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Double-Dose Algebra

Profile of Practice Brief

Joel Knudson

Nicholas Sorensen, Ph.D.





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Introduction

High school graduation rates in the United States are at their highest in U.S. history—81 percent (NCES, 2015). Even so, nearly one in five students nationally does not graduate from high school, and dropout rates are particularly high for low-income students, racial and ethnic minorities, and students with disabilities (National Center for Education Statistics, 2015). Though students drop out of high school for a variety of reasons, research consistently reveals that students who fail Algebra I are at an especially high risk (e.g., Oriheula, 2006; Silver, Saunders, & Zarate, 2008). Algebra I, or its equivalent, is typically required for graduation from high school and is a critical gateway course to more advanced mathematics and science courses as well as potential postsecondary degree pursuits (e.g., Ham & Walker, 1999; Helfand, 2006).

Requiring Algebra I of all students does not on its own guarantee that students will succeed in gaining the content knowledge and skills they will need to advance in their educational pathways. For example, students who are underprepared for Algebra I may struggle in the course and these challenges could set them on a path toward gradual disengagement—not only with mathematics, but also with school (Stoelinga & Lynn, 2013). However, districts and schools can engage in at least five research-based strategies that may promote student success in Algebra I: instructional practices, professional development, instructional coaching, curriculum alignment, and supplementary learning supports for struggling students.¹

To share information about these strategies, the U.S. Department of Education’s High School Graduation Initiative (HSGI) funded the Promoting Student Success in Algebra I (PSSA) project at American Institutes for Research (AIR).² PSSA is designed to provide actionable information for educational program developers in three ways. First, a series of research briefs summarizes research on the five strategies above that HSGI grantees are implementing to help struggling students succeed in Algebra I. Second, the project includes a forum for practitioners—district program developers or administrators and teachers—to make connections between the findings from the research briefs and their daily work. The results of these discussions have been published in a series of perspective briefs. Third, the project includes profiles of practice that provide an in-depth look at implementation of these five strategies.

¹ For research summaries on each of these strategies, see Sorensen, 2014; Smith, 2014a, 2014b; Walters, 2014a, 2014b.

² This brief contains examples of, adaptations of, and links to resources created and maintained by other public and private organizations. This information, gathered in part from practitioners, is provided for the reader’s convenience and is included here to offer examples of the many resources and models that educators, parents, advocates, administrators, and other concerned parties may find helpful and use at their discretion. These materials may contain the views and recommendations of various subject matter experts as well as hypertext links, contact addresses, and websites to information created and maintained by other public and private organizations. The opinions expressed in any of these materials do not necessarily reflect the positions or policies of the U.S. Department of Education (Department). The Department does not control or guarantee the accuracy, relevance, timeliness, or completeness of this outside information. Further, the inclusion of links to resources and examples do not reflect their importance, nor is it intended to represent or be an endorsement by the Department of any views expressed, or materials provided.

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This profile of practice brief focuses on one research-based strategy—supplementary learning opportunities for struggling students in Algebra I provided through double-dose algebra. The PSSA project reviewed the most relevant research related to double-dose algebra—a course that gives struggling students a second class period during the school day to focus on algebraic content beyond their standard Algebra I course—as well as other expanded learning opportunities (Sorensen, 2014; see <http://www2.ed.gov/programs/dropout/learningsupports092414.pdf>). This profile of practice focuses on double-dose algebra due to its widespread use as a strategy to support success specifically in Algebra I. For example, a recent study found that 96 percent of high schools in North Carolina used double-dosing as a strategy to support struggling students in math, and 26 percent of high school students had received a double-dose of mathematics (Henry, Barrett, & Marder, 2016).

Briefly, our review found that carefully designed double-dose programs can demonstrate positive outcomes. For example, research conducted in Chicago Public Schools suggested that double-dose algebra may improve algebra test scores (PLAN and ACT), graduation rates, and college enrollment rates (Cortes, Goodman, & Nomi, 2013; Nomi & Allensworth, 2009; Sorensen, 2014). However, these outcomes depend on important implementation factors. For example, improving course passing rates may depend on how students are assigned to the course (Nomi & Allensworth, 2013). If students are grouped into Algebra I classrooms on the basis of prior achievement, instead of enrolling students in mixed classrooms, the peer composition of Algebra I classrooms for both higher and lower performing students could undermine potentially positive effects of providing double-dose supports. Finally, evidence suggests that providing more instructional time to help students learn Algebra I content may be less helpful than using additional instructional time to address gaps in foundational skills needed for success in Algebra I (Balfanz, Legters, & Jordan, 2004; Sweet, 2010). Together, this emerging research suggest that double-dose algebra can improve outcomes for underprepared students but that additional instructional time must be structured in ways that best support students’ specific learning needs.

To provide real-world examples of high-quality double-dose practices, this brief profiles the experiences of two different schools: Douglas City and Anderson Park High Schools.³ Both schools adopted a double-dose algebra program to improve student learning in algebra, and their approaches reflect important similarities and differences in design and implementation. The goal of this profile is not to suggest that other schools and districts should mimic these approaches, but rather to share experiences and ideas that other schools and districts may adapt to meet their own students’ needs.

The information presented in this profile of practice emerged from visits to the two schools, during which AIR staff conducted interviews and focus groups with district mathematics leaders, mathematics coaches, school administrators, mathematics department chairs and teacher leaders, and mathematics teachers. AIR also reviewed curricular documents used to support implementation of the double-dose algebra courses.

³ See the Appendix for sampling, data collection, and analytic methods, including district selection criteria. All names of people and places in this practice profile are pseudonyms.

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Lessons From the Field

The following lessons reflect the experiences of the two schools profiled in this study.

- **Double-dose algebra needs to be targeted and intentional; it cannot simply be “more of the same.”** Consistent with research on best practices for expanded learning (Redd et al., 2012), teachers and administrators in both schools we visited adopted and implemented an approach that made deliberate use of the added instructional time. Teachers and administrators suggest that what might have been most important was not the Algebra I curriculum itself, but ensuring that the course provides the right supports to address some of the reasons students struggle with algebra.
- **High-quality instructional practices are particularly important when teaching double-dose algebra.** Teachers and administrators responsible for implementing double-dose programs highlighted elements of good algebra instruction discussed in other briefs in this series (Smith, 2014a). In the classroom, real-world connections helped to improve student engagement and understanding, and calls for students to explain their thinking helped build skills to support success in other subjects and later schooling. Teachers received support through training, collaboration, and coaching that prepared them to make double-dose algebra maximally effective. Formative assessment practices enabled teachers to constantly monitor and address student learning needs, making the most of the extra time at their disposal.
- **Selecting the right teachers can be critically important for student success in double-dose algebra.** In both schools we visited, double-dose teachers were not just good algebra teachers; they were the kind of teachers who were great at connecting and building positive relationships with struggling students. Schools intentionally selected double-dose algebra teachers committed to establishing and maintaining high expectations, believing that all students can learn, and supporting the needs of individual students.
- **Double-dose algebra programs need to diagnose and address the individual needs of students.** The double-dose algebra programs in Douglas City and Anderson Park High Schools carefully monitored and addressed student learning needs through regular online formative assessments, which provided real-time feedback to teachers about student misconceptions and areas for further improvement. Administrators and teachers also modified schedules to improve attendance, reached out to parents to foster support at home, and integrated technology and other curricular tools to improve student engagement.

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Douglas City High School at a Glance

Douglas City High School is a lively and welcoming neighborhood school, resembling an old academic building on a college campus that serves a predominantly Latino/Hispanic community in a city in the Midwest. Nearly three of four students who attend the school identify ethnically as Hispanic. Douglas City High School is one of more than 600 schools within its district. The city itself is a large, fast-moving metropolis characterized by cultural contributions in art, music, and architecture. The neighborhood served by Douglas City High School is culturally vibrant, peaceful, and most of the community lives in poverty. Nearly all students in Douglas City High School are eligible for free or reduced-priced lunch, about one in five have Individualized Education Plans, and one in four are English language learners. The school’s graduation rate (63 percent) is below the district average. However, surveys administered to students show that students perceive instruction at Douglas City High School to be both challenging and engaging.

Table 1: Douglas City Schools at a Glance

Geographic Region	Midwest
Setting	Urban
District Enrollment	Approximately 400,000
Total Number of Schools	660
Number of High Schools	176
Douglas City High School Enrollment	Approximately 1,500
Douglas City High School, Percentage Proficient in Mathematics	20 percent
District High School Graduation Rate	66 percent
Douglas City High School Students Eligible for Free or Reduced-Price Lunch	97 percent

Data reported are estimates based on publicly available data for the 2013–14 school year and are approximate to ensure that sites are not easily identified.

Douglas City’s current double-dose algebra program is structured as two back-to-back classes taught in a single block by one teacher using a commercially available curriculum designed explicitly to support struggling students. Ninth-grade students who score below the sixth-grade level on their eighth-grade state mathematics assessment (approximately two-thirds of freshmen) are enrolled in the course. Their blended curriculum utilizes online technology to drive whole-class and small-group instruction and individual learning activities for students. The curriculum also includes units and activities that address students’ engagement in mathematics—beliefs about their academic abilities, motivation, and theories of intelligence. Double-dose teachers are provided one week of summer training on the curriculum, monthly meetings to debrief challenges with the provider, and weekly common planning time.

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Since adopting a double-dose algebra program as part of a districtwide initiative in 2003, Douglas City High School has weathered substantial changes in school and district leadership. Although double-dose algebra began as a districtwide program (see *Why Schools Turned to Double-Dose Algebra*), programmatic and financial support from the district waned as a result of budgetary challenges and multiple shifts in district leadership. For many years, Douglas City High School received little guidance or support for implementing a double-dose algebra program. In 2012, Mr. Kennedy, a faculty collaborator from a neighboring university, worked with the school leadership to obtain a grant from an external funder to support the profiled double-dose algebra program. With support from the grant and university partner, Douglas City High School was able to maintain the double-dose algebra program, despite having four different principals between the 2012–13 and 2014–15 school years. However, the future of their double-dose program remains unclear as they reach the end of their grant funding.

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Anderson Park High School at a Glance

Anderson Park High School is a bright and welcoming school located in a large city in the Southeast and serves nearly 2,000 students with a sprawling structure and campus. Between classes, students pass through sunny courtyards, filled with conversation. The majority of the students served by Anderson Park are Black (approximately 60 percent); 30 percent are White and the remaining 10 percent includes students who identify as Hispanic, Asian, or with two or more races/ethnicities. Although the city is known for its bustling industry, the students served by Anderson Park are largely impoverished; one in two students receives free or reduced-priced lunch.

Table 2. Anderson County Schools at a Glance

Geographic Region	Southeast
Setting	Urban
District Enrollment	Approximately 125,000
Total Number of Schools	197
Number of High Schools	19
Anderson Park High School Enrollment	Approximately 1,900
Anderson Park High School, Percentage Proficient in Algebra	55 percent
District High School Graduation Rate	74 percent
Anderson Park High School Students Eligible for Free or Reduced-Price Lunch	55 percent

Data reported are estimates based on publicly available data for the 2013–14 school year and are approximate to ensure that sites are not easily identified.

Double-dose algebra at Anderson Park is a districtwide effort coordinated from the central office. The district currently uses a combination of two commercially available curricular packages—one for the standard districtwide Algebra I course and one for the double-dose “enrichment” course. The two courses are offered as two classes, although the teachers coordinate their instruction to address similar concepts and skills at the same points in time. The two courses alternate everyday on an A/B block schedule. Students engage with the standard Algebra I curriculum on their “A days” and experience a blended learning model—integrating both face-to-face and online tutoring—on their “B days,” when the enrichment course is taught. Administrators use test scores and prior academic performance to determine which students are placed in the double-dose algebra course. Double-dose algebra teachers receive two or three days of summer training on the curricular resources along with weekly professional development during common planning time from district- and school-based math coaches.

Since Anderson Park began implementing a double-dose algebra program in 2008-09 as part of a districtwide initiative, the curriculum used to support struggling algebra students has shifted with changes in district leadership. The profiled curricular resources and supporting professional development were selected and purchased by new district administrators in 2013. Members of the profiled administration had previously adopted the same curricular resources at a different

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district and believed they were well suited to support Anderson County Schools' struggling students. The district math coordinator, Ms. Herrera, asserted that despite ongoing changes every few years, the curricular materials and supports have been most successful because the administration has made a sustained commitment to the approach and to implementing a double-dose algebra program well. As a result, teachers and instructional leaders across the district have become more invested in learning to use the curricular resources well rather than anticipating that they will be obsolete in the near future. Furthermore, Ms. Herrera has established a team of math coaches (former math teachers in the district) who work with high schools across the district to support high-quality instructional practices in mathematics.

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Why Schools Turned to Double-Dose Algebra


Double-dose algebra at Douglas City High School began as part of a districtwide initiative in the early 2000s designed to provide additional supports to struggling students. This need emerged as teachers and administrators observed increased failure rates in Algebra I following the implementation of a policy that required that all students take Algebra I in ninth grade and pass the course to graduate from high school. The district initially provided curricular resources and professional development to support double-dose algebra courses, much like those used at the schools included in this profile. However, in the late 2000s budgetary challenges and changes in district leadership resulted in the loss of district-level supports for the program. Since then, Douglas City High School received limited guidance from the district office about how to implement the double-dose algebra course, and the school's teachers largely implemented double-dose algebra courses as they saw fit for their students.

A grant from the U.S. Department of Education breathed new life into Douglas City's double-dose algebra program in 2012. The grant program, which was designed to improve postsecondary preparedness and success for low-income students, enabled the school to purchase a new curriculum package built around an extended Algebra I course and to provide training for teachers on its use. These resources enabled the school to make more intentional use of the extra class time; instructional practice was guided and shaped by both the curriculum and common planning among members of the algebra team.

Anderson Park High School began implementing a double-dose algebra course in 2008–09 as part of a districtwide initiative. District administrators recognized the need for extra supports to address low algebra course performance and district test scores, and they believed that struggling students needed more frequent opportunities to engage with mathematics, given that their block schedule had students taking Algebra I only every other day.

In contrast to Douglas City, double-dose algebra at Anderson Park remains a districtwide effort coordinated from the central office. Since initial efforts to implement a double-dose algebra program began, Anderson County Schools has used three different curricular programs. The first curriculum was selected in 2008–09 prior to adoption of challenging state academic content standards but was guided by standards developed by the National Council of Teachers of Mathematics (NCTM, 1991, 2000). A few years later, Anderson County adopted the same commercially available curriculum used by Douglas City High School. Some teachers across Anderson County Schools struggled with that curriculum because of the increased focus on conceptual understanding and use of technology in the classroom. The profiled curriculum and supporting resources, which are also available commercially, were selected in 2013–14. These resources were selected by new district leaders who had used them at another district and observed positive results.

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“It didn’t even matter what program we brought on. It was the implementation of the program and teachers willingness to move [their classroom practice].”

—Anderson Park Math Coach

Teachers and instructional leaders at Anderson Park noted that the current curriculum has been useful for guiding and supporting instruction, but also emphasized that it is the quality of teaching and learning that moves the needle for students. According to one math coach, “It didn’t even matter what program we brought on. It was the implementation of the program and teachers willingness to move [their classroom practice].”

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Double-Dose Algebra at Douglas City and Anderson Park High Schools

Figure 1. Sample Double-Dose Algebra Lesson Agenda

Time: 8:15–9:45 a.m. (90 minutes)

1. Opener and preview of daily lesson (10 minutes)
2. Core learning activity (45 minutes)
3. Process homework (10 minutes)
4. Consolidation activity (25 minutes)
5. Wrap-up and homework introduction (10 minutes)

Douglas City has structured double-dose algebra as two back-to-back classes taught in a single block. Although students receive credit for two different courses—Algebra I and Algebra Extended—students experience these classes as a single course focused on coherent content and with a consistent teacher and curricular materials. The students who take the double-dose course at Douglas City are ninth graders who scored below a sixth-grade level on their eighth-grade state mathematics assessment; approximately two thirds of freshmen take the double-dose course.

Teachers at Douglas City High use a commercially available program that is specifically designed as an extended-period Algebra I course for students who are significantly behind grade level in mathematics. The program was co-developed by a commercial provider and university researchers whose work focuses on supporting at-risk students in mathematics. Each lesson was designed specifically for a 90-minute double-block period (see Figure 1 for an example agenda for each class period).

The blended program utilizes online technology to drive whole-class and small-group instruction and individual learning activities for students. These include instructional tasks and interactive simulations that help students visualize difficult concepts, problems sets, and tasks, as well as assessments that address concepts and skills students have not yet mastered. For example, when learning about rate of change, students solve a problem in which they manipulate the

“What we really want to show everyone in that inquiry cycle, when you look at the data and you recognize what you need to reteach, you don’t reteach in exactly the same format as what you taught the first time. It has to be a new learning experience.”

—Douglas City Administrator

speed of a skateboarder and explore what happens graphically as the rate changes. They also solve similar types of assessment problems that require conceptual understanding and application. Interview respondents emphasized the ways in which the curriculum package supports diverse instructional practices. As a school administrator explained, “What we really want to show everyone in that inquiry cycle, when you look at the data and you recognize what you need to reteach, you don’t reteach in exactly the same format as what you taught the first time. It has to be a new learning experience.”

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The curriculum also includes units and activities that explicitly address students’ beliefs about their academic abilities, including motivation and theories of intelligence rooted in social psychology research. Incorporating these social-psychological concepts draws on emerging practices focused on developing a “mathematical mindset” (Boaler & Dweck, 2016). A mathematical mindset applies a large body of research on “growth mindset” (Dweck, 2007) to mathematics by helping students believe that they can develop their most basic abilities through dedication and hard work rather than believing that skills and intelligence in mathematics are fixed traits. Teaching these lessons, however, may not come naturally for some math teachers. Indeed, one teacher expressed that she initially skipped those units because she was not comfortable with the exercises that made her feel more like a guidance counselor. With practice, she now teaches these units and recognizes their importance for engaging students who do not believe they are good at mathematics.

Teachers at Douglas City also received support to improve the implementation of the program. All double-dose algebra teachers participated in training from the developers of the blended program when the school introduced it three years ago. The initial professional development included 10 sessions, 60–120 minutes each, administered across five days. A sample of topics and activities covered is included in Table 3. As part of that experience, teachers learned about the rationale behind the program and had an opportunity to engage with the software from the perspective of a student. In addition, during the first year of implementation, Douglas City High held two-hour meetings once per month with the provider to debrief progress and challenges to date in implementing the curriculum. Double-dose algebra teachers also scheduled weekly common planning time (60–90 minutes) to collectively plan lessons and reflect on student progress. The typical agenda for these meetings included reviewing data from assessments, adjusting pacing of lessons based on data, and discussing instructional challenges. Teachers describe their common planning time as data driven. They also use some of this time to create common assessments beyond those in the curriculum package—administered every five weeks—to generate student performance data that drive their ongoing conversations.

Table 3. Douglas City Agenda for Initial Professional Development

Session	Topic	Minutes	Description of Activities
1	Overview of Curricular Resources and Training	100	Trainer will establish the norms and goals of the teacher training, and introduce teachers to the overarching goals and key features of the online curriculum.
2	Review Sample Syllabus and Structure of Curriculum	100	Teachers will review the syllabus and lesson structure of the online Curriculum to become familiar with daily lesson components. Trainer will model instructional activities for each lesson including how to open, preview a lesson, instruct a core activity, and consolidate and close a lesson.
3	Modeling Classroom Engagement	120	Trainer will model classroom engagement strategies recommended by the curriculum.

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Session	Topic	Minutes	Description of Activities
4	Planning for Instruction Part I	60	Teachers will get into triad groups and plan how to deliver a lesson from the curriculum.
5	Assessments	100	Trainer will cover both the online and paper-and-pencil assessments, including how to use the real-time reports and student data to inform instruction.
6	Homework	90	Teachers will read an article on growth mindset by Carol Dweck and discuss how the concepts apply to their own teaching practices.
7	Growth Mindset and Mathematics	120	Teachers will explore the content in the curriculum focused on changing students' attitudes toward learning. Teachers will also investigate the ways in which two strands of mathematical concepts—rate of change and slope—are developed over time in the curriculum.
8	Planning for Instruction Part II	90	Teachers will continue to plan in triads to prepare to deliver a model lesson
9	Modeling a Lesson	120	Teachers will deliver a model lesson in their triads.
10	Planning the Year	120	Teachers will practice planning backward looking at the mid- and end-of-unit assessments first as a lens through which to study and plan lessons. Then, they will use the curriculum and the scope and sequence documents to begin planning the year focusing on the first three topics.

At Anderson Park, the double-dose algebra course is separate from the standard Algebra I class. The school has organized a block schedule with an “A day” and “B day” that alternate over the course of two weeks so that students engage with a standard Algebra I curriculum used across the district on their “A day” classes on Monday, Wednesday, and Friday of one week and on Tuesday and Thursday of the following week (see Table 4). On their “B days,” students experience a blended learning model—integrating both face-to-face and online instruction. The district designed its double-dose option for students who fall below a specific cut-off score on a math skills assessment; educators also inform course placement decisions with historic academic performance for each student.

Table 4. Anderson Park Sample Schedule

Monday	Tuesday	Wednesday	Thursday	Friday
<ul style="list-style-type: none"> A Day Standard Algebra I course Standard curriculum 	<ul style="list-style-type: none"> B Day Double-Dose Algebra I course Blended learning curriculum 	<ul style="list-style-type: none"> A Day Standard Algebra I course Standard curriculum 	<ul style="list-style-type: none"> B Day Double-Dose Algebra I course Blended learning curriculum 	<ul style="list-style-type: none"> A Day Standard Algebra I course Standard curriculum
Monday	Tuesday	Wednesday	Thursday	Friday
<ul style="list-style-type: none"> B Day Double-Dose Algebra I course Blended learning curriculum 	<ul style="list-style-type: none"> A Day Standard Algebra I course Standard curriculum 	<ul style="list-style-type: none"> B Day Double-Dose Algebra I course Blended learning curriculum 	<ul style="list-style-type: none"> A Day Standard Algebra I course Standard curriculum 	<ul style="list-style-type: none"> B Day Double-Dose Algebra I course Blended learning curriculum

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The content of the double-dose class tracks closely to the standard class, sometimes frontloading material and sometimes providing reinforcement for especially challenging concepts. In fact, Anderson County district administrators have created a crosswalk for the school year that maps the units for both classes onto the calendar to ensure that they address similar material at the same time. An example of this crosswalk is provided in Table 5, which details how many days in each quarter of the year are dedicated to each topic and in what order. However, although teachers believed these alignment tools smoothed transitions between the standard and double-dose course content, they expressed that a shift between different presentation styles of the two courses is not always perfect and can make it challenging for students to make connections across content. One teacher noted, “One of the things I think that confused our kids was that we went from [the double-dose curriculum] one day to a more traditional book on the opposite day. I think that for [double-dose blended curriculum] to work, I would have to pretty much use it every day.” In addition, another teacher at Anderson Park expressed that alternating curricular materials only works if teachers are provided flexibility to adapt materials to students’ specific learning needs.

“One of the things I think that confused our kids was that we went from [the double-dose curriculum] one day to a more traditional book on the opposite day. I think that for [double-dose blended curriculum] to work, I would have to pretty much use it every day.”
—Anderson Park Double-Dose Algebra Teacher

Table 5. Anderson Park Sample Curricular Alignment Between Standard and Double-Dose Algebra Courses

Standard Algebra I Section Curriculum			Double-Dose Section Curriculum		
Quarter	Topic	Instructional Days	Topic	Instructional Days	Total Days
Quarter 1	1. Foundations of Algebra	5	1. Quantities and Relationships	6	
	2. Solving Equations	7	2. Graphs, Equations, and Inequalities	7	
	3. Solving Inequalities	5	3. Linear Functions	10	
	4. Functions	5			
Total Days		22		23	45
Quarter 2	5. Linear Functions	10	4. Systems of Equations	9	
	6. Systems of Linear Equations and Inequalities	6	5. Systems of Inequalities	7	
	7. Exponents and Exponential Functions	6	6. Exponential Functions	6	
Total Days		22		22	44
Quarter 3	8. Polynomials and Factoring	9	7. Quadratic Functions	10	
	9. Quadratic Functions	7	8. Polynomials and Quadratics	10	
	10. Radical Expressions and Equations	5			
Total Days		21		20	41

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Standard Algebra I Section Curriculum			Double-Dose Section Curriculum		
Quarter	Topic	Instructional Days	Topic	Instructional Days	Total Days
Quarter 4	11. Rational Expressions and Functions	9	9. Solving Quadratic Equations and Inequalities, Including Complex Solutions	11	
	12. Data Analysis and Probability	7		11	
	13. Tools of Geometry	6	10. Rational Expressions and Functions		
Total Days		22		22	44

The standard Algebra I course uses a traditional textbook aligned to the challenging state academic content standards in Mathematics as the primary instructional resource. The extra period includes a combination of a textbook and an online intelligent tutoring system. Each teacher utilizes the program in a slightly different way, but one central component is an online program that addresses each student’s learning needs. After a student logs on, they move through a series of exercises targeted to their own areas for growth. Real-world examples—from exercise habits to money management—help make the material relevant and improve student engagement. Throughout the student experience, the program acts as a tutor, walking the student through each step in solving a mathematical problem, providing tips when the student requests them, and tracking places where the student makes a mistake or asks for help. In doing so, the computer software not only provides additional practice (and advice) for students in those areas but also gives the teacher information about the content and skills in which each student might need additional support. However, these online supports worked better for teachers who had consistent access to the necessary technology. For example, one teacher noted, “Since we don’t have permanent computers in the room, I’m going to say within a month time...we would use [the online program] two, maybe three times a month.”

“If we have a teacher that did very well on a particular standard, we’ll have a conversation and maybe ask that teacher to model. How did you teach that particular concept?”

—Anderson Park Math Coach

Anderson Park was similar to Douglas City in the supports provided to teachers to improve their instruction. Algebra teachers at Anderson Park received two or three days of training on the curriculum package during the summer. They learned about the online tutoring program, set up the software for their class, and then navigated through the system as a student so they could understand the student experiences and the resources at their disposal. The algebra teachers also have established common planning sessions (90 minutes) on Wednesday afternoons, supplemented by early release and professional development days, during which teachers can collaborate around lesson plans, classroom practices, and student results. Similar to Douglas City, Anderson Park teachers described these meetings as data driven. Specifically, common assessments mandated by the district and developed collaboratively by teachers provide data that drive

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instructional practices in the classroom. As a math coach explained, “If we have a teacher that did very well on a particular standard, we’ll have a conversation and maybe ask that teacher to model. How did you teach that particular concept?”

In addition to the initial professional development that teachers received on the curricula, and these peer-to-peer learning opportunities, district- and school-based math coaches attend weekly common planning meetings. The coaches provide weekly supports through training, co-planning, modeling, and co-teaching that position teachers to maximize the quality of the double-dose instruction. They also help teachers use data to better support struggling students. For example, when identifying deficits in students’ skills and understandings, one coach noted, “We try to track the unit assessments and touch it right then. [We] don’t let it move on three and four weeks later...When [teachers] test, the next thing they should be doing in the common planning time is reviewing data.” The coaches also help Algebra I and double-dose algebra teachers plan together and coordinate instruction. A district coach explained, “If something gets behind in Algebra I, the enrichment [double-dose] teacher doesn’t press on...let’s see what we can do to make sure they have mastered it as a group effort.”

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Implementation of Double-Dose Algebra

Three key implementation decisions have shaped the ways in which double-dose algebra has evolved in Douglas City and Anderson Park High Schools.

1. **Both high schools deliberately structured additional instructional time to support and enrich learning for struggling students.** A commercially available curricular package with a technology component that fosters personalization, relevance, and formative assessment has helped create the conditions for teaching and student learning at both sites. Educators at both sites often talk about the extended period and the curriculum program interchangeably, an indication that at these sites, the instructional materials are an instrumental component of added learning time. In the absence of resources to purchase a commercially available curricular package, districts or schools could locally develop and implement key components of these packages on their own. In addition, training, coaching, and collaboration have provided teachers with essential tools to support struggling students in a double-dose course. With ongoing opportunities to build their skillset and discuss struggles and best practices with peers, double-dose teachers can help make the experience more productive for teachers and students alike.

“It’s the academic youth development piece. You have to change their mindset [and] let them know, ‘You’re smarter than you think.’”

—Math Coach

Some key ingredients of the curriculum packages are noteworthy. Designers of both programs have attempted to create enriched learning experiences intended to reach struggling students. Embedding problems in real-world examples helps draw students into the mathematics and see connections with their own lives. One program in particular integrates units on growth mindset to help students understand their own learning progress and counteract perceptions that a student is “not a math person.” A math coach emphasized the importance of this approach in explaining the student learning experience: “It’s the academic

youth development piece. You have to change their mindset [and] let them know, ‘You’re smarter than you think.’” The packages also foster peer-to-peer learning experiences for students, recognizing the importance of communication and “math talk” to both the learning process and the skills needed for postsecondary success.

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- 2. Technology-based curricular programs allow teachers to efficiently assess students' unique learning needs.** Students struggle for different reasons, and one-size-fits-all supports may not work. Both programs include online formative assessment components. One program's online component adapts to the students' levels and adjusts content and difficulty accordingly. The other provides real-time feedback to teachers on students' progress through formative assessment—providing information to teachers via a data dashboard in real time as students are responding to questions—to help teachers differentiate and address misconceptions.
- 3. Selecting the right teachers is especially important for supporting struggling students.** The pedagogical skills required of a strong math teacher are always important, especially for struggling students. Beyond this baseline of quality, both Douglas City and Anderson Park have tried to identify the teachers who have the dispositions and relationships that enable them to understand and address the barriers to student success in algebra. As the Douglas City High School math department chair explained, “It’s more about making it engaging and the whole academic youth component of developing an attitude towards math, and a love of math.” A district math coordinator went on to describe the skills that a strong double-dose teacher needs:

I think that selecting the teacher is huge for something like this. You need to have one of your strongest teachers in the classroom. They have to believe that these students can meet grade-level expectations . . . [have] a growth mindset for both themselves and kids, can manage a classroom, have some strong content knowledge, [and] knows how to engage kids.

Although neither school used a systematic process for selecting double-dose algebra teachers, both schools deliberately selected teachers who are both strong algebra teachers and who best connect socially and emotionally with struggling students.

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Challenges and Facilitating Factors

District and school support for double-dose algebra—both programmatic and financial—is a critical factor in facilitating an effective double-dose program. This support includes the following:

- **Financial commitment to support double-dose algebra teachers along with flexibility around course scheduling.** Offering a double-dose algebra course for struggling students requires that double-dose teachers' instructional time be tied up for two class periods instead of one for a single class of students. As a result, other math teachers will need to pick up an additional course or a school may need to hire additional math teachers to free up additional instructional time for double-dose algebra teachers. The costs of additional personnel will vary for schools and districts in different contexts but will require an explicit commitment of additional personnel to support a double-dose algebra course. Offering a double-dose course also means that school leaders need to carefully integrate this course into their master schedule, given that students may be changing courses and classrooms at different times. Integration may be easier for schools implementing block schedules in which all courses run approximately 90 minutes; the double-period course would simply continue all year long in contrast to other courses that last only one half of the school year.
- **Sustained commitment to curricular supports for struggling students.** In Douglas City and Anderson Park, curricula and supporting resources—training, textbooks, technological supports, and formative assessments—were all developed by external providers and purchased by the school or district. A curricular program that includes a technology component will also require an investment in the computers or other devices necessary to implement that program. Not all schools will have access to the financial resources to purchase products from external providers, but they may be able to integrate the key ingredients of the approaches profiled here into their current resources. In either case, if curricular resources shift frequently with changes in district or school leadership, then it may be difficult, if not impossible, to implement supports for struggling students effectively. Educators at both Douglas City and Anderson Park emphasized the importance of continuity in their double-dose algebra approach and of a sustained commitment to offering curricular resources to struggling students.

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Nearly everyone at both sites expressed frustration about endless waves of reform that overwrite or undercut previous initiatives while preventing educators from fully understanding or implementing any approach well.

Sustaining these programmatic and financial supports is critical. Nearly everyone we interviewed at both sites expressed frustration about endless waves of reform that overwrite or undercut previous initiatives while preventing educators from fully understanding or implementing any approach well. In Douglas City, a consistent Algebra I team and consistent use of the curricular package have helped the school weather changes in school administration and funding. The school no longer has the resources to support future training around the curriculum package, but the teachers who received the initial training three years ago are all still at the school. Their commitment to the program and to one another has helped maintain the

double-dose program across leadership changes that might otherwise have swept it away. At Anderson Park, ongoing support from the district for the double-dose period and teacher collaboration time have helped teachers maintain their focus despite teacher turnover and frequent changes to the curriculum package. The sources of stability are completely different in the two sites, but they have allowed the programs to improve and thrive over time.

- **Professional development and structured collaboration to support implementation of a double-dose algebra course.** Both schools provided three to five days of professional development to support implementation of their double-dose algebra during the summer months. This training allowed teachers to experience the curricular resources from the perspective of their students and to learn how to use these resources effectively in the classroom. Furthermore, both schools provided structured common planning time for collaboration—approximately 90 minutes each week. This time allowed double-dose teachers to meet with their peers to discuss successes and challenges and to use formative assessment data to drive instruction. At Anderson Park, the district also provided each school access to a math coach to support implementation.

In addition to programmatic and financial support for double-dose algebra, district and school leaders should consider how best to support struggling students before and after double-dose algebra. Algebra I instruction does not happen in a bubble. Students’ mathematics preparation throughout the elementary and middle grades builds the knowledge and skills that they apply to algebraic content. Providing supports for students learning algebra is a necessary but insufficient approach to addressing skill gaps for students. Mathematics courses after Algebra I also pose challenges as the complexity of the content increases. It will be important to consider how prepared students will be to succeed in a single period of geometry or Algebra II after growing accustomed to the additional time and supports that double-dose algebra offered them.

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Finally, consistent with research, one of the most important components of the successful double-dose algebra courses across both sites was a commitment to use additional instructional time intentionally rather than provide “more of the same” Algebra I instruction and content. Extra time alone may do little to move the needle on student performance. Both profiled schools took deliberate steps to structure a double-dose course that diagnosed and addressed student learning needs through formative assessment and quality classroom experiences. Policies and procedures for scheduling and placement, combined with guidance and support for teachers, created the conditions for a positive learning environment. For double-dose algebra to meet the needs of struggling students, success is likely to require more than scheduling time on the calendar; the structures and supports make the time worthwhile and encourage student’s increased achievement in Algebra I.

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As you consider how best to implement a practice within your local context, it is important to consider the insights gained from a variety of sources. Table 6 highlights how key findings from a systematic literature review of double-dose algebra (Sorensen, 2014; see <http://www2.ed.gov/programs/dropout/learningsupports092414.pdf>) and implications of those findings were reflected in the districts and schools profiled for this brief. As references previously, this project also includes a series of perspective briefs, one of which is focused on the topic of supplementary supports for struggling students, particularly double-dose algebra. This perspective brief highlights practitioners’ reactions to the findings from the systematic literature review (Sorensen, 2016; see http://www2.ed.gov/programs/dropout/supplementarysupports_perspectivebrief.pdf).

Table 6. Findings From Double-Dose Algebra Literature Review

Double-Dose Algebra Programs Can...	Program developers or Administrators Should Consider...	Was This Reflected Douglas City and Anderson Park?
...improve algebra test scores (PLAN and ACT), graduation rates, and college enrollment rates, but there is no evidence for improved overall Algebra I course passing rates in Chicago.	...incorporating the features of successful double-dose programs but couple these programs with additional supports that focus on improved student engagement and participation in school. Programs may need to address challenges for students that may not be algebra specific.	The curriculum packages used for double-dose algebra at both schools purposefully seek to create more engaging learning opportunities through instructional materials that make real-world connections and leverage the power of technology. The package used at Douglas City also went beyond the algebra content to cultivate a growth mindset in mathematics as part of the course material. In addition, both sites reported selecting teachers that connect socially and emotionally with struggling students.
...critically change the peer composition and context of classrooms if students are grouped into courses on the basis of prior achievement.	...developing course placement policies that support struggling students but minimize segregation based on prior achievement. If course placement policies place some average or struggling students in more challenging classrooms with higher-performing peers, it will be important to ensure that students have the supports they need to succeed in a course that may move at a more challenging pace.	At both sites, schools grouped students based on prior achievement into the same cohort of peers—and the same teacher—for both the standard Algebra I course and the double-dose period. The schools did this to build stronger relationships between the students and teacher so that the teacher was better able to understand and address each student’s learning needs through more prolonged exposure and interaction with them.
...have less benefit than alternative models that use the same amount of extra instructional time to focus on preparing students with foundational skills for Algebra I.	...exploring the potential benefits of using extra instructional time to build the skills that struggling students need to succeed in algebra. Programs should use extra instructional time to focus on what struggling students need most rather than “more of the same” content and activities from the standard Algebra I course.	At both sites, educators designed their double-dose programs to ensure that additional learning time identified and addressed student learning needs rather than simply provide “more of the same.” Both sites delivered content through traditional or online curricula, promoted communication and collaboration with peers, conducted ongoing formative assessment, and individualized instruction and intervention to focus on what struggling students need most.

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Appendix. Sampling, Data Collection, and Analytic Methods

In selecting sites for Promoting Student Success in Algebra I, the primary objective was to identify districts and schools that implemented activities associated with the five topical areas that are the focus of this project (instructional practices, professional development, instructional coaching, curricular alignment, and supplementary learning opportunities). In addition, for the practice profiles to be of greatest utility to practitioners and policymakers, we sought to identify sites that were implementing the practices identified in the research (see Research Briefs) as showing the strongest evidence of effectiveness. To enhance the probability that practitioners would identify with the school and district sites, we sought variation with regard to urbanicity, school size, and student demographics. Briefly, the selection criteria included the following:

- Criterion 1: Sites will represent exemplars.
- Criterion 2: Each site should provide some evidence of improved outcomes.
- Criterion 3: Sites will reflect geographic diversity.
- Criterion 4: Sites will reflect the diversity of enrolled students.

Relative to double-dose algebra, our specific expectations were as follows:

Double-Dose Algebra: Selected sites will be schools that provide professional development and curricular frameworks for double-dose algebra teachers. High-quality double-dose algebra programs must go beyond extending students' learning time for algebra and provide specific guidance and curricular materials for enriching and supporting learning for struggling students in double-dose algebra courses. These materials should be accompanied with appropriate professional development opportunities for teachers.

Both sites profiled here also provided evidence of improvement. Douglas City High School participated in a pilot study of first-year (2012–13) implementation of its double-dose algebra curriculum along with two other schools in Douglas City. This study, conducted by a university partner, found impressive results. Using three established items designed to assess key algebra concepts and skills, the study found that students assigned to enroll in the double-dose algebra course scored

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substantially lower than their higher-performing peers on a pretest but closed the gap or exceeded the performance of their higher-performing peers on an end-of-year posttest. Douglas City High School has also reported increased Honors Geometry enrollments after the first year of implementation. Anderson Park High School also achieved substantial improvements by more than doubling the percentage of students proficient in Algebra I—increasing from 26 percent to 55 percent between 2011 and 2014.

Teams of at least three project staff visited each of the profiled sites following training in data collection procedures. On-site data collection activities included interviews, focus groups, observations of professional learning opportunities, document data collection, and informal classroom observations. The interview and observation protocols were developed by project staff with expertise in algebra content, research on double-dose algebra, and qualitative research. Each protocol was piloted and refined based on feedback from practitioners before being fielded for this project. A total of 13 educators were interviewed across the two sites: 3 administrators and 4 teachers in Douglas City, and 4 administrators and 2 teachers in Anderson. All interviews and focus groups were audio-recorded and transcribed. Following the school and district visits, the project team immediately summarized their observations. These observations were used to identify initial themes and supported the development of codes.

Interview and focus group transcriptions were coded in Dedoose, a qualitative data analysis software package. Prior to coding, the project team developed a set of codes with associated definitions and trained staff for consistent application of codes. Additionally, a senior staff member reviewed the coded data as a quality control procedure. Coded data enabled the project team to retrieve data on common topics across interviews. For example, code retrieval allowed the team to analyze all the relevant data points on such topics such as district supports or teacher collaboration. The coding process ultimately allowed for the identification of prominent themes and informed the development of the Key Considerations.

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1000 Thomas Jefferson Street NW
Washington, DC 20007-3835
877.322.8700

www.air.org

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