

The Algebra Project: Overview of Research & Evaluation

Background

The Algebra Project's founder and participants have worked in classrooms for two decades to develop classroom teaching methods, teacher professional development, and community development that will enable students to succeed in a typical Algebra I course in late middle school or early high school.

Originally, the project targeted classrooms with large proportions of African American students. Recently, the project has been invited to work in sites with large Latino/a populations with varying heritage (e.g. Yuma, AZ; Boston; Chicago; Miami), and has been contacted by sites with other underserved populations.

Originally, the project targeted middle schools, addressing the transition from arithmetic to algebraic thinking. In 1995, founder Robert Moses began addressing high school mathematics, working at Lanier High School, the lowest performing high school in Jackson, MS, and with interested university mathematicians, resulting in NSF grants in 2002 and 2006 to develop instructional materials for high school beginning algebra.

The Algebra Project received a four-year NSF grant in 1997 for teacher professional development and site community development. Recently, the project's youth initiative (the Young People's Project) received an NSF grant to develop college and high school mathematics literacy workers who lead out-of-school sessions for younger students upon invitation from community based organizations.

Note: Since an implementation of the Algebra Project is designed by site members and depends largely on site resources, implementation differs from site to site.

Measures of implementation:

- 1. interest and participation of site members in designing and implementing;*
- 2. development of a local board to guide project implementation;*
- 3. requests for professional development services for teachers;*
- 4. change in teachers' beliefs about students, mathematics, and educational outcomes;*
- 5. change in teaching practices;*
- 6. adoption and spread of Algebra Project pedagogy within a school;*
- 7. use of Algebra Project instructional materials in the classroom;*
- 8. increasing integration of the Algebra Project with other classroom materials;*

Measures of impact on students:

- 9. increased interest of students in algebra, math, and learning in general;*
- 10. increased enrollment (and passing rates) in higher level mathematics courses in high school;*
- 11. student performance on math tests (Algebra Project classroom tests, state mandated tests, college admission tests, college math placement tests)*
- 12. students' deep understanding of mathematics concepts as indicated by in-depth performance assessments and interviews on mathematics problems.*

Sample Results (chronologically)

- Seven cohorts of graduates (1991-1997) of the founding middle school in Cambridge, MA, were tracked into high school (see Tables 1-3). Graduates entered Geometry in Grade 9 at roughly twice the rate of nonAlgebra Project peers (44% vs. 17% in 1992, and 92% vs. 47% in 1996) and the program was effective for African American students in particular (70% vs. 56%). Students also did well in Grades 10-12, with more than 60% passing Trigonometry by Grade 11. School demographics at the time were: 30% African American, 20% Asian, 5% Latino, 45% white. About 45% of students citywide qualified for free or reduced-cost lunch.

- In 1992, the Cambridge, MA, Public Schools mandated that all Grade 8 students be offered Algebra I, largely as a result of the organizing efforts of the Algebra Project there.

- In 1994, a national panel of experts evaluated the Algebra Project in Mississippi, and concluded:

The quality of life in AP classrooms is high in terms of the overall nature of instruction, and in teachers' and students' commitment and engagement. AP classes are fine examples of active and participatory classes where students' experiences are central to instruction.... The AP is having a major influence on teachers' beliefs about mathematics and how it should be taught. Students' verbal articulation around mathematical ideas, and the positive engagement in the project overall, are impressive....

- In 1994, teachers in the Mississippi Delta noted: (1) teachers and students begin to express themselves -- the project develops a "comfort zone" for this expression; (2) teachers are drawn into the project when they see students expressing themselves; (3) teachers learn and accept the facilitator's role because summer trainings, workshops, and community meetings provide continual modeling and practice; (4) "we can continue this hard work because we are not alone".

- Beginning in 1993, under the leadership of the principal and several Algebra Project teachers, a middle school in San Francisco serving Latino/a, African American and Asian students reformed its math program so that all 8th graders take Algebra I. This practice continues today, even though the Algebra Project teachers have now retired. The school's graduates were tracked and found taking (and passing) higher math courses in Grades 9 and 10 at about twice the rate of graduates of demographically similar middle schools (see Tables 4-5). On the state Academic Performance Index, the school has performed above the median for the 100 most demographically similar schools since the index began in 1999, and rose from 628 in 2002 to 725 for 2006 (scale from 200-1000, with target of 800). The lead Algebra Project teacher, who became Assistant Principal in 2003, has now been assigned to "turn around" another underperforming middle school. (Note: Between 1990 and 2006, FRE increased from 50% to 70%, and percentage of English language learners increased from 10% to 25%, and Special Ed from 15-20%.)

- The Algebra Project developed a competency-based program for Algebra Project teachers to learn to facilitate the professional development of other teachers, and to lead

groups in their schools, communities, or national-level Algebra Project activities. Candidates attended intensive workshops, served as apprentices to experienced project leaders, and were assessed on research-based observational measures. By 2001, a “model of excellence” was developed, and over 50 teachers and several university faculty were certified.

- At Brinkley Middle School, Jackson, MS, Bob Moses worked together with several teachers on classroom instruction, with support from the principal, from 1993-96. Algebra Project graduates from Cambridge, MA, also began working with Jackson youth. Although about half of the students participated in classes with project-trained teachers, or in afterschool activities, the project was not implemented school wide. Nevertheless, when all of the school’s graduates were tracked into high school, the findings resembled those in Cambridge and San Francisco: Brinkley graduates entered college preparatory mathematics courses in Grades 9 and 10 at about twice the rate of those from demographically similar middle schools in Jackson (see Tables 6 for math course enrollment throughout Jackson, and Table 7 for results for Cohort 2).

- Small districts in the Mississippi Delta: Many schools in the Mississippi Delta have only 2-4 teachers at each middle grade level. A comparison of Grade 6 test scores on the math portion of the norm-referenced test used by the state (Iowa Test of Basic Skills) between 7 Delta districts where teachers had participated in the project, and 9 similar districts that did not, indicated that the Algebra Project students performed at a higher level (Table 8).

- In 1994, Weldon, North Carolina, was the lowest performing district in the state. Algebra Project organizers began holding community-wide discussions. Some teachers and the principal became involved, and middle school students attended a summer leadership academy. The students began organizing themselves and their community. In 1998-99, 22 of the 58 Weldon 8th graders determined to take Algebra I as well as their regular Grade 8 Mathematics, even though there was no Algebra teacher. Principal Lydia Harding Elder, and Algebra Project Trainers Laura Smith (from NCCU) and Freddie David (a high school teacher from Bennettsville, SC) volunteered to teach Algebra I after school and every other Saturday. Result: 82% scored “proficient” or above on the state Algebra test. Scores for regular Grade 8 Mathematics also rose sharply, from 48% proficient in 1998 to 74% in 1999. As a result of students’ and parents’ advocacy, a new middle school was constructed, a community center created, and a place for tutoring. In Fall 2003, 15 of the students were located: 12 were enrolled in colleges (many won scholarships), 2 were in the armed services, and 1 had no current plans. One of them, Ernest Brooks Jr., has graduated from Morehouse College, is in graduate school and serving on the Algebra Project Board.

- From 1997 to 2001, under an NSF grant for work in Cambridge, MA, Brooklyn, NY; Plainfield, NJ, and several areas of the south, the Algebra Project attracted over 700 teachers into professional development institutes and workshops. 31% participated more than the 100 hours expected, and 17% participated from 150-400 hours, because they

volunteered to attend additional workshops, to lead workshops for other teachers, or to organize and lead supplementary sessions for students.

- At St. Helena Elementary School near Beaufort, SC, where nearly all students are African American and qualify for free or reduced-cost lunch, under the leadership of the principal and several Algebra Project teachers, Grade 5 state math test scores rose from 20 percentile points below state average in 1999 to 25 points above in 2004. 80% of 5th graders performed at or above proficiency, higher than nearby, affluent Hilton Head.

- Lanier High School in Jackson, MS, is the Algebra Project's first high school for R&D. All students are African American and 85% qualify for free or reduced cost lunch. Bob Moses began teaching there in 1995-96, and developed a team by recruiting additional teachers from inside and outside of the school. In 2002, the team began to collaborate with several university mathematicians to develop instructional materials for Algebra I. Tables 9, 10, and Fig. 1 show that, during the first five years of Algebra Project work at the school, enrollment increased in the higher level math courses. Tables 11-12 compare the Algebra I state test scores of the Algebra Project and nonAlgebra Project 9th graders, on their first attempt in spring 2003: 56% of Algebra Project teachers passed the state compared with 38% of nonAlgebra Project students (ns=106, 87). (Students were placed in to classes by counselors according to scheduling need – they were not volunteers.) The Algebra Project continued to offer instruction to this cohort in Grades 10-12, with experimental versions of college preparatory math courses. In Grade 12, these students used college-level textbooks. The majority took the ACT and applied to colleges. Comparisons of the 12th grade and 9th grade math course lists showed that 33% of the original Algebra Project 9th graders were taking Grade 12 math courses at Lanier, compared with 7% of the nonAlgebra Project students.

- Two recent micro-ethnographic studies of the classrooms of master Algebra Project teachers found that students are positioned effectively to become math learners, that mathematics is conveyed as a transparent rather than opaque subject, and that teaching incorporates four important epistemologies of learning.

Sample of research and evaluation reports

- Cazden, C., Conner, S., Davis, R. B., Delpit, L., Edwards, E., Irvine, J. J., et al. (1995). *The Algebra Project in Mississippi: An evaluation report*. Cambridge, MA: Program Evaluation & Research Group, Lesley College.
- Davis, F.E., West, M.M., Greeno, J.G., Gresalfi, M. & Martin, H.T. (2006). Transactions of mathematical knowledge in the Algebra Project. In N. S. Nasir & P. Cobb (Eds.), *Improving access to mathematics: Diversity and equity in the classroom* (pp. 69-88). New York: Teachers College Press.
- Davis, F. E., & West, M. M. (2000). *The impact of the Algebra Project on mathematics achievement*. Cambridge, MA: Program Evaluation & Research Group, Lesley University.
- Godfrey, L., & O'Connor, M. C. (1995). The vertical hand-span: Nonstandard units, expressions and symbols in the classroom. *Journal of Mathematical Behavior*, 14, 327-345.
- Lee, C. D. (2003). "Every shut eye ain't sleep": Studying how people live culturally. *Educational Researcher*, 32 (5), 6-13.
- Moses, R. P., Davis, F. E., & West, M. M. (in preparation). Why does A minus B equal A plus negative B? In B. Greer, S. Mukhopadhyay, A. Powell & S. Nelson-Barber (Eds.), *Culturally responsive mathematics education*. Mahwah, NJ: Lawrence Erlbaum.
- O'Connor, M. C., Godfrey, L., & Moses, R. P. (1998). The missing data point: Negotiating purposes in classroom mathematics and science. In J. G. Greeno & S. V. Goldman (Eds.), *Thinking practices in mathematics and science learning* (pp. 89-125). Mahwah, NJ: Lawrence Erlbaum.
- Schoenfeld, A. (2002). Making mathematics work for all children: Issues of standards, testing, and equity. *Educational Researcher*, 3 (17), 13-25.
- West, M. M., & Davis, F. E. (2004). *The Algebra Project at Lanier High School, Jackson, MS*. Cambridge, MA: Program Evaluation & Research Group, Lesley University.
- West, M. M., & Davis, F. E. (2006). *The Algebra Project's high school initiative: An evaluation of the first steps*. Cambridge, MA: Program Evaluation & Research Group, Lesley University.
- West, M. M., Davis, F. E., Lynch, M., & Atlas, T. (1998). *The Algebra Project's middle school intervention in 1997-98*. Cambridge, MA: Program Evaluation & Research Group, Lesley University.

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date: April 10, 2007