



The Chicago Algebra Initiative

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In 2003 eighth-grade students nationwide took algebra at a rate of 33% (NAEP, 2003). In the city of Chicago, the comparable rate was a mere 7%. To address this problem, the Chicago Algebra Initiative was developed as a collaboration between mathematicians at three prominent Chicago-area universities and district leaders in the Chicago Public Schools (CPS). The main purpose of this ongoing project has been to provide a high-quality eighth-grade algebra course to Chicago public school students that would enable them to take higher-level mathematics courses upon entry into high school. The means to this end has been a rigorous teacher development program consisting of university-

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based coursework, curricular review, and qualifying exams for both teachers and students.

The opportunity for a well-prepared eighth-grade student to take a ninth-grade-level algebra course in the middle school leads to the student's taking more advanced math courses in high school, including college-level AP courses. Research has clearly shown that advanced math courses in high school greatly increase the chances of a student enrolling in college (Horn and Nuñez, 2000). In addition, advanced math in high school is more strongly associated with successful completion of college than any other factor, including GPA and socioeconomic class (Adelman, 1999). Finally, Rose and Betts (2001) have shown that more math classes and higher-level mathematics classes in high school enhance earnings ten years after high school graduation, even after differences in the student's demographic, family, high school characteristics, and eventual educational attainment are taken into account.

The Chicago Algebra Initiative was developed in 2003 as a collaboration between the CPS Office of Math and Science (OMS) and the university partners: DePaul University, the University of Chicago, and the University of Illinois-Chicago. The intention was to implement an initiative so that every CPS middle school (~480 schools) could offer algebra to qualified students in the eighth

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grade. As the project unfolded, it became clear that a number of interlocking components were necessary to meet this goal. A brief history of the Initiative will introduce these distinct components.

The universities began by developing new courses and refining existing courses for teachers, and OMS began recruiting teachers to take them. Very soon after the universities began offering the first such courses in 2003–04, the need for uniform accountability across the institutions motivated the development of a district-wide teacher qualifying exam. At the same time, the district began developing guidelines in the form of a student readiness rubric to assist schools in choosing students who were ready for algebra. In 2004–05 the first certified teachers offered eighth-grade algebra in schools, and OMS started additional professional development opportunities for these teachers.

One of the major hurdles that had to be overcome was the lack of coordination between the middle grades and the high schools in CPS. In 2005–06 OMS began discussions with the high schools on awarding placement for students taught by Algebra Initiative-certified teachers. The end result was that in June 2006, the Chicago Board of Education adopted a policy providing advanced standing for students who took algebra in the eighth grade from Algebra Initiative-certified teachers (with K–9 state certification) and who also passed a student exit exam that had been developed by the partners.

The components of the Chicago Algebra Initiative as it exists today are:

- Courses for teachers
- Qualifying exam for teachers
- Professional development and coaching
- Student readiness rubric
- Student exit exam
- Articulation with the high schools
- District support for schools

It should be noted that the university partners continue to meet on a biweekly basis with representatives from the district to discuss examination content, course refinement, policies for students and teachers, and the continued growth of the Initiative.

The mathematics content areas included in the university-based courses and on the teacher qualifying exam include number systems, problem solving, linear equations and inequalities, systems of equations, quadratic equations and functions, polynomials, exponents and exponential functions, and arithmetic and geometric sequences. The course work and the professional development and coaching that follow it emphasize making sense of the mathematics, involving students in

the mathematics, understanding the justification and coherence of the mathematics, and understanding connections among mathematical ideas. Sample teacher qualifying exams can be downloaded from <http://www.cmsi.cps.k12.il.us/ViewNewsDetails.aspx?pid=777&id=8712>.

By the 2008–09 school year, 311 middle school teachers had been credentialed through the program. Of the approximately 480 middle schools, 145 are now offering ninth-grade algebra to their eighth-grade students, and 12% of eighth graders are now taking algebra at these schools. In 2009 3,137 middle school students took the student exit exam, with 40% achieving scores that allowed them to take the next level of mathematics at the high schools.

Both internal and external research groups have studied the Algebra Initiative. Working with the 2006–07 cohort of eighth-grade students who took the student exit exam ($N = 951$), Schmidt (2009) examined the effect on ninth-grade math performance of both student participation in the program and student proficiency on the exit exam. Participating students were more likely to have succeeded in their ninth-grade math courses and to have had higher standardized mathematics test scores, even when demographics and prior achievement were taken into account. These participation effects were larger for students with lower prior achievement. Furthermore, students who passed the student exit exam and went on to advanced classes had statistically significantly higher math course grades and test scores. These results also took into account demographics and prior achievement, with effects again stronger for students with low prior achievement. Deiger et al. (2009) used surveys and classroom observations to present accurate descriptions of actual implementation in eighth-grade algebra classrooms and to determine the effectiveness of instructional practice, particular curricula, professional development, and coaching in helping students to pass the exit exam. Using a representative sample of thirty-four classrooms, they showed that, controlling for prior achievement, eighth-grade students who took more mathematics and more intellectually demanding mathematics were statistically more likely to achieve the benchmark score for advancement. Students in schools using approved curricula performed better on the exam, and teacher participation in district professional development and coaching was positively correlated with student success.

The key aspects that have enabled the Chicago Algebra Initiative to be successful have been the maintaining of high mathematical standards, the close collaboration among the three universities, the continual communication with the district to address political and practical needs, and the overarching shared goals of all of the participants

to affect student outcomes. The Initiative has a large number of components, which have developed over time to address different practical considerations, and the overall effort has been strengthened by each additional component. With proper cooperation, extraordinary effort, and unusual persistence from university and school district personnel, the Chicago Algebra Initiative has shown that true change can take place in urban education.

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