



What's Happening

August 2016

“Double-dosing” in math in North Carolina public schools

Gary T. Henry
Vanderbilt University

Nathan Barrett
Tulane University

Camille Marder
Florida State University

Key findings

This study provides a picture of double-dosing in math—the enrollment of a student in two (or occasionally more) math courses during the regular school day—in North Carolina in 2011/12. Key findings include:

- Ninety-six percent of high schools, and at least one high school in every district, used double-dosing in math. Fifty-eight percent of middle schools and 21 percent of elementary schools used double-dosing.
- Double-dosing was used for remediation, maintenance, and enrichment. All three academic purposes were common in high schools, but enrichment and maintenance were less common than remediation in middle and elementary schools.
- Twenty-six percent of high school students, 5 percent of middle school students, and 1 percent of elementary school students received a double dose of math.

U.S. Department of Education

John B. King, Jr., *Secretary*

Institute of Education Sciences

Ruth Neild, *Deputy Director for Policy and Research*
Delegated Duties of the Director

National Center for Education Evaluation and Regional Assistance

Joy Lesnick, *Acting Commissioner*
Amy Johnson, *Action Editor*
Sandra Garcia, *Project Officer*

REL 2016–140

The National Center for Education Evaluation and Regional Assistance (NCEE) conducts unbiased large-scale evaluations of education programs and practices supported by federal funds; provides research-based technical assistance to educators and policymakers; and supports the synthesis and the widespread dissemination of the results of research and evaluation throughout the United States.

August 2016

This report was prepared for the Institute of Education Sciences (IES) under Contract ED-IES-12-C-0011 by Regional Educational Laboratory Southeast administered by the Florida Center for Reading Research, Florida State University. The content of the publication does not necessarily reflect the views or policies of IES or the U.S. Department of Education, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

This REL report is in the public domain. While permission to reprint this publication is not necessary, it should be cited as:

Henry, G. T., Barrett, N., & Marder, C. (2016). *“Double-dosing” in math in North Carolina public schools* (REL 2016–140). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Southeast. Retrieved from <http://ies.ed.gov/ncee/edlabs>.

This report is available on the Regional Educational Laboratory website at <http://ies.ed.gov/ncee/edlabs>.

Summary

Double-dosing in math expands the time for students to learn by having them enroll in two (or occasionally more) math courses during the regular school day. Although the practice can take different forms and be used at different grade levels (Chait, Muller, Goldware, & Housman, 2007; Nomi & Allensworth, 2009), most research on double-dosing in math has focused on students who need preparation to make the transition to Algebra I or similar rigorous high school math courses—typically, grade 8 or grade 9 students. This study aims to provide a more complete picture of the prevalence of double-dosing in math in North Carolina in 2011/12, the most recent year that data were available. It also reports on the use of double-dosing for remediation, maintenance, and enrichment; compares schools that use double-dosing in math with those that do not; and examines the various characteristics of students who receive a double dose of math.

Double-dosing was prevalent across North Carolina schools and districts in 2011/12. Every district had at least one high school using double-dosing, and most districts also had at least one elementary and middle school using double-dosing. However, not every school used the practice. It was used in 21 percent of elementary schools, 58 percent of middle schools, and 96 percent of high schools. The elementary and middle schools using double-dosing tended to be larger and more urban.

A large proportion of elementary schools used double-dosing for remediation (when at least one course is below the student's grade level) and, to a lesser extent, for maintenance (when both courses have content at the student's grade level). A very small proportion of elementary schools used it for enrichment (when at least one course contains content above the student's grade level). By contrast, for middle schools enrichment was the second most common use after remediation, and maintenance was the least common. A large majority of high schools used it for each of these academic purposes.

While many schools incorporate double-dosing, not every student at those schools received a double dose. Statewide, 10 percent of students received a double-dose of math, but the percentage varied considerably by school level. About 1 percent of elementary students, 5 percent of middle school students, and 26 percent of high school students received a double dose of math. Grade 9 was the most common grade level for double-dosing. Among high school students (those who did and did not receive double-dosing), maintenance was the most common academic purpose for double-dosing (11 percent), with enrichment (8 percent) and remediation (7 percent) about equally common.

The average achievement of high school students who received a double dose of math tended to be related to the academic purpose of the double-dosing. Students who received a double dose for remediation had the lowest incoming test score averages, students who received a double dose for maintenance had a slightly higher average, and students who received a double dose for enrichment had the highest average. Students who received a single dose of math had an average score in between that of students who received a double dose for maintenance and students who received a double dose for enrichment.

Contents

Summary	i
Why this study?	1
What is double-dosing?	1
Research questions	2
Study goals	3
What the study found	4
Districts' use of double-dosing in math	4
Schools' use of double-dosing in math	5
Teachers whose students received a double dose of math	7
Students who received a double dose of math	9
Limitations and implications of the study	11
Appendix A. Data and methodology	A-1
Appendix B. Supplemental tables	B-1
Notes	Notes-1
References	Ref-1
Boxes	
1 Key terms	1
2 Data and methods	3
Figures	
1 In 2011/12 all North Carolina school districts had at least one high school using double-dosing in math for remediation and at least one high school using it for enrichment	4
2 The proportion of North Carolina schools using double-dosing in math in 2011/12 was lowest for elementary schools and highest for high schools	5
3 Variation in the proportion of schools using double-dosing in math by academic purpose was highest for elementary schools and lowest for high schools	6
4 Middle school teachers had lower percentages of students who received a double dose than high school teachers	8
5 Among high school students, double-dosing in math in 2011/12 was most common among grade 9 students	9
6 A similar proportion of North Carolina high school students received a double dose of math for remediation and enrichment, while a slightly higher proportion received a double dose for maintenance in 2011/12	10
7 The previous-year math performance of North Carolina high school students who received a double-dose of math in 2011/12 differed substantially by academic purpose	11
8 The prevalence of double-dosing among North Carolina high school students in 2011/12 varied with student demographics and the academic purpose of double-dosing	12

Tables

1	Characteristics of North Carolina elementary and middle schools, their students, and their teachers, by use of double-dosing in math, 2011/12	7
A1	North Carolina students by grade level and number of math courses taken, 2011/12	A-3
A2	Terms used to identify the academic level of a course	A-4
A3	Number of students who received a double dose of math, by grade level and combined typology of academic purpose, 2011/12	A-5
A4	Common course combinations of double-dosing, by grade level and combined typology of academic purpose, 2011/12	A-5
B1	Number of North Carolina students, by grade level and number of math courses taken, 2011/12	B-1
B2	Number of North Carolina students receiving a double dose of math, by grade level and combined typology of academic purpose, 2011/12	B-2

Why this study?

New and revised standards adopted in recent years, partly in line with Common Core State Standards, have raised expectations for all students' understanding of math and their ability to apply math skills (Achieve, 2013; Common Core State Standards for Mathematics, n.d.). To assist students in meeting the standards and increase their readiness for college and careers, many states now require rigorous math courses (for example, two years of algebra and one year of geometry or the equivalent) to graduate high school (Achieve, 2013; Zinth, 2012). Among these states are five of the six states served by Regional Educational Laboratory Southeast (Alabama, Florida, Georgia, Mississippi, and North Carolina). These reforms have occurred simultaneously with a push to increase high school graduation rates (Stetser & Stillwell, 2014).

To simultaneously raise math standards, graduation requirements, and graduation rates, states have recognized the need for students to better master math content. Several strategies have been used for that purpose, such as providing intensive tutoring, coaching, or mentoring and increasing the time students spend on math through extra homework, before- or after-school classes, summer school, or additional math classes during the regular school day (Mac Iver, 1991).

What is double-dosing?

This last practice, known as double-dosing, increases the time for students to learn math by having them enroll in two (or occasionally more) math courses (see box 1 for definitions) during a normal school day or, in the case of block scheduling, during a given school year. The additional courses or the related course content may be delivered in a variety of ways. Students could be pulled out of their regular nonmath courses and sent to supplemental math instruction, students could be assigned additional math courses (meaning a student takes two different math courses in the same academic year), or a student's daily scheduled math course time could be extended (Chait et al., 2007; Nomi & Allensworth, 2009).

Double-dosing has been used to prepare struggling math students for the transition from middle school math to high school math for some time. As early as 1991, approximately one in five U.S. public middle schools, and almost one in three private secular middle

To simultaneously raise math standards, graduation requirements, and graduation rates, states have recognized the need for students to better master math content. One strategy to do that is double-dosing—or having students enroll in two (or more) math courses

Box 1. Key terms

Double-dosing in math. The enrollment of a student in more than one math course during the regular school day in a given school year. Although double-dosing implies a student taking two courses in the same subject, it is possible for a student to be enrolled in three or more courses (especially when that student is taking college credit courses while still in high school). The term double-dosing is used in this report because it is the general term used in the field.

Double-dosing for enrichment. Double-dosing in which at least one course contains content above the student's grade level.

Double-dosing for maintenance. Double-dosing in which all courses contain content at the student's grade level.

Double-dosing for remediation. Double-dosing in which at least one course contains content below the student's grade level.

schools, enrolled grade 8 students struggling in math in two math courses (Mac Iver, 1991). Similarly, Catholic schools enrolled students who were deemed unprepared for high school in two periods of English or math (Bryk, Lee, & Holland, 1993).

Double-dosing has grown considerably and is part of a number of different reform efforts. For example, the Talent Development Model project, which began with two schools in 1994 and has expanded to include 33 high schools in 12 states, includes double-dosing in math as part of its school reform approach (Kemple & Herlihy, 2004). In 2003 Chicago Public Schools initiated a systemwide mandate requiring double doses of math for all low-achieving grade 9 students (Achieve, 2013; Nomi & Allensworth, 2009). More than half of Maryland high schools used extended instruction time or a double dose of math or reading for grade 9 students in 1999/2000 (Balfanz, Legters, & Jordan, 2004). In 2006 Louisiana began a program in 30 schools using a double dose of reading and math (Chait et al., 2007). By the 2006/07 school year, almost half the 53 large urban districts that responded to the Great City Schools High School Reform Survey indicated that double periods of instruction were their most common method of literacy and math remediation for struggling high school students (Council of the Great City Schools, 2009).

Most research has focused on math and has found a positive association between double-dosing and academic performance in the short term (Bryk et al., 1993; Nomi & Raudenbush, 2013; Taylor, 2014), although some research has found no short-term effect (Cortes, Goodman, & Nomi, 2013). Findings for long-term impacts have been mixed: Cortes et al. (2013) found a positive effect after two or three years, but Bryk et al. (1993) found no effect one year after a return to a single dose of math.

With few exceptions (for example, Taylor, 2014), research on double-dosing has focused on grade 8 and grade 9 students who need preparation to make the transition to algebra I or similar rigorous high school math courses. Relatively little is known about double-dosing in other grade levels. In addition, the research literature's focus on double-dosing for struggling students has ignored the fact that the practice can also be used for maintenance and enrichment. The current study includes grades 3–8 and all forms of double-dosing to provide a more comprehensive picture of how prevalent the practice is in North Carolina.

Most research on double-dosing has focused on math and has found a positive association between double-dosing and academic performance in the short term; findings for long-term impacts have been mixed

Research questions

This report addresses four questions on double-dosing in North Carolina in 2011/12 (the most recent year that data were available):

- What proportion of *school districts* used double-dosing in math, and how did the proportion vary by school level and academic purpose?
- What proportion of *schools* used double-dosing in math, and how did the proportion vary by school level and academic purpose? Did schools that used double doses of math differ from those that did not?
- What proportion of *teachers* had students who received a double dose of math, and how did the proportion vary by school level? Did teachers teach courses primarily composed of students who received a double dose of math?
- What proportion of *students* received a double dose of math, and how did the proportion vary by school level, grade level, and academic purpose? Did students who received a double dose differ from those who did not?

See box 2 for a summary of the study's data and methods and appendix A for more details.

Study goals

The study was designed to provide information to both policy and research audiences. Few states provide specific policy direction regarding double-dosing. North Carolina policymakers have expressed interest in better understanding whether double-dosing is an appropriate tool to help students meet the state's math standards, but the state lacks a way to measure the use of double-dosing. Basic information on the prevalence and form of double-dosing is needed before initiating more in-depth analyses that could examine effectiveness. By creating an operational definition, this study enables policymakers in North Carolina and elsewhere to apply the methods used here to measure double-dosing, enabling them to better track, analyze, and study its use.

North Carolina district leaders can use the study findings to better understand how double-dosing is implemented and the factors that influence implementation. Information about how often and with which students double-dosing is used could help districts and schools improve their use of it. In addition, researchers can use the information in this report to identify areas for future research, including the possible effects of double-dosing (by academic purpose) on student achievement. For researchers, the academic purposes (that is, remediation, maintenance, and enrichment) of double-dosing used in this report and the description of double-dosing may support future analyses of the practice, particularly the potential impacts of different double-dosing models.

North Carolina district leaders can use the study findings to better understand how double-dosing is implemented and the factors that influence implementation

Box 2. Data and methods

The North Carolina Department of Public Instruction provided roster (that is, administrative) data for the 2011/12 school year. Course data range from prekindergarten through early college high school (for students enrolled in high school while pursuing an associate's degree) for all local education agencies and charter schools. The data include one observation for each course taken by each student, including the course number and title, the teacher who taught the course, and the school in which the course was taught. Additional data such as the student's grade and race/ethnicity and teacher characteristics were merged into the dataset. Students, teachers, schools, and courses each had unique identifiers and could be linked.

After identifying math courses, the number and types (that is, academic level) of such courses taken by each student were examined. Academic level was determined through analysis of course titles and course number coding, and academic purposes were deduced from combined typologies of paired courses. Counts of students who received a single dose and those who received a double dose were generated for each teacher and in each school. Students' grade level, previous year's standardized North Carolina end-of-grade math test scores, and demographic characteristics in the data file allowed examination of student characteristics associated with each purpose for double-dosing.

In the school-level analyses, some schools are counted more than once, but students are always counted only once. Elementary schools are schools with at least one grade level of 1–5, middle schools are schools with at least one grade level of 6–8, and high schools are schools with at least one grade level of 9–12. Schools with grade configurations that overlap these are counted in each of the levels in which they enroll students but only for the grades associated with the school configuration.

What the study found

This section describes the results of the analyses used to identify districts, schools, teachers with students who received a double dose of math, and the students themselves. The analyses begin at the district level because district leadership typically authorizes or supports using double-dosing as an instructional strategy.

Districts' use of double-dosing in math

Every district used double-dosing in math. In 2011/12 every North Carolina public school district used double-dosing in at least one school, and most districts used double-dosing at all school levels. Every district had at least one high school using double-dosing. Just over 80 percent of districts had at least one middle school using double-dosing, and 62 percent of districts had at least one elementary school using double-dosing.

The proportion of districts using double-dosing in math varied by school level and academic purpose. All districts had at least one high school using double-dosing for remediation and at least one high school using it for enrichment (figure 1). Ninety-nine percent of districts also had at least one high school using double-dosing for maintenance.

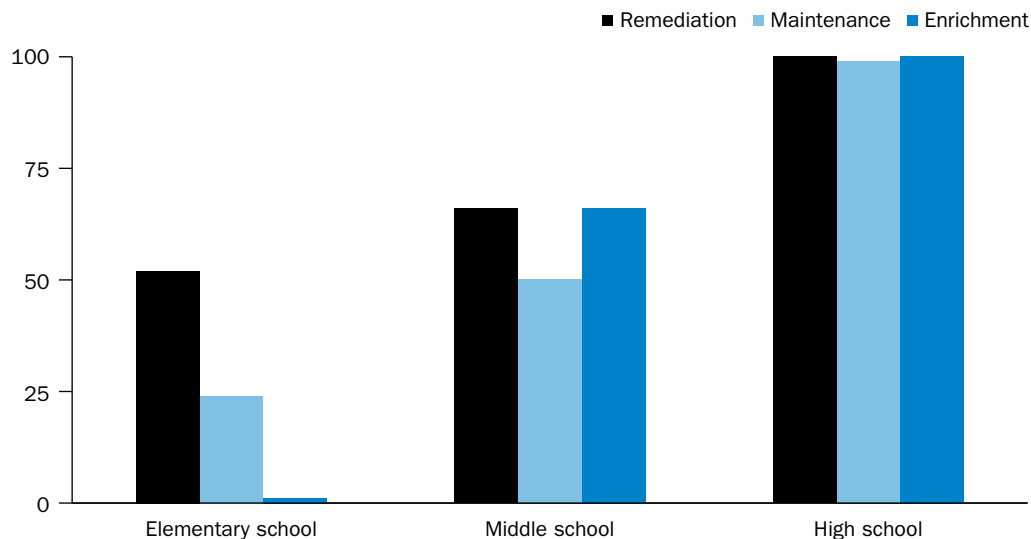
Variation in middle schools was higher than that in high schools. Sixty-six percent of districts had at least one middle school using double-dosing for remediation, and the same percentage had at least one middle school using it for enrichment (see figure 1). Half the districts had at least one middle school using double-dosing for maintenance.

The greatest variation was in elementary schools. Fifty-two percent had at least one elementary school using double-dosing for remediation, but 24 percent had at least one

All districts had at least one high school using double-dosing for remediation and at least one high school using it for enrichment, and 99 percent of districts also had at least one high school using double-dosing for maintenance

Figure 1. In 2011/12 all North Carolina school districts had at least one high school using double-dosing in math for remediation and at least one high school using it for enrichment

Percent of districts with at least one school at the given level using double-dosing in math



Note: $n = 115$ districts.

Source: Authors' analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

elementary school using it for maintenance, and 1 percent had at least one elementary school using it for enrichment.

Schools' use of double-dosing in math

The proportion of schools using double-dosing in math varied by school level and, especially in elementary schools, by academic purpose. Across North Carolina 47 percent of schools used double-dosing. The proportion was lowest for elementary schools (21 percent) and highest for high schools (96 percent)—a 75 percentage point difference (figure 2). Some 58 percent of middle schools used double-dosing.

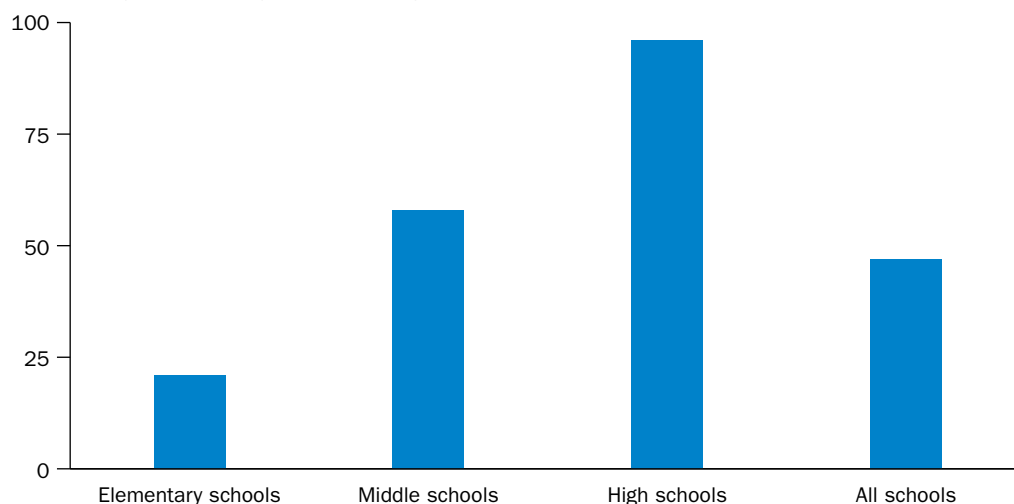
Remediation was the most common purpose for double-dosing. Across all school levels combined, a larger proportion of schools used double-dosing in math for remediation (37 percent) than for grade-level maintenance (28 percent) or for enrichment (28 percent). However, this varied by school level, with the greatest variation found among elementary schools and the least among high schools (figure 3). A large proportion of elementary schools used double-dosing for remediation. A smaller, but still sizable, proportion used double-dosing for maintenance. A very small proportion used it for enrichment. By contrast, for middle schools enrichment was the second most common use after remediation, and maintenance was the least common purpose. Differences across high schools were 4 percentage points or less, with a large majority using it for each academic purpose.

Across North Carolina 47 percent of schools used double-dosing

Elementary schools using double-dosing in math differed little from those not using it; more differences were found for middle schools. North Carolina elementary schools using double-dosing had small differences in academic performance and characteristics of teachers and students (table 1). However, they varied on other characteristics. The proportion of schools that were urban was smaller among elementary schools using double-dosing (27 percent) than among those not using it (34 percent), and the proportion that were rural

Figure 2. The proportion of North Carolina schools using double-dosing in math in 2011/12 was lowest for elementary schools and highest for high schools

Schools using double-dosing in math at the given level as a share of all schools at that level (percent)

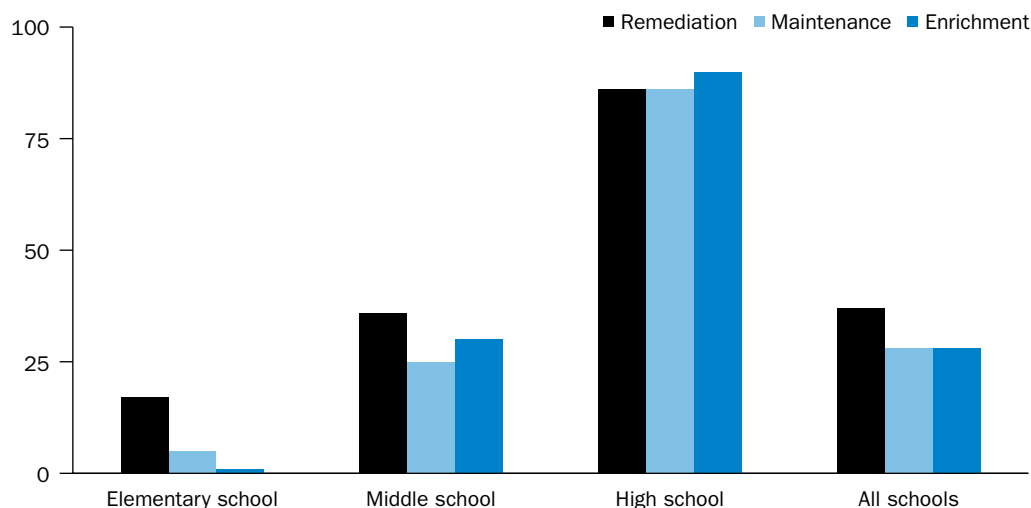


Note: $n = 1,392$ for elementary schools, $n = 754$ for middle schools, and $n = 583$ for high schools.

Source: Authors' analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

Figure 3. Variation in the proportion of schools using double-dosing in math by academic purpose was highest for elementary schools and lowest for high schools

Schools using double-dosing in math at the given level as a share of all schools at that level (percent)



Remediation was the most common purpose for double-dosing

Note: $n = 1,392$ for elementary schools, $n = 754$ for middle schools, and $n = 583$ for high schools. Schools could use double-dosing for multiple purposes.

Source: Authors' analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

was larger among elementary schools using double-dosing (58 percent) than among those not using it (49 percent). Elementary schools using double-dosing tended to be larger than elementary schools not using it, and average expenditure per pupil was about 10 percent less in elementary schools using double-dosing than in those not using it.

By contrast, middle schools using double-dosing differed from those not using it on several dimensions. The proportion of schools that were urban was larger among middle schools using double-dosing (32 percent) than among those not using it (20 percent), and the proportion that were rural was smaller among middle schools using double-dosing (52 percent) than among those not using it (66 percent). Middle schools using double-dosing averaged 15 percent more students but 26 percent lower expenditure per pupil than those not using it.

The average proportion of students who were a race/ethnicity other than White was larger in middle schools using double-dosing (49 percent) than in those not using it (44 percent), but the average proportion of students eligible for the federal school lunch program was smaller in middle schools using double-dosing (60 percent) than in those not using it (65 percent).

Academic growth presents a mixed picture. The proportion of schools that met expected academic growth was larger among middle schools using double-dosing (52 percent) than among those not using it (36 percent). But the proportion of schools exceeding expected academic growth and not meeting expected academic growth was smaller in middle schools using double-dosing (33 percent exceeding and 15 percent not meeting) than in those not using it (39 percent exceeding and 22 percent not meeting).

Differences among high schools were not examined because nearly all high schools used double-dosing in math.

Table 1. Characteristics of North Carolina elementary and middle schools, their students, and their teachers, by use of double-dosing in math, 2011/12

Characteristic	Elementary schools		Middle schools	
	Using double-dosing in math	Not using double-dosing in math	Using double-dosing in math	Not using double-dosing in math
Number of schools	296	1,096	439	315
Number of teachers	7,992	29,702	19,070	12,036
Number of students	154,152	537,040	218,183	136,080
<i>School locale (percent)</i>				
Urban areas	27	34	32	20
Suburban areas	15	17	16	15
Rural areas	58	49	52	66
<i>School size and expenditure per pupil</i>				
Mean number of students per school	522	490	497	432
Mean number of classroom teachers per school	36	34	43	38
Mean expenditure per pupil (\$)	7,529	8,383	7,497	10,184
<i>Academic performance of schools</i>				
Mean percentage of students proficient on statewide math achievement test	76	75	74	72
<i>Growth in student test scores (percent)</i>				
Exceeding expected growth	44	41	33	39
Meeting expected growth	37	35	52	36
Not meeting expected growth	19	22	15	22
<i>Teacher characteristics^a (percent)</i>				
Less than four years of experience teaching	19	17	20	17
National board certification	18	17	15	17
Graduate degree	30	29	28	29
<i>Student characteristics (percent)</i>				
Race/ethnicity other than White	48	49	49	44
Eligible for the federal school lunch program	64	66	60	65
Academically gifted	13	11	15	12
Students in special education	13	14	12	14
<i>Other school characteristics</i>				
Short-term suspension rate ^b (per 1,000 students)	89	95	378	368
Number of violent acts (per 1,000 students)	3	3	13	14

a. Includes all elementary school teachers and middle and high school math teachers.

b. Suspensions of less than 10 days.

Source: Authors' analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

Teachers whose students received a double dose of math

About a quarter of North Carolina's teachers had students who received a double dose of math. In 2011/12 about 28 percent of all teachers in the state had at least one student who received a double dose of math. The rate was lowest at the elementary level (9 percent) and highest at the high school level (88 percent). At the middle school level 35 percent of teachers had at least one student who received a double dose.

The proportion of teachers who taught courses made up entirely of students who received a double dose of math was small. Double-dosing is often pictured as taking place

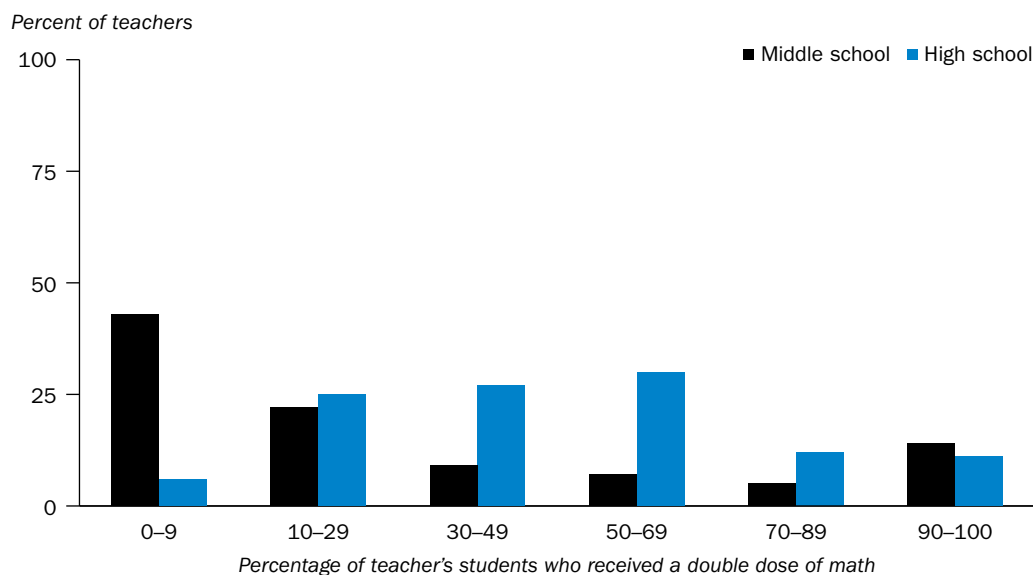
in self-contained classrooms where all enrolled students are receiving a double dose. While some schools likely use this approach, the reality of scheduling forces schools to adopt a range of approaches. As a result, many teachers have some students receiving a double dose of math and some students receiving a single dose in the same class. In other words, students receiving a double dose may be mixed in with students receiving a single dose.

This was the case in North Carolina. Few teachers had classes that were composed entirely of students who received a double dose. Instead, most teachers who had students who received a double dose taught classes that included some students who received a double dose and some who did not (figure 4). For example, in middle school 43 percent of teachers with students who received a double dose had less than 9 percent of their students receiving a double dose, and 22 percent of teachers had 10–29 percent of their students receiving a double dose. Put simply, most middle school teachers with students who received a double dose taught classes with a combination of students who were taking extra math and students who were not.

Even in high school, where double-dosing was more common, most teachers taught a combination of students who received a single dose and students who received a double dose (see figure 4). Most high school teachers with students who received a double dose had 10–69 percent of their students receiving a double dose; only 11 percent of teachers taught classes composed almost entirely of students who received a double dose.

Most teachers who had students who received a double dose taught classes that included some students who received a double dose and some who did not

Figure 4. Middle school teachers had lower percentages of students who received a double dose than high school teachers



Note: $n = 2,132$ for middle school; $n = 4,245$ for high school. Each bar indicates the percentage of teachers who taught a given percentage of students who received a double dose of math. The analysis refers only to teachers with at least one student who received a double dose of math (that is, teachers who did not have any students who received a double dose of math were excluded). For example, the first two bars show that among teachers with students who received a double dose of math, 43 percent of middle school teachers and 6 percent of high school teachers had 0–9 percent of their students receiving a double dose of math.

Source: Authors' analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

Students who received a double dose of math

About 10 percent of North Carolina students received a double dose of math in 2011/12, but the proportion varied considerably by school level and high school grade.

Although only 10 percent of all students received double-dosing, the data cover only a single school year. A larger percentage likely received a double dose at some point during their schooling, though that is outside the scope of this report. Double-dosing in math was less common among elementary school students (about 1 percent) and middle school students (5 percent) than among high school students (26 percent).

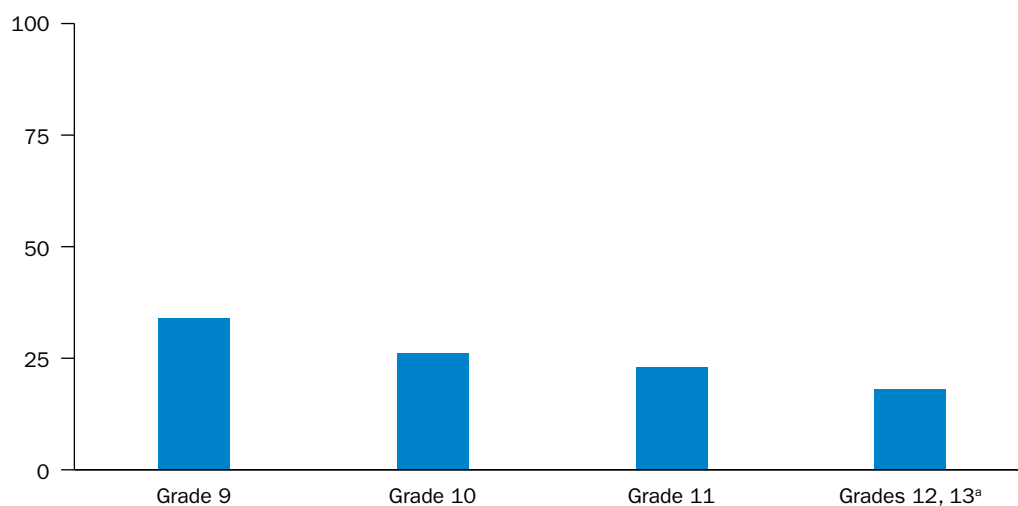
Breakdowns by grade are not provided for middle and elementary school students because the proportions involved were so low. Among high school students, double-dosing was most common among grade 9 students (34 percent; figure 5). The frequency declined with each grade level through grades 12 and 13, in which 18 percent of students received a double dose.

The frequency of double-dosing declined with each grade level

Similar proportions of high school students received a double dose of math for remediation and enrichment, while a slightly higher proportion received a double dose for maintenance. Students' average prior academic achievement was related to the academic purpose of double-dosing. At the high school level, double-dosing was used for each purpose at roughly equal rates. A similar proportion of students received a double dose for remediation and enrichment, while a slightly higher proportion received a double dose for maintenance (figure 6). Breakdowns by academic purpose are not provided for middle and elementary school students because the proportion of students in elementary and middle schools who received a double dose was so low.

Figure 5. Among high school students, double-dosing in math in 2011/12 was most common among grade 9 students

Percent of students who received a double dose of math

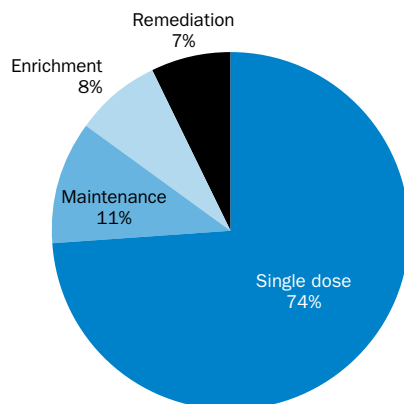


Note: $n = 125,231$ for grade 9, $n = 110,798$ for grade 10, $n = 100,574$ for grade 11, and $n = 95,841$ for grades 12 and 13.

a. Grade 13 is the grade level attended primarily by students who are enrolled in early college high schools and who are completing an associate's degree in addition to their high school coursework.

Source: Authors' analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

Figure 6. A similar proportion of North Carolina high school students received a double dose of math for remediation and enrichment, while a slightly higher proportion received a double dose for maintenance in 2011/12



At the high school level, double-dosing was used for each academic purpose at roughly equal rates

Note: $n = 432,444$ for students in grades 9–13. Grade 13 is the grade level attended primarily by students who are enrolled in early college high schools and who are completing an associate's degree in addition to their high school coursework.

Source: Authors' analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

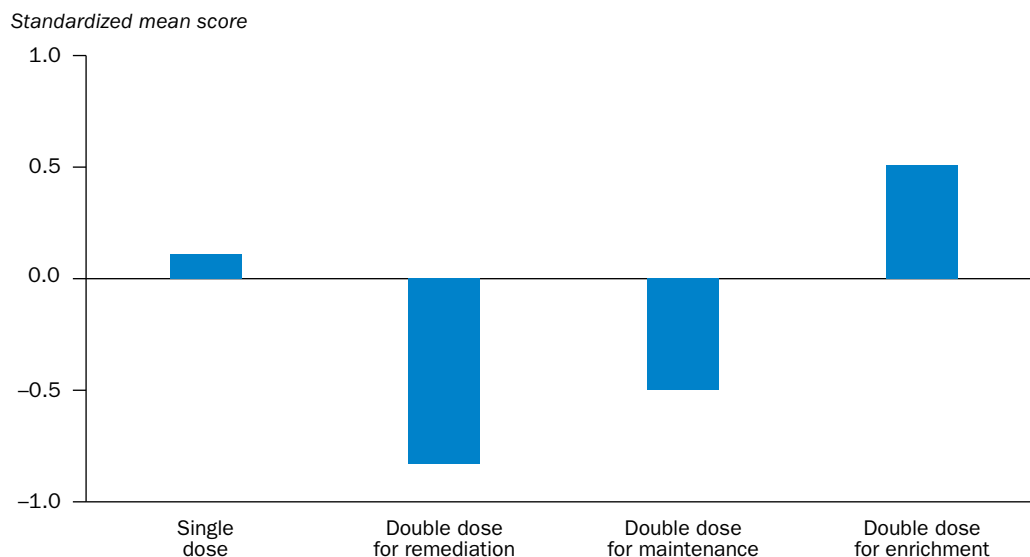
The previous-year math performance on the North Carolina state test of high school students who received a double dose of math differed substantially by whether the student received a double dose for enrichment, maintenance, or remediation. This suggests that previous performance may have been considered when placing students into particular courses for double-dosing (figure 7). Putting North Carolina's state test on the same scale for each grade (with a mean of 0 for all students, and a standard deviation of 1 for each grade) makes it possible to combine scores across grades for all high schools.

The lowest average previous-year test score was for students who received a double dose for remediation: 0.83 standard deviation below the statewide mean and almost 1 standard deviation below the average for students who received a single dose. The average for students who received a double dose for maintenance was somewhat higher but still 0.50 standard deviation below the statewide mean. This could indicate that students judged at risk of not achieving a passing or grade-level score on the state's assessment were selected for extra assistance. Students who received a double dose for enrichment—whose average was 0.51 standard deviation above the statewide mean—were the only group whose average was above that of students who received a single dose.

Double-dosing varied by characteristics of students. The prevalence of double-dosing among high school students varied with student demographics and the academic purpose of double-dosing (figure 8):

- Some 18 percent of students classified as academically gifted received a double dose of math; when they did, it was typically for enrichment.
- A third of students eligible for the federal school lunch program received a double dose of math. They were most likely to receive a double dose for maintenance (14 percent) or remediation (11 percent) and least likely to receive it for enrichment (8 percent).

Figure 7. The previous-year math performance of North Carolina high school students who received a double-dose of math in 2011/12 differed substantially by academic purpose



Students who received a double dose for enrichment were the only group whose average previous-year math performance on the North Carolina state test was above that of students who received a single dose

Note: $n = 289,663$ for students who received a single dose, $n = 29,585$ for students who received a double dose for remediation, $n = 44,792$ for students who received a double dose for maintenance, and $n = 38,299$ for students who received a double dose for enrichment. Test scores are standardized with a mean of 0 and a standard deviation of 1, so scores above 0 are higher than average and scores below 0 are lower than average.

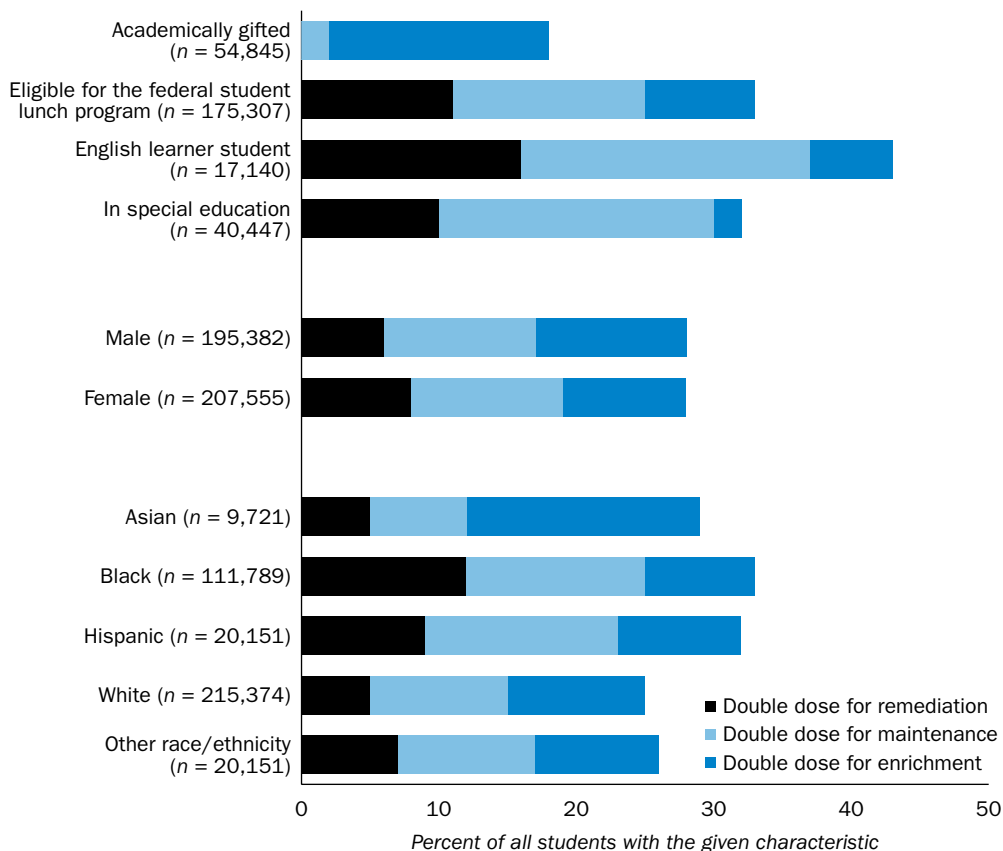
Source: Authors' analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

- English learner students had the highest rate of double-dosing (43 percent). They were most likely to receive a double dose for maintenance (21 percent) or remediation (16 percent).
- Almost a third of students in special education received a double dose of math. They were most likely to receive a double dose for maintenance (20 percent) or remediation (10 percent).
- There were only small differences between male and female students in the overall proportion that received a double dose of math and in the proportion that received a double dose for each purpose.
- White students had the lowest proportion of students who received a double dose of math. The proportion of students who received a double dose for enrichment was higher among Asian students (17 percent) than among White students (10 percent). About a third of Black and Hispanic students received a double dose; a larger percentage of Black students (12 percent) than of Hispanic students (9 percent) received a double dose for remediation.

Limitations and implications of the study

This study has several limitations. The study sought to examine the current prevalence of double-dosing in math in North Carolina public schools in the 2011/12 school year, the academic purposes of double-dosing, the characteristics of schools that use double-dosing, the proportion of teachers with students who received a double dose, and the demographics of students who received a double dose. The study was not designed to examine the effectiveness of double-dosing in math or its resource requirements.

Figure 8. The prevalence of double-dosing among North Carolina high school students in 2011/12 varied with student demographics and the academic purpose of double-dosing



Note: Includes students in grades 9–13; grade 13 is the grade level attended primarily by students who are enrolled in early college high schools and who are completing an associate’s degree in addition to their high school coursework. The bars represent the percentages of all students in a group who received a double dose in math, with each academic purpose distinguished. For example, the first bar shows that 18 percent of academically gifted students received a double dose: 16 percent received it for enrichment, and 2 percent received it for maintenance.

Source: Authors’ analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

The first limitation concerns the use of data for 2011/12 only. Although that was the most recent school year for which data were available, and analyses not reported here found very little change from 2010/11 to 2011/12, the report cannot comment on changes that may have happened after 2011/12. The prevalence of double-dosing may have changed since 2011/12. Similarly, some students may have received a double dose at some point in their schooling but not in 2011/12 and so would not be reflected in this report.

The second limitation concerns the methodologies used to identify and classify courses used in double-dosing. As outlined in appendix A, a structured process was followed to analyze the available data. The study team sought to be as inclusive as possible, but because double-dosing is not explicitly identified in the administrative data, some instances of double-dosing or typologies could have been missed. Similarly, the academic purpose of double-dosing was inferred from the data based on the student’s grade level and courses taken, but there is no direct measure of the purpose.

The third limitation concerns the teachers who do and do not teach students who received a double dose of math. The data can identify teachers who had at least one student who received a double dose of math and how many such students each teacher had. But the data do not indicate whether a teacher taught an individual course composed entirely of students who received a double dose. Clearly, few teachers taught all such courses, but some teachers could have had some course sections that were composed entirely of students who received a double dose. As a result, while the data can describe the percentage of a teacher's students who received a double dose, the study team could not determine how individual courses were composed.

Despite the limitations, the study makes clear that although North Carolina had no state-wide policy on double-dosing in math, all the state's districts had at least one school that engaged in the practice in 2011/12. In fact, almost all high schools, more than half of middle schools, and approximately a fifth of elementary schools used double-dosing in math.

Double-dosing is one of many strategies that can be used to support students who are struggling in math. Other commonly used strategies are one-on-one tutoring, an extended school day or year, extra homework, and computer support. Each strategy requires different types and levels of resources—extra teachers, classrooms, computers, and so on. In addition, each strategy may have different levels of effectiveness, possibly differing across groups of students. If the prevalence of double-dosing in math in North Carolina has not declined substantially since 2011/12, its use may be common enough to support an examination of its implementation challenges, costs, and effectiveness compared with other strategies, especially in high schools, where it is a common practice. Given the practice's more infrequent use in elementary and middle schools, researchers might also design experimental studies to examine its relative effectiveness at those school levels.

Appendix A. Data and methodology

This appendix describes the data and methodology used in the analyses. Because double-dosing is not specifically identified within North Carolina’s data system, substantial detail is provided on how the study team identified double-dosing in the data.

The North Carolina Department of Public Instruction provided roster data for the 2011/12 school year. The roster data covered prekindergarten through grade 13¹ for all local education agencies and charter schools, with an observation for each course taken by each student containing the course number and title, the teacher who taught the course, and the school in which the course was taught. Each student, teacher, school, and district has a unique identification number. Observations also contain additional data, such as the student’s grade level, gender, race/ethnicity, and score on the previous year’s North Carolina standardized math test.

Each course is designated by a local course number and course title. The local course number, established for public and charter schools in North Carolina, consists of seven digits grouped into five blocks as follows:

(DD)(CC)(A)(G)(L).

The designate (DD) indicates the discipline of the course, (CC) indicates the specific course within that discipline, (A) indicates the academic level or rigor of the course (see the section below on identifying the academic purpose of double-dosing in math for more details), (G) indicates the grade level of the course, and (L) indicates the length of the course. For example, a course coded as “202329Y” would signify a math course (20), specifically Algebra I (23), taught at standard level (2) to grade 9 students (9) for the entire length of the school year (Y). See North Carolina Department of Public Instruction (2009) for a complete listing of the numbers and their definitions.

While the course number provides a simplified process for identifying and describing courses, in practice there is variation in the way schools implement the coding. The variation is particularly evident for the sixth and seventh digits—grade level and length. In many cases in the dataset received, the sixth and seventh digits were blank or had values that did not correspond to the indicators designated in the coding structure. The discipline (DD), specific course (CC), and academic level (A) indicators were more consistently coded, although there were some errors. The process for identifying math courses and addressing the potential for miscoding is discussed in more detail below.

Identifying math courses

The first step was to identify all math courses. To ensure that the process was comprehensive, two parallel strategies were employed: one based on the course number and one based on the course title. The first strategy isolated the first two digits of the course number (academic discipline); math courses were typically indicated by either “20” or “24” (but also by “92” and “93” when math courses were intended for students with special needs). In any case, the third and fourth digits (CC above) for math courses were “20,” “21,” “22,” or “23.” These codes are important for identifying math courses for ambiguously coded academic disciplines as well as for providing further information for identifying the academic level of a course.

While course numbers captured most math courses, some numbers might have included subjects other than math, and some might have been miscoded. To ensure accuracy, a math terminology identification algorithm was applied to the course title. This algorithm searched for common math terms in the course title and designated them as math courses if the terms matched. If both the course number and course title coding strategies indicated that the course was a math course, the course was determined to be a math course, and a value of “1” was assigned for the math course indicator variable.

Additional reviews were conducted of courses identified as math courses by only one of the two identification strategies using an automated search to identify recurring patterns in the course numbers. Some course numbers were used primarily for college-level courses, while others generically designated any number of subjects. When such course numbers were found and the course title included math terms as determined by the terminology identification algorithm, the course was determined to be a math course, and a value of “1” was assigned for the math course indicator variable. In some cases the terminology matching algorithm generated a false positive for course titles such as “drama theatre” that contained, consecutively, the letters of one of the search terms (in this case, “math”). For false positives, a value of “0” was assigned to the math course indicator variable. The remaining nonmatched cases were individually reviewed. During the review, additional math terms were identified and added to the matching algorithm, which was run again on the complete dataset to ensure as many math courses were identified as possible.

Identifying double-dosing

A double dose of math occurs when an individual student has more than one math course during a normal school day or, in the case of block scheduling, during a given school year. The identification system may have produced both false positives and false negatives. False positives occur when a student who received a single dose of math appears to have two or more math courses in the roster data, coded as described above. False positives often resulted from duplicate roster listings of a single math course. False negatives occurred when a student who received a double dose of math appeared to receive a single dose of math, which occurred when a math course was incorrectly coded as a nonmath course. Efforts were made to reduce both false positives and false negatives when reviewing courses identified using one, but not both, of the two methods of identifying math courses.

Eliminating false positives caused by duplicate entries began with reducing the dataset to seven variables: student identifier, school identifier, teacher identifier, course number, course title, grade level, and math course indicator. Multiple listings for a single course occurred when schools entered courses by semester instead of by year. When matches occurred on all variables, the duplicate entry was dropped from the data. However, duplicate entries might have occurred for other reasons and needed to be minimized. Two other main causes for duplication were different teachers and different schools. For example, a student might appear in the dataset twice for an Algebra I course because he or she had two different teachers (team teaching) or because he or she took the course at two different schools (a within-year transfer). To identify these cases, two separate indicator variables were created to reflect duplicate course numbers or titles within an individual student’s course listing. The separate indicators were created because some course numbers could be used as a generic course listing and could include different course names. Duplicate titles were automatically designated as a single course and cross-referenced to ensure that the

duplicate entry was attributable to a different teacher or school. The study team individually reviewed the remaining course number–based duplicates. Once duplicate values were eliminated, the study team calculated the number of math courses taken by an individual student. Somewhat unexpectedly, a number of students were found to have received a triple dose of math within the same school year in addition to those who received a double dose of math. These were kept in the analyses and combined with those who received the more common double dose (see box 1 in the main text).

Some students had no designated math course in the dataset (table A1). For grades 1–10, this was primarily the result of courses designated as self-contained classrooms. Although such courses likely included math, there was no way to verify this assumption. In grades 3–5, almost all students had both a designated math course and a self-contained course. Because the analysis could not definitively determine whether a self-contained course covered math, all self-contained courses were designated as nonmath. This rule minimized overidentification of math courses by assuming that students who appeared to have a single self-contained course or both a self-contained course and one designated math course did not receive a double dose of math. For students in grades 11–13, not having a math course resulted primarily from their having fulfilled their math graduation requirements. This assumption is supported by the fact that these students were not enrolled in a self-contained course but were enrolled in other nonmath courses.

With the data coded as explained, the data show that in 2011/12, 119,966 students received a double dose of math, and 15,584 received a triple dose of math (see table A1).²

Identifying the academic purpose of double-dosing in math

The study team identified three common purposes of double-dosing—remediation, maintenance, and enrichment—based on the academic level of each math course a student took. Remedial courses covered material below a student’s grade level, maintenance courses covered material at a student’s grade level, and enrichment courses covered material above a student’s grade level. Double-dosing for remediation occurs when at least one course contains content below the student’s grade level, double-dosing for maintenance occurs when both courses contain content at the student’s grade level, and double-dosing

Table A1. North Carolina students by grade level and number of math courses taken, 2011/12

Grade level	Number of math courses taken								Total	
	0		1		2		3			
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1–2	3,122	1.4	225,227	98.5	355	0.2	31	0.0	228,735	100
3–5	6,447	1.8	344,374	96.6	5,305	1.5	269	0.1	356,395	100
6–8	1,038	0.3	331,615	94.9	15,179	4.3	1,735	0.5	349,567	100
9–10	3,335	1.4	160,371	67.9	63,343	26.8	8,980	3.8	236,029	100
11–13 ^a	26,770	13.6	129,292	65.8	35,784	18.2	4,569	2.3	196,415	100
All	40,712	3.0	1,190,879	87.1	119,966	8.8	15,584	1.1	1,367,141	100

Note: See table B1 in appendix B for number of students and number of math courses taken by grade.

a. Grade 13 is the grade level attended primarily by students who are enrolled in early college high schools and who are completing an associate’s degree in addition to high school coursework.

Source: Authors’ analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

for enrichment occurs when at least one course contains content above the student’s grade level.

As indicated above, the fifth digit of the course number (A) identified the course’s academic level. Although the fifth digit appeared to be reasonably consistent, a manual review suggested some systematic misclassifications when compared with the course title: for example, indicators not defined in the course manual or indicators meant for coding courses associated with a different school level (each school level has its own set of academic level indicators). Furthermore, the fifth character identified only the academic level of the course; it did not identify instances in which a student might be taking a course above or below his or her grade level.

Consequently, the study team used a three-step process to determine the academic purpose of double-dosing by identifying the academic level of each course taken. First, the study team analyzed course titles using a terminology-matching algorithm similar to the algorithm used to identify remedial and advanced math courses (table A2). This matching algorithm searched for common terms such as “advanced,” “remedial,” “AP” (Advanced Placement), and “developmental” to indicate the academic level. Standard-level courses were those that were not remedial or advanced.

Second, for entries in the dataset that contained student courses not identified by the terminology-matching algorithm, the study team analyzed grade—obtained from enrollment data—and course combinations that were above, below, or consistent with grade-level math progression based on the North Carolina State Standards for math curriculum. For example, Algebra I taken by a grade 8 student would be designated as enrichment, Algebra I taken by a grade 9 student would be designated as maintenance, and Algebra I taken by a grade 10 student would be designated as remediation.

Third, the study team used the fifth digit of the course number (A) and the North Carolina course coding structure translation table to identify the academic level for any courses not identified in the previous two steps.³ This allowed all remaining courses to be identified so that each could be assigned a typology.

Once an academic purpose was determined for each course taken by a student, the study team determined the combined typology for each double- and triple-dose observation for each student (see table A2).⁴

Table A2. Terms used to identify the academic level of a course

Remedial courses	Advanced courses
Developmental	Accelerated
Foundations	Advanced
Fundamentals	AP
Introduction	Honors
Occupational	IB
Remedial	
Support	
Transitional	

Source: Authors’ construction.

Table A3. Number of students who received a double dose of math, by grade level and combined typology of academic purpose, 2011/12

Grade level	Remediation/ remediation	Maintenance/ remediation	Maintenance/ maintenance	Maintenance/ enrichment	Enrichment/ enrichment	Total
1-2	0	235	120	0	0	355
3-5	36	2,635	2,614	20	0	5,305
6-8	349	4,234	6,366	2,183	2,047	15,179
9-13 ^a	6,580	18,973	40,556	11,796	21,222	99,127
Total	6,965	26,077	49,656	13,999	23,269	119,966

Note: See table B2 in appendix B for number of students, number of courses, and typology by year.

a. Grade 13 is the grade level attended primarily by students who are enrolled in early college high schools and who are completing an associate's degree in addition to high school coursework.

Source: Authors' analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

Most elementary school students who received a double dose of math received either a combination of remedial and maintenance courses or two maintenance courses (table A3). Middle school students also received these two combinations with greater frequency than others, but double doses of math began to include enrichment courses as well. In high school, the assignment of two remedial math courses increased sharply, as did the assignment of two enrichment courses.

The typologies of course and type combinations are listed in table A4.

Table A4. Common course combinations of double-dosing, by grade level and combined typology of academic purpose, 2011/12

Grade level	Remedial/ remedial	Maintenance/ remedial	Maintenance/ maintenance	Maintenance/ enrichment	Enrichment/ enrichment
1-5	<ul style="list-style-type: none"> Math K-8/ Individualized Math 	<ul style="list-style-type: none"> Math K-8/Math K-8 Math K-8/ Individualized Math 	<ul style="list-style-type: none"> Math K-8/Math K-8 Math K-8/ Individualized Math 	<ul style="list-style-type: none"> Math K-8/ Individualized Math 	<ul style="list-style-type: none"> na
6-8	<ul style="list-style-type: none"> Math K-8/ Individualized Math 	<ul style="list-style-type: none"> Math K-8/Math K-8 Math K-8/ Individualized Math Math K-8/Extended Math 	<ul style="list-style-type: none"> Math K-8/Math K-8 Math K-8/Special Topics Math 	<ul style="list-style-type: none"> Math K-8/Special Topics Math Math K-8/Algebra I 	<ul style="list-style-type: none"> Math K-8/Algebra I
9	<ul style="list-style-type: none"> Math K-8/ Foundations of Algebra Introductory Math/ Foundations of Algebra 	<ul style="list-style-type: none"> Algebra I/ Foundations of Algebra Algebra I/Intro Math 	<ul style="list-style-type: none"> Algebra I-A/ Algebra I-B Algebra I/ Foundations of Algebra 	<ul style="list-style-type: none"> Algebra I/Geometry and II Integrated Math I and II 	<ul style="list-style-type: none"> Algebra II/Geometry
10	<ul style="list-style-type: none"> Algebra I/ Foundations of Algebra Algebra I/ Introductory Math 	<ul style="list-style-type: none"> Algebra I/Geometry Algebra I/Algebra II 	<ul style="list-style-type: none"> Algebra II/Geometry Geometry/Special Topics Math 	<ul style="list-style-type: none"> Integrated Math II and III Advanced Functions and Modeling/ Algebra II 	<ul style="list-style-type: none"> Advanced Functions and Modeling/ Advanced Placement Statistics Algebra II/ Pre-calculus

(continued)

Table A4. Common course combinations of double-dosing, by grade level and combined typology of academic purpose, 2011/12 (continued)

Grade level	Remedial/remedial	Maintenance/remedial	Maintenance/maintenance	Maintenance/enrichment	Enrichment/enrichment
11	<ul style="list-style-type: none"> Algebra I/Special Topics Math Algebra I/Geometry 	<ul style="list-style-type: none"> Algebra II/Geometry Foundations of Algebra/Algebra II 	<ul style="list-style-type: none"> Algebra II/Foundations of Advanced Algebra Algebra II/Discrete Math 	<ul style="list-style-type: none"> Algebra II/Pre-calculus Integrated Math III and IV 	<ul style="list-style-type: none"> Advanced Placement Calculus (AB)/Advanced Placement Calculus (BC) University Math/University Math
12	<ul style="list-style-type: none"> Algebra I/Algebra II Algebra II/Geometry 	<ul style="list-style-type: none"> Advanced Functions and Modeling/Pre-calculus Algebra II/Pre-calculus 	<ul style="list-style-type: none"> Algebra II/Pre-calculus 	<ul style="list-style-type: none"> Advanced Placement Calculus (AB)/Special Topics Math 	<ul style="list-style-type: none"> Advanced Placement Calculus (AB)/Fifth Year Math University Math/University Math

na is not applicable because there was no enrichment/enrichment code in the database for elementary grades.

Note: As a benchmark, only course combinations accounting for at least 25 percent of the double doses within each grade/typology combination are included; thus grade 13 is omitted. Grades 1–5 and 6–8 are grouped together because they have the same course combinations for each type. Grades 9–12 are reported separately because the course combinations vary by grade because of North Carolina’s math curriculum standards.

Source: Authors’ analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

Appendix B. Supplemental tables

This appendix presents total counts of students in North Carolina, counts of students who took various numbers of math courses, and counts of students who received a double dose of math for various academic purposes. All data are disaggregated by grade level, and counts correspond to the 2011/12 school year.

Table B1. Number of North Carolina students, by grade level and number of math courses taken, 2011/12

Grade	Number of math courses taken					Total
	0	1	2	3	More than 3	
1	1,424	118,006	175	19	0	119,624
2	1,698	107,221	180	12	0	109,111
3	2,280	114,799	1,495	50	0	118,624
4	2,104	113,898	1,695	84	13	117,794
5	2,063	115,677	2,115	135	11	120,001
6	335	113,263	4,474	569	71	118,712
7	334	110,776	4,712	504	146	116,472
8	369	107,576	5,993	662	119	114,719
9	1,646	80,445	37,291	5,849	218	125,449
10	1,689	79,926	26,052	3,131	665	111,463
11	5,279	72,029	20,665	2,601	730	101,304
12	21,028	56,995	14,947	1,925	500	95,395
13 ^a	463	268	172	43	28	974
Total	40,712	1,190,879	119,966	15,584	2,501	1,369,642

a. Grade 13 is the grade level attended primarily by students who are enrolled in early college high schools and who are completing an associate's degree in addition to high school coursework.

Source: Authors' analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

Table B2. Number of North Carolina students receiving a double dose of math, by grade level and combined typology of academic purpose, 2011/12

Grade	Remedial/ remedial	Maintenance/ remedial	Maintenance/ maintenance	Maintenance/ enrichment	Enrichment/ enrichment	Total
1	0	105	70	0	na	175
2	0	130	50	0	na	180
3	12	675	808	0	na	1,495
4	12	866	807	10	na	1,695
5	12	1,094	999	10	na	2,115
6	92	1,839	2,409	96	38	4,474
7	149	1,357	2,185	362	659	4,712
8	108	1,038	1,772	1,725	1,350	5,993
9	510	6,437	20,628	6,037	3,679	37,291
10	2,882	5,340	8,803	2,620	6,407	26,052
11	1,320	3,062	8,857	2,381	5,045	20,665
12 and 13 ^a	2,297	4,179	1,118	1,387	6,138	15,119
Total	7,395	26,121	48,506	14,628	23,316	119,966

na is not applicable because there was no enrichment/enrichment code in the database for elementary grades.

Note: Calculations do not include triple doses or more.

a. Grade 13 is the grade level attended primarily by students who are enrolled in early college high schools and who are completing an associate's degree in addition to high school coursework.

Source: Authors' analysis based on 2011/12 data from the North Carolina Department of Public Instruction.

Notes

1. Grade 13 is the grade level attended primarily by students who are enrolled in early college high schools and who are completing an associate's degree in addition to high school coursework.
2. A small number of students had four to six math courses. A review of the course lists for these students suggests that these are legitimate designations. They occurred most frequently for students in grades 12 and 13 who were enrolled in multiple math courses at a community college.
3. See North Carolina Department of Public Instruction (2015) for the course coding guide.
4. The coding process included the assumption that no observations could contain a remedial/enrichment combination. Any combination that satisfied this condition was designated for manual review and the academic-level designation was verified and used to improve the automated process for determining academic level. Using the updated designations, the automated process was then rerun until all combinations satisfied the assumption stated above.

References

- Achieve. (2013). *Closing the Expectations Gap: 2013 Annual Report*. Washington, DC: Author. <http://eric.ed.gov/?id=ED546620>
- Balfanz, R., Legters, N., & Jordan, W. (2004). *Catching up: Impact of the talent development ninth grade instructional interventions in reading and mathematics in high-poverty high schools*. Baltimore, MD: Johns Hopkins University, Center for Research on the Education of Students Placed At Risk. Retrieved April 12, 2016, from <http://www.csos.jhu.edu/crespar/techReports/Report69.pdf>.
- Bryk, A. S., Lee, V. E., & Holland, P. B. (1993). *Catholic schools and the common good*. Cambridge, MA: Harvard University Press.
- Chait, R., Muller, R. D., Goldware, S., & Housman, N. G. (2007). *Academic interventions to help students meet rigorous standards. State Policy Options*. National High School Alliance Partners. Washington, DC: Institute for Educational Leadership. Retrieved February 17, 2016, from http://www.txechs.com/downloads/14_academicinterventions_final.pdf.
- Common Core State Standards for Mathematics. (n.d.). Retrieved February 17, 2016, from <http://www.corestandards.org/Math>.
- Cortes, K., Goodman, J., & Nomi, T. (2013). A double-dose of algebra. *Education Next*, 13(1), 70–76. Retrieved February 17, 2016, from http://educationnext.org/files/ednext_20131_cortes.pdf.
- Council of the Great City Schools. (2009). *High School Reform Survey, 2006–2007*. <http://eric.ed.gov/?id=ED505530>
- Kemple, J. J., & Herlihy, C. M. (2004). *The talent development high school model*. New York, NY and Oakland, CA: MDRC.
- Mac Iver, D. J. (1991). *Helping students who fall behind: Remedial activities in the middle grades* (Report 9). Baltimore, MD: Johns Hopkins University, Center for Research on Effective Schooling for Disadvantaged Students. <http://eric.ed.gov/?id=ED339545>
- Nomi, T., & Allensworth, E. (2009). “Double-dose” algebra as an alternative strategy to remediation: Effects on students’ academic outcomes. *Journal of Research on Educational Effectiveness*, 2(2), 111–148. <http://eric.ed.gov/?id=EJ866973>
- Nomi, T., & Raudenbush, S. W. (2013). *Academic differentiation, classroom peer skill, and inequality: Evidence from a natural experiment in 60 urban high schools*. University of Wisconsin-Madison Interdisciplinary Training Program in Education Sciences Working Paper. Retrieved February 17, 2016, from: <http://itp.wceruw.org/documents/raudenbushrevised.pdf>.

- North Carolina Department of Public Instruction. (2009). *Outline of the Course Coding Structure for NC Public Schools 2009–10*. Raleigh, NC: Author. Retrieved July 1, 2016, from <http://www.ncpublicschools.org/curriculum/links>.
- North Carolina Department of Public Instruction. (2015). Course code guidance. Raleigh, NC: Author. Retrieved July 1, 2016, from http://www.nc-sis.org/Documents/course_information/Course_Code_Guidance.pdf.
- Stetser, M., & Stillwell, R. (2014). *Public high school four-year on-time graduation rates and event dropout rates: School years 2010–11 and 2011–12. First Look* (NCES No. 2014–391). U.S. Department of Education. Washington, DC: National Center for Education Statistics. <http://eric.ed.gov/?id=ED544798>
- Taylor, E. S. (2014). Spending more of the school day in math class: Evidence from a regression discontinuity in middle school. *Journal of Public Economics*, 117(1), 162–181.
- U. S. Department of Education. (2015). *Public high school 4-year adjusted cohort graduation rate (ACGR) for the United States, the 50 states and the District of Columbia: School years 2010–11 to 2012–13. EDFacts: Consolidated State Performance Report, school years 2010–11, 2011–12, and 2012–13*. Washington, DC: Author. Retrieved February 17, 2016, from <http://www2.ed.gov/admins/lead/account/consolidated/index.html>.
- Zinth, J. D. (2012). *50-state mathematics requirements for the standard high school diploma*. Denver, CO: Education Commission of the States. Retrieved February 17, 2016, from <http://www.ecs.org/clearinghouse/01/01/28/10128.pdf>.

The Regional Educational Laboratory Program produces 7 types of reports



Making Connections

Studies of correlational relationships



Making an Impact

Studies of cause and effect



What's Happening

Descriptions of policies, programs, implementation status, or data trends



What's Known

Summaries of previous research



Stated Briefly

Summaries of research findings for specific audiences



Applied Research Methods

Research methods for educational settings



Tools

Help for planning, gathering, analyzing, or reporting data or research