

Preventing Students from Becoming Low-Math Achievers

Nell Cobb, DePaul University
William Crombie, Algebra Project

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The Algebra Project (AP) is a direct descendent of the community organizing tradition of America's Civil Rights Movement. Bob Moses, the founder of the Algebra Project, as field secretary of the Student Non-violent Coordinating Committee in Mississippi during the 1960s, was a community organizer working with poor Black sharecropper communities in the Mississippi Delta. The mission then was to assist members of those communities to gain the right to vote and consequently more fully participate in American society. The mission, today, for the Algebra Project is, similarly, to work with disenfranchised communities of young people in order to assist them in becoming more fully citizens of 21st century America. A necessary condition for full participation in our society requires more than just the reading/writing literacy of 20th century. Young people today need in addition to the literacy standards of the last century a higher standard of mathematical literacy – the ability to read, write, and reason quantitatively.

The Algebra Project has chosen to work with the lowest performing schools and students in underserved urban and rural communities. The traditional approach has been to arrest the development of underperforming students, impede their access to higher studies, and remediate them until they meet a specified performance benchmark. This strategy, a form of cognitive Taylorism, focuses on basic skills, is typically highly procedural, and shows little hope of effectively engaging these populations of students. Over the past 25 years the Algebra Project has developed an approach to working with these populations of students which is both culturally sensitive and experientially-based. Given the present impasse in raising the achievement of the lowest performing student in the US we believe our Cohort Model ultimately offers an effective alternative to current remediation strategies.

The Algebra Project's Cohort Model is a program to accelerate the mathematical learning of students previously under-performing in mathematics. It is based on experiences at Lanier High School in Jackson, MS and at Edison High School in Miami, FL. The Cohort model involves keeping a group of students together for math instruction from grade 9 through grade 12. The students, over time, develop a commitment to their own and each others success in achieving their target of mathematical literacy. Based on our past experience, we have identified features of the cohort model that we find will enable students who enter high school performing in the bottom quartile on national or state tests to become prepared for college study.

Essential Features of the Cohort Model

1. A Cohort school commits for four years to maintaining a class size of 20 students, providing mathematics and English classes every day for a 90-minute block, and a providing a common planning period for teachers everyday; and
2. Cohort students commit to take math and English classes every day for 90 minutes and to

- participate in summer institutes as well as other aspects of the program listed below; and
3. In the mathematics program students use the Algebra Project's experientially-based classroom materials for all four years; and
 4. The students' teachers are prepared and supported in the use of these materials by 2-6 weeks of summer and winter Professional Development (PD) institutes annually, as well as receiving job-embedded daily support during the school year with a experienced Algebra Project professional development specialist in mathematics and a corresponding professional development specialist in English; and
 5. Cohort students attend summer institutes (that are locally developed and designed) to enhance their learning.

The Algebra Project has also identified additional characteristics that we recommend as important for cohort schools, but the forms in which these characteristics are implemented will have to vary from school to school. .

- Community groups develop a local network of parents, school personnel, community activists, and leaders, who focus on sustaining the above intervention; and
- Cohort students have support from counselors who can work with them individually and/or in groups; and
- Cohort students are exposed to the wider culture in some way that overcomes their isolation from the larger society; and
- Cohort students receive some form of support for college entry and an introduction to various careers and job opportunities.

Expected Outcomes for Students

If the five Cohort Characteristics are implemented, we predict the following outcomes for cohort students. These outcomes are the focus of a research effort presently being conducted at four sites participating in a five-year, National Science Foundation, Discovery Research initiative (#DRL0822175):

1. More than 90% of the cohort students will chose to remain in the program for all four years;
2. Cohort students will exhibit-
 - a. positive attitudes toward mathematics and confidence in their own mathematical thinking;
 - b. a desire and capacity to engage in deep mathematical thinking about various concepts;
 - c. a willingness to demand engagement from their peers, and to take responsibility for the classroom environment;
 - d. an insistence on support from adults, including teachers, parents, administrators, and government officials.

In addition there are three critical and measurable student outcomes that we are looking to achieve in the Cohort Program:

1. All cohort students who remain will pass state mathematics tests and mathematics sections of graduation exams;
2. All cohort students who remain will perform sufficiently well on college entrance exams (SAT or ACT) to gain admission into college; and
3. A large majority of the cohort students who remain will place out of remedial math in college and will be qualified to enroll in mathematics courses for college credit.

The Process of Program Implementation

The Algebra Project's Cohort Program involves three areas of development and an organizing strategy. In order to implement the Cohort Program the AP has been involved in Materials Development, Professional Development and Professional Development for Professional Developers.

Materials Development

From 2003 to 2008, with the support of two grants from the National Science Foundation's Instructional Materials Development Program, the Algebra Project began the development of materials for high school based in part on lessons previously learned from work with middle schools and middle school curricula during the 1990s. These materials, however, were developed in partnership with university research mathematicians and math educators. The most salient features of the materials were:

- As with the middle school materials, the high school materials were experientially-based. By that we mean that the central concepts of the curricula were introduced by some common experience for the students. In the first instance the purpose of the experience is to help students take ownership over the process of learning by giving them, first and foremost, an emotionally and intellectually engaging context to consider and reflect upon.
- The materials, themselves, are conceptually-challenging. But in adopting an experiential approach to the mathematics they are also leveling the playing field. That is to say that while the entry point they provide into the mathematics does not require specialized knowledge the materials do require careful reflection on the part of students. The materials are built to support and promote sense-making, conjecturing, and reasoning.
- The experiences were specifically chosen and constructed in order to establish a grounding metaphor for students, i.e. a way for students to make sense of abstract mathematical ideas by reference to these core experiences.
- The materials guided students, via a curricular process, in mathematizing their experiences to finally arrive at the abstract symbolic characterizations of mathematical concepts that the high school curriculum requires.
- And finally because the materials built the mathematics in this experiential fashion the curricula provided a concrete basis for student voice and discussion. Consequently the curricular materials put a great deal of emphasis on developing both the orality and literacy of students.

Professional Development

Materials structured in this fashion make qualitatively different and greater demands on teachers than more traditional curricula or even, in some instances, the more recent reform curricula in mathematics. The professional development of teachers in Cohort Programs requires support for a deep change in teacher practice. And by practice, we are referring to both a teachers' practice of teaching (pedagogy) but also their practice of learning – the teachers' relationship to mathematics as a discipline, how they conceptualize, and even more importantly, how they re-conceptualize the mathematics they are to teach. The experiential approach to mathematical concepts and the prominence given to student voice means that teachers find themselves facilitating a much more open discussion of mathematical topics than most mathematics teachers in the US are use to.

We find these demands are best met by helping teachers organize themselves into effective professional learning communities. In the process of working together in small and large collaborative groups teacher practice, both the practice of teaching and the practice of learning, necessarily become public, a public practice open to observation, comment, and critique by peers. Within this context, the professional development of teachers in a Cohort Program is directed towards helping teachers, both individually and collectively, achieve:

- Content Mastery – a deep re-conceptualization of the mathematics they need to teach, its conceptual precursors and consequences.
- Lesson Mastery – the ability to plan, deliver, and assess “polished” lessons.
- Classroom Leadership – providing more than just (classroom) management for the Cohort of students that they teach, support, and develop.

Professional Development for Professional Developers

The Algebra Project's work with high school as opposed to the work with middle schools in the 1990s has highlighted the need for much stronger collaboration between AP professional development specialists, mathematicians and math educators, and the need to focus on increasing both the quality and capacity of professional development services for teachers, PD specialists and mathematicians at all levels.

This need is demonstrated in at least two basic ways. In its efforts to promote math literacy for under-served populations, the Algebra Project developed at the middle school level and is presently developing at the high school level conceptually-challenging curricula delivered through an experientially-based pedagogy. This combination of content and process presents unique demands upon both the teachers who will implement AP curricula and the research mathematicians and AP PD specialists working with and supporting these teachers. As mentioned above, it requires teachers to re-conceptualize the mathematics they have been teaching at a much deeper conceptual level than they previously have. But it also requires research mathematicians and AP PD specialists to work closely together in order to aid and support teachers in this process.

The nature and type of work at the high school level requires an especially deep collaboration between teachers, research mathematicians and AP PD specialists. The nature of this work places

the culture of research mathematicians' right next to and more often within the culture of the k-12 educational system. These two cultures often carry very different norms and expectations. Consequently this work requires from both research mathematicians and AP PD specialists not only a high degree of cultural sensitivity but also an ability to effectively negotiate the cultural differences between these groups.

The Algebra Project's PDPD Program is consequently aimed at supporting the development of professional development specialists and university mathematicians who are working with cohort schools to provide on-going support to Algebra Project teachers. This begins with the delivery of a 5-day *Professional Development for Professional Developers Institute* appropriate for AP PD specialists and AP mathematicians at both the secondary and middle grades levels. It continues periodic support for those supporting cohort teachers.

An essential tool which the Algebra Project is the development of a competency model of effective PD practice, a Model of Excellence, for AP mathematicians, AP PD specialists, and the teaching of teachers within the Algebra Project at the secondary school level.

Organizing Students – Building Demand for Math Literacy

Founded in 1996 as an outgrowth of the Algebra Project, it is the mission of the Young People's Project (YPP) to use Math Literacy as a tool to develop young leaders and organizers who radically change the quality of education and life in their communities so that all children have the opportunity to reach their full human potential. YPP trains and organizes high school and college students to work with their younger peers and families, and in their communities, to build demand for math literacy. Math literacy is the point of entry to, and foundation for, the broader leadership development and skills-building YPP engages in to develop young people as effective organizers and advocates for high quality public education in their communities. YPP operates from the premise that there cannot be successful school reform without community reform, i.e. the culture of the community around education has to change. This cultural transformation must take place on three levels: 1) communities develop confidence that their youth are capable of academic success; 2) communities develop a sense of responsibility for ensuring the academic success of their youth; and 3) communities begin to see themselves as agents of social change, responsible for building the requisite demand and capacity necessary to ensure high quality public education for all youth. The Young People's Project is thus the organizing strategy for developing student leadership within the Cohort.

The Cohort Model in Mississippi

The Cohort Model was initiated at Lanier High School, Jackson, MS. Beginning with those students who took Algebra I with the Algebra Project in 2002-03, the project kept together a group of students, who took math every day in long periods. The graphs below show the results at Lanier High School, where the first cohort graduated in 2006. The features of the model are based on work at Lanier and are the result of collaboration among teachers, students, Algebra Project members, and university and math educators.

Through a grant from the National Science Foundation's DRK-12 program the Algebra Project has established six 9th grade cohorts in four schools: Crenshaw and Franklin High Schools in Los Angeles, CA; Mansfield High in Mansfield, OH; Eldorado High in Eldorado, IL; and Ypsilanti

High in Ypsilanti, MI. With this grant, the Algebra Project holds itself accountable to radically transform the lives of additional students who have so far not been reached by education reforms, and to stimulate the interest of educators across the economy in this model.

Results from the first Cohort in Jackson MS

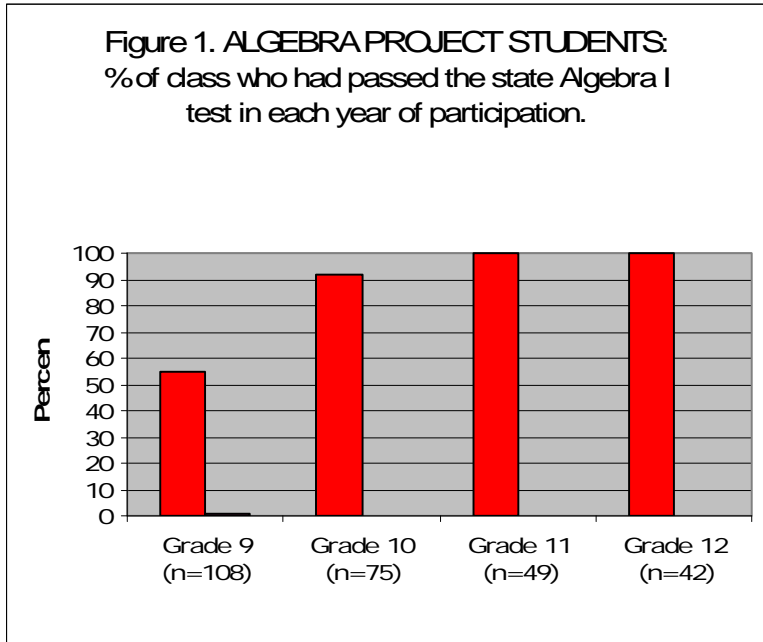
The students, who took Algebra I with project-trained teachers in 2002-03, were offered the chance to stay together for the next year, taking math daily in double periods. This was repeated each year. We later tracked all of the students at Lanier who took Algebra I in 2002-03, and compared outcomes for the Algebra Project students (108 in Grade 9) and those who took Algebra I using traditional materials (86 in grade 9).

The Algebra Project students had improved outcomes in passing the state Algebra I test, in on-time graduation rates, and fewer students dropped out of school, compared to the non-Algebra Project students.

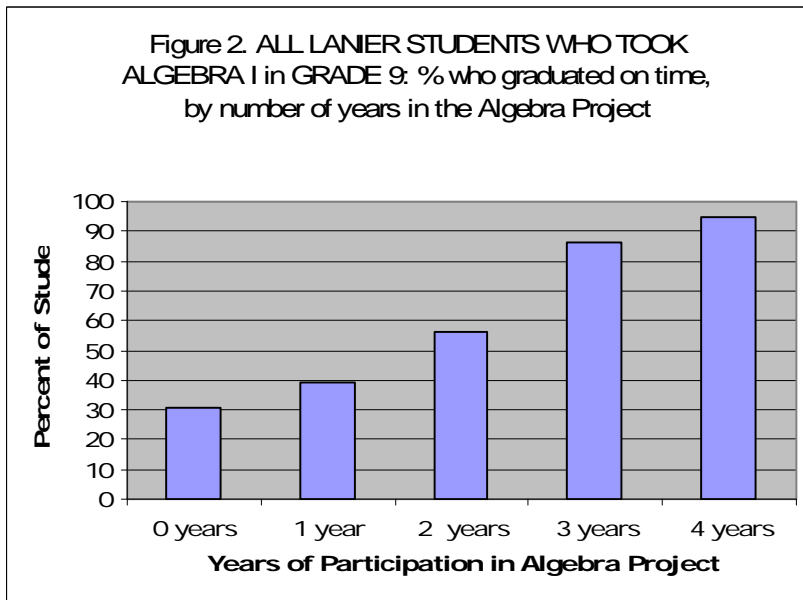
These effects strengthened after TWO years in the project (see tables below). This is due to the project's strategy to enable students who failed the state test at the end of Grade 9 to continue with the project's Geometry course in Grade 10, with extra support to re-take the state test. The project's approach places value on student outcomes, in contrast with the school accountability approach embedded in the NCLB policies. Results are also attributable to the formation of the peer culture for persistence and achievement, enhanced by keeping students together.

1. **Increase in the proportion of students who passed the state Algebra I test (required for graduation).** At the end of 2003, all Algebra I students took a state Algebra I test. Fifty five percent of Algebra Project students passed compared to 37% of non-Algebra Project students. After two years, 92% of Algebra Project students had passed.
2. **Increase in the on-time graduation rate.** 53% of students in the Algebra Project who stayed in the cohort for at least one year graduated on time, compared with 31% of students never in the project; however, if students remained in the project for at least two years 69% graduated on time, compared to 27% who were in for only one year, or not at all.
3. **Decrease in the proportion of students who drop out of high school.** Only 17% of students who were known to have dropped out of high school, compared to 35% for those never in the project (based on state records).

Algebra Project Cohort I (2002 – 2006) Lanier High School, Jackson, MS



Nearly all students passed the state Algebra I exam by the end of sophomore year



On-time graduation increased with time in the Algebra Project Cohort

Adoption to APEC economies

In order to develop and implement a Cohort Program APEC economies would need to consider experiential learning, culturally relevant curriculum built upon a cultural base of literacy. The curriculum would focus on the language and experiences of their students just as the AP curriculum in the US focuses on the respective student populations.

The training requirements could best be met through the establishment of a Design Team. Such a team would need to consist of community organizers, university mathematicians and math educators, school administrators, professional developers, and teachers. We recommend that this Design Team complete an apprenticeship with an Algebra Project Cohort site. The apprenticeship would be the first step in a seven year implementation strategy.

Challenges

The principal challenge for an APEC economy would be the time and financial commitments for the projected seven year term. Short term commitments are easier than long term commitment, at least in the short term. We have outlined a seven year proposal for program adoption.

A Seven Year Implementation of a Cohort Program

- Year One – Design Team apprenticeship with the Algebra Project and an Algebra Project Cohort site.
- Year Two – Materials development in classrooms involving mathematicians, teachers and other design team members.
- Year Three to Six – Cohort development across four years
- Years Five and Six – Development of a Model of Excellence for Teachers and Professional Developers
- Year Seven Summative evaluation of the Cohort Program

Coda

Human resources, unlike natural resources, do not sit still waiting to be developed. Human resources are always in motion. If they are not progressing they are regressing. Young people, students, from the most under-served, disenfranchised parts of our societies are either tomorrow's source for innovation and discovery or tomorrow's source for social instability. The Algebra Project chooses to work with those students who society has seemingly given up on. The Algebra Project is looking for a path to accelerate their development rather than remediate. And most importantly the Algebra Project locates the key to success with those young people themselves, with the demand they raise for a quality education, with the demands they make of themselves.

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