-skill students, but instruction often focuses on those in the middle.[14] Thus, educators face a dilemma. How can schools respond to the call to equip all students with the math skills required in college and the workforce when students are working at widely varying skill levels?

Offering extended instructional time in algebra, or double-dose instruction, offers one potential solution to this dilemma and has become an increasingly popular approach for supporting students in high school math. Nearly half of large urban districts report double-period math instruction as the most common form of support for students with lower skills.[15] Yet, despite the popularity of the double-dose strategy, there has been little research on the implementation of these reforms, or on their effectiveness. This policy brief summarizes the key findings from CCSR' s study of a double-dose algebra policy in Chicago and highlights implications for schools, districts, and policymakers.

The Double-Dose Policy in Chicago

In 1997, CPS decided that all students should complete a college-preparatory curriculum: in math, students were required to enroll in Algebra I in ninth grade, followed by geometry and Algebra II in the subsequent two years. However, many Chicago students entered high school with math skills well below grade level, and failure rates in ninth-grade algebra were high—nearly one-quarter of ninth-graders failed their first year of algebra.[16] In response to those high failure rates, a double-period algebra policy was developed to improve algebra passing rates.

The double-dose support strategy provided low-skill students with twice as much algebra instruction as they would have received otherwise. First-time ninth-grade students who tested below the national median on the eighth-grade math test enrolled in two periods of algebra coursework—a regular algebra class and an additional algebra support class, for a full academic year. In addition, teachers of double-dose classes were provided a number of instructional supports. The district offered professional development workshops three times during the year to provide guidance for teaching extended instruction classes, and teachers also were given new curricular materials.

14 Rosenbaum (1999); Gamoran (2009).

15 Council of the Great City Schools (2009).

16 Allensworth and Easton (2005); Roderick and Camburn (1999).

BY THE NUMBERS

23%

of CPS freshmen failed their first year of algebra.

Source: Allensworth and Easton (2005).

To try to ensure that schools offered coherent instruction for low-skill students, the district made three guidelines for implementation: (1) double-dose algebra students should have the same teacher in algebra and algebra support, (2) the courses should be offered sequentially, and (3) students should take their algebra support course with the same students who were in their regular algebra course. These programming criteria resulted in significant changes in how schools placed freshmen in math courses. Most schools divided students into separate algebra classes based on their eighth-grade test scores; those scoring above the national median took single-period classes, those below the national median took double-algebra classes.

Effects of Chicago's Double-Dose Policy

Test Scores Improved for Both Low- and High-Skill Students

The implementation of double-dose algebra in Chicago affected both students who were targeted by the policy and those who were not. Researchers found that low-skill and high-skill students improved their math skills, as evidenced by higher test scores (see Figure 1).

Test scores rose significantly for students in double-dose algebra classes despite declines in peer skill levels and greater concentrations of students with attendance and disciplinary problems. Though these factors tend to depress test scores under normal circumstances, double-dose teachers changed their practices in response to the professional development they received and the flexibility in time provided by two periods of instruction. Instruction improved substantially compared with algebra instruction before the policy change; in particular, teachers in double-dose classes were much more likely to use interactive pedagogy. What is more, academic demand actually increased for targeted students, upending concerns that sorting classes by skill level would prompt teachers to water down content for lower-performing students.

For higher-skill students, the more homogenous classroom environment also produced more demanding classes, with teachers covering more difficult material than in the past. Though pedagogy did not change measurably, these single-period algebra classes had fewer students with behavioral and attendance problems, which created a better learning environment for the higher-skilled students.

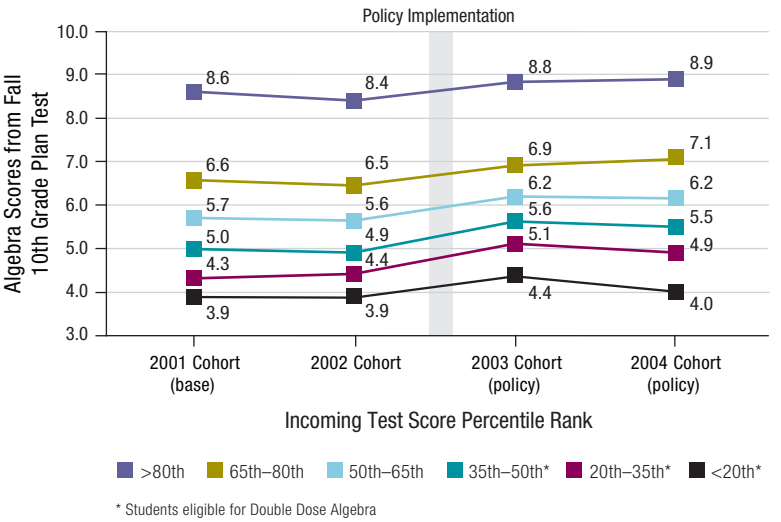
After the policy, low-skill students were much more likely to report that they would frequently:

- Write sentences to explain how they solved a math problem
- Explain how they solved a problem to the class
- Write math problems for other students to solve
- Discuss possible solutions to problems with other students
- Apply math to situations outside of school

Source: CCSR survey data

FIGURE 1

Algebra Scores by Incoming Skills by Cohort



* Students eligible for Double Dose Algebra

Failure Rates Did Not Improve, and Grades Declined for Higher-Skilled Students

The double-dose policy fell short of its original goal: to reduce failure rates in algebra. Though students' algebra test scores increased under the policy, course-passing rates did not improve.

Before the policy, failure rates were modestly improving among students entering high school with below-average math scores. However, after the new policy was implemented, failure rates leveled off. Even though students were learning more algebra, teachers expected more of them than in the past. Furthermore, the concentration of peers with behavioral and attendance problems had an adverse effect on some students' attendance and effort, making them more likely to fail; this offset the benefits of improved learning among other students.

Failure rates actually increased for higher-skill students who continued to take single-period algebra, and their average grades declined. Faced with more challenging material and stronger peers, students with slightly above-average skills were now the weaker students in their classes and their course performance suffered accordingly. Other work has shown that teachers tend to give lower grades to students who are not performing well in comparison with stronger students in the same class.[17]

17 Farkas et al. (1990); Kelly (2008).

Similarly, students' perceptions of their own work may have been affected by being in classes with other high-ability students. Grades fell, even though these students learned more algebra than students with similar skills in prior cohorts.

Double-Dose Was Least Effective for Students with the Weakest Incoming Skills

Very low-skill students were more likely to fail algebra after the implementation of the double-dose algebra policy, and test score gains were lower for these students than for students closer to the policy cutoff. Many of the very low-skill students had identified learning disabilities, yet the policy did not specifically address how schools should accommodate their needs in double-dose algebra classes. In many schools, students with learning disabilities went from small, homogeneous classes to larger double-period algebra courses. Not surprisingly, they failed to keep up.

Implications for Schools, Districts, and Policymakers

Well-Implemented Double-Dose Reforms Can Positively Impact Learning

Chicago's double-dose algebra reform did lead to improvements in student learning. These occurred, in large part, because the reform was accompanied by significant instructional supports, including extended instructional time, curricular resources, and professional development on instructional practice. Learning improved because classroom teaching improved and because the policy produced classroom environments that were conducive to effective teaching. This suggests a more general lesson for reformers and policymakers from the Chicago experience: curriculum reforms like double-dose are more likely to succeed when they include the kinds of deep supports for teaching provided in this instance.

Ability Grouping Can Be Effective When Accompanied by Supports for Teachers

A primary reason for the success of Chicago's double-dose policy was that it reorganized algebra classes by incoming skill levels, producing a form of ability grouping, or tracking. Tracking has been widely condemned for leading low-skill students to have weaker instructional environments with low expectations, little time on critical thinking, and substantial behavioral management problems.[18] As a result, many

18 Oakes (1985, 2005); Gamoran and Mare (1989); Page (1991); Rosenbaum (1979).

KEY TAKEAWAY

Curriculum reforms like double-dose are more likely to succeed when they include deep supports for teachers.

schools and districts have actively de-tracked their curriculum. However, heterogeneous grouping requires teachers to be skilled at differentiating instruction to students with varying abilities and can result in declining instructional quality for higher-skill students.[19] Studies have shown that students—especially high-achieving students—perform better, on average, in tracked schools than in schools with a single track for all students.[20] One recent study has gone so far as to argue that de-tracking efforts are a significant barrier to producing greater numbers of high-achieving students.[21] Cases of successful de-tracking have been found, but only where there are concerted efforts to address the difficulties that accompany it, including successful professional development around inclusive teaching practices and additional supports for struggling students.[22]

A primary reason for the success of Chicago's double-dose policy was that it reorganized algebra classes by incoming skill levels.

The double-dose policy in Chicago circumvented many of the problems associated with traditional tracking; lower-skilled students benefited from more instructional time and better resources provided for their teachers, which offset the greater concentration of students with attendance and disciplinary problems in their classrooms. Meanwhile, high-skill students' learning also benefited from more homogenous classes for most students. The students who were least well served were the students with the weakest skills, most of whom were receiving special education services. As mentioned previously, a large percentage of these students had taken algebra in smaller, more homogeneous classrooms but after the policy were placed in math classes alongside students without identified disabilities. Thus, while the double-dose policy resulted in more homogenous classes for most students, it had the opposite effect for many special education students. Their struggles provide further evidence of the importance of providing differentiated instruction for students with varying ability levels, support that is easier to provide in classrooms with a narrower range of skill levels.

The policy's negative effect on the grades of higher-skilled students does raise a potential challenge for policymakers considering reforms that involve ability grouping. Grades declined for the students near the cutoff in part because they now became the weakest students in their algebra classes. Grades also declined for some higher-achieving students because the absence of low-achieving students allowed teachers to move at a faster

19 Rosenbaum (1999); Loveless (2009).

20 Argys et al. (1996); Loveless (2009).

21 Loveless (2009).

22 Boaler and Staples (2008); Oakes (2005); Rubin (2008).

pace and cover more complex material. Though lower grades may be a reasonable tradeoff for a policy that improved test scores, academic demand, and teaching practices, they are not inconsequential. Work by CCSR and others has shown that grades are strong predictors of important outcomes like high school and college graduation.[23]

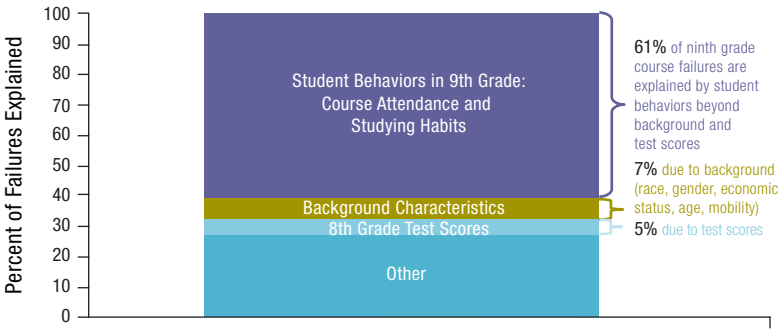
Reducing Course Failure Requires Alternative Strategies that Directly Address Academic Behaviors

Chicago's double-dose curriculum policy substantially improved algebra learning but did not have the same positive effect on course failures. This is perhaps not surprising, given the limited scope of the double-dose policy and what we know about the root causes of course failures. CCSR researchers have shown that academic behaviors are strongly predictive of whether students pass or fail their classes. In particular, there is an extremely strong relationship between attendance and course failures (see Figure 2).[24]

CCSR researchers also have found that few students experience problems in one class and success in others; more than three-fourths of students who fail just one full-year course have grades averaging 2.0 or lower in the classes they pass. This suggests that strategies like double-dose that address learning in only one particular subject area will be limited in their ability to affect broader outcomes.[25] Instead, policymakers should consider coupling double-dose with more comprehensive strategies designed to improve attendance and other academic behaviors in all courses.

FIGURE 2

Ninth Grade Course Failures Are About Student Behaviors



23 Roderick et al. (2009); Neild et al. (2008).

24 Allensworth and Easton (2007).

25 Allensworth and Easton (2007).

FACT:

Attendance is eight times more predictive of course failures in the freshman year than eighth-grade test scores.

Source: Allensworth and Easton (2007).

KEY TAKEAWAY

The double-dose strategy did successfully improve students' math skills, but policymakers should not expect curricular reforms to improve failure rates without concurrent strategies to improve academic behaviors.

Conclusion

Because double-dose did not have the desired effect on failure rates, many in Chicago viewed the policy as a failure. However, it seems math failure may have been the wrong outcome on which to judge the double-dose policy. This was a policy that sought to improve failure rates by giving students more and better algebra instruction—that is, by improving their algebra skills. By this measure, the policy was a success. However, in order to chip away at the stubborn, pervasive problem of course failures in urban high schools, policymakers must also critically examine school culture and organization to identify methods for improving academic behaviors like attendance and for facilitating student participation and engagement in all classes.

For More Information:

Nomi, Takako, and Elaine Allensworth. 2009. Double-Dose Algebra as an Alternative Strategy to Remediation: Effects on Students' Academic Outcomes. *Journal of Research on Educational Effectiveness*, 2(2): 111–48.

To download the working paper, "'Double-Dose' Algebra as an Alternative Strategy to Remediation: Effects on Students' Academic Outcomes," go to: **http://ccsr.uchicago.edu/content/page.php?cat=3&content_id=34**

To download the working paper, "The Effects of Tracking with Supports on Instructional Climate and Student Outcomes in High School Algebra," go to: **http://ccsr.uchicago.edu/downloads/5347effects_of_tracking_working_paper.pdf**

Findings from the series of studies by the Takako Nomi and Elaine Allensworth will be published by Brookes Publishing Co. in a forthcoming book. For more information go to: **www.brookespublishing.com**.

The Double-Dose Study Data

The studies by CCSR use multiple CPS data sources. Administrative records provide demographic information, including student enrollment status, age, gender, race, and special education status. Indicators of student socioeconomic status are derived from U.S. census data about the economic conditions in students' residential block groups. Semester-by-semester course transcript and grade data files contain detailed class information, such as teacher IDs, class periods, subject names, subject-specific course codes, and course grades. These were used to classify students' algebra courses. Elementary achievement test scores are based on the Iowa Test of Basic Skills, taken by all students from the third through eighth grade. High school achievement test scores come from the PLAN exam, a test that is part of the EPAS system developed by ACT, Inc., which CPS students take in the fall of tenth grade. Data from CPS were supplemented with data from CCSR surveys of ninth-graders, who were asked questions about the academic demand and pedagogy in their algebra classes. A description of CCSR surveys is available at **http://ccsr.uchicago.edu/content/page.php?cat=4**. The CPS high schools subject to the double-dose policy included 60 neighborhood schools, 11 magnet schools, and six vocational schools.

The Double-Dose study combined two designs—a regression discontinuity and a time series design. The study used data on the population of first-time ninth-graders who entered CPS high schools between 2000 and 2004 (five cohorts). Approximately 85 percent of students were eligible for free/reduced price lunch programs; the racial/ethnic composition was 54 percent African American, 34 percent Latino, 9 percent white, and 4 percent Asian. The outcome variables of this study included course grades and failures in algebra and geometry, and algebra test scores in the fall of tenth grade (results of the PLAN exam). Grades are taken from students' primary algebra course (not their support course) in their first year of high school and from their geometry course in their second year of high school.

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Acknowledgements

The authors would like to acknowledge the many people who helped make this policy brief possible. In particular, we would like to thank Takako Nomi and Elaine Allensworth, who conducted the research that forms the basis of this brief. Special thanks also go to Valerie Lee and Nicholas Montgomery, who provided valuable support and feedback on the research. We thank Chicago Public Schools, particularly the teachers and students who participated in CCSR surveys, and the members of the central office research staff who prepared the administrative, transcript, and test files necessary for this work. Thanks also to Sue Sporte for providing useful editorial comments on earlier versions of the brief. We gratefully acknowledge the Institute for Educational Sciences, which funded the larger study on which this brief is based. However, CCSR assumes sole responsibility for the findings and conclusions reported in the brief.

This report was produced by CCSR's publications and communications staff.

Editing by Ann Lindner
Graphic Design by Jeff Hall Design
Photos by David Schalliol
8-10/PDF/jhdesign

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Our Mission

The Consortium on Chicago School Research (CCSR) at the University of Chicago conducts research of high technical quality that can inform and assess policy and practice in the Chicago Public Schools. We seek to expand communication among researchers, policy makers, and practitioners as we support the search for solutions to the problems of school reform. CCSR encourages the use of research in policy action and improvement of practice, but does not argue for particular policies or programs. Rather, we help to build capacity for school reform by identifying what matters for student success and school improvement, creating critical indicators to chart progress, and conducting theory-driven evaluation to identify how programs and policies are working.

ISBN 978-0-9845076-2-7
51500>
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