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Algebra for All in Middle School? Perceptions and Experience of Eighth Grade Algebra Teachers in Philadelphia's Talent Development Middle Schools

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Adolescents have to pass an introductory algebra course if they plan to go to college and, increasingly, must pass it in order to be promoted to ninth grade or to graduate from high school. Research findings have demonstrated that all students—even those with poor prior preparation in math—have higher math achievement levels as a result of taking algebra.¹ As of the 1999-2000 school year, the School District of Philadelphia mandates that ninth graders pass a full-year algebra course before moving on to tenth grade. Yet algebra has long been the academic equivalent of Waterloo for a substantial number of the city's students. Sixty-five percent of the 11,644 first-time ninth graders took Algebra I or its equivalent during the 1999-2000 school year, and one third of them failed the course.² A 1998-99 study of a district-wide cohort of students in comprehensive (non-magnet high schools) who were participants in a program for the college-bound found that one third of these students had not passed algebra or its equivalent by the end of their junior year.³

Three of Philadelphia's 42 middle schools have tackled the algebra issue by requiring algebra for all students in the eighth grade. These three high-poverty schools have implemented the Talent Development Middle School comprehensive school reform design developed at the Center for Research on Students Placed at Risk (CRESPAR) at Johns Hopkins University. The Talent Development effort includes components that create a high performing learning community characterized by both academic rigor and personal nurture for students. This model advocates a three-year approach to developing algebraic knowledge in the middle grades whereby students are gradually introduced to algebraic concepts through use of the University of Chicago School Mathematics Project (UCSMP) Everyday Mathematics curriculum in the sixth grade, the pre-algebra Transition Math book in the seventh grade, and then the Algebra text and course sequence in the eighth grade.

¹ Gamoran, A. & Hannigan, E.C. (2000). Algebra for Everyone? Benefits of College-Preparatory Mathematics for Students with Diverse Abilities in Early Secondary School. *Education Evaluation and Policy Analysis* 22 (3), 241-254.

² Data made available by the School District of Philadelphia and analyzed by Ruth Curran Neild, CRESPAR, Johns Hopkins University, October, 2000. Neild also reports that 35 percent of all students in the high schools who were taking Algebra I or its equivalent (IMP or General Algebra) during 1999-2000 failed the course. Similarly, 37 percent of all ninth graders attempting Algebra I, including those repeating ninth grade, did not pass the course.

³ Neild, R.C. (2000). *The College Access Cohort: A Report on the Second and Third Years*. Philadelphia: Philadelphia Education Fund.

Students who take algebra in the eighth grade--25 percent nationally do so⁴—benefit in several ways. If they are not strong mathematics students or have had years of mediocre or poor instruction, then a year of algebra in middle school enhances their chances of passing algebra when they take it in the ninth grade in high school. Given the high failure rates in algebra courses in Philadelphia and other urban districts, this extra year of exposure can be of critical importance. Recent research confirms that students who take algebra in both the eighth and ninth grades achieve at higher levels than those who start algebra in high school.⁵ Stronger students benefit from taking algebra in the eighth grade because it gets them on a “fast track” in mathematics leading to successful completion of advanced math courses and access to calculus or another advanced math course in the twelfth grade.⁶ Calculus is the gateway to college majors in mathematics, science, and technology.

This report summarizes the perceptions of the ten eighth grade teachers who taught algebra to all eighth graders in the three Talent Development Middle Schools during 1999-2000, the first full year any of these schools had attempted such an ambitious effort. These teachers were interviewed at the end of the 1999-2000 school year. The aim of the interviews was to check in with the teachers to see how their year had gone—what worked well and what didn't—and to get ideas for improving the program.

The Algebra Teachers

These ten teachers—four men and six women--were all veteran instructors in the School District of Philadelphia. Two of the ten held a secondary teaching certification in the field of mathematics—the rest were elementary-certified teachers who had participated in additional training over the years in mathematics. All looked forward to teaching algebra again during the 2000-2001 school year and defined themselves as math teachers. Several had assumed leadership positions in their schools in math instruction and/or had become teacher trainers for the Talent Development program's after-school, summer, or Saturday workshops. In short, these were seasoned teachers who had been immersed in math professional development activities of various sorts.

Six of the teachers had taught three sections of students in eighth grade algebra all year; another two had instructed two sections; and two had taught just one section each. Nearly all of the classes had 33 students enrolled, the norm for Philadelphia's schools. Seven of the ten teachers had “looped” with one or more of their algebra classes, meaning they had taught those students

⁴ Reese, C.M., Miller, K.E., Mazzeo, J., & Dossey, J.A. (1997). NAEP 1996 Mathematics Report Card for the Nation and the States. Washington, DC: National Center for Education Statistics.

⁵ Gamoran, A. & Hannigan, E. C. (2000). Algebra for Everyone? Benefits of College-Preparatory Mathematics for Students with Diverse Abilities in Early Secondary School. *Educational Evaluation and Policy Analysis* 22 (3), 241-254.

⁶ Smith, J. B. (1996). Does an Extra Year Make Any Difference? The Impact of Early Access to Algebra on Long-Term Gains in Mathematics Attainment. *Educational Evaluation and Policy Analysis* 18 (2), 148-160; Smith, J.B. (1992). Access to Algebra: Social Stratification in Students' Access to Eighth Grade Mathematics Courses. Doctoral Dissertation. University of Michigan: DAI, 54 no. 01A:0120. Useem, E. (1992). Getting on the Fast Track in Mathematics: School Organizational Influences on Math Track Assignment. *American Journal of Education*, Vol. 100 (3), 325-353.

in seventh grade (and sometimes sixth grade) as well. Another teacher intended to loop during the coming year.

Student Success Levels in Eighth Grade Algebra

Teachers talked about deficiencies in students' preparation levels—knowledge of multiplication tables, decimals, and fractions--as they came into the eighth grade algebra class. One algebra teacher who started teaching an additional extra help session before school in the morning mid-year said she did not realize their deficiencies until she tutored students one-on-one in those sessions. She estimated that 40 percent of the students in her classes did not know their multiplication tables. One teacher estimated that 85 percent of the students had weak arithmetic skills while another thought that “only” 20 percent fell in that category. Teachers said that students were better prepared if they had “looped” with them the year before or if their prior teachers had faithfully attended professional development sessions in the math curriculum. They were scornful of their colleagues who avoided these sessions and only halfheartedly implemented the mathematics curriculum. One teacher was hopeful that NSF-approved curricula adopted in the lower grades in recent years would better prepare students for middle grades math.

After a year's experience teaching algebra to eighth graders, however, eight of the ten teachers said that the goal of algebra for all in that grade was feasible. One teacher felt “the jury is still out” and another said it was not for all students. All but one felt that taking the course in the eighth grade would enable students to be successful in high school algebra classes. One talked about the importance of the course in giving them critical thinking and problem-solving skills. Overall, teachers were surprisingly positive in their assessments about the course given their discouragement about students' weak level of prior preparation:

Every year it will get better. We keep refining it. The more you make them do, the better they get.

It was a good year. It really was. I enjoyed the year and the students have at least been exposed to algebra. It won't be a foreign language to them next year.

My premise is you don't know what these kids can do because they have never been pushed.

Grades

Substantial proportions of students got low grades in the eighth grade algebra course. At one school, 42 percent of the students got a D (65-69) and another 5 percent got an F. Only 2 percent got an A. At another school, approximately 30 percent got a D; 4 percent got an F; and 9 percent were awarded an A. The third school's grades were not available but teachers' self-reports indicated that 5 percent got an F and about 20 percent got a D.

Teachers were candid about their grading policies for the eighth grade algebra course. For the most part, they reserved Fs (and sometimes Ds) for students who did no work. Students who put out some effort usually passed even though their test grades did not warrant a passing grade. As

a result, when asked about grade distributions, teachers talked about “legitimate” passing grades versus those given just for effort. Several estimated that 20 to 30 percent of their students should have gotten an F. One teacher said he was giving fewer Fs because of the more stringent promotion requirements to ninth grade. Another teacher noted that no one failed or deserved to fail in a class she had “looped” with for three years whereas 20 to 25 percent of those in the classes she had not looped with deserved to fail.

Generally speaking, the teachers felt that their students would need to repeat algebra in the ninth grade, with perhaps a very small percentage moving directly into Geometry (assuming they passed a placement test in the fall of ninth grade). They thought that students needed another year in the subject because a) in some cases, the teachers had not covered all of the key topics in the algebra I course; and b) the students had only partial mastery of the material and some had almost none. A two-year algebra sequence beginning in the eighth grade made sense to the teachers, particularly since so many of their students were still struggling with computation.

Teachers’ estimates of the percentage of their students who were likely to pass the ninth grade algebra course varied substantially: two of the teachers estimated that 80 percent or more of their students would pass; four others put the number at 60 percent or a little more; two conjectured that half would succeed; and one thought that fewer than half would pass algebra as freshmen. Several teachers said that about 10 percent of their students could place out of algebra and go directly into a geometry course.

Classes are heterogeneously grouped in schools adopting the Talent Development model. Several teachers were troubled by the wide range in skill levels in their classes and recommended some mild forms of grouping to deal with it:

I believe that if you’re going to do algebra for all, there needs to be some [ability grouping]. Some students can handle the pacing, others need to be moved further. These kids who are the cream of the crop need to be challenged, and they’re not [being challenged] in a heterogeneously grouped algebra setting because there are so many kids lacking basic skills that prevent them from learning the algebra, so the teacher is concentrating on basic math skills. In my opinion, take the cream of the crop, create an advanced math class, and let’s move on with them. The other students, give them the algebra and move a little slower with them.

We have too many lows [low skilled students] and not enough highs and almost no kids in the middle. It was just a struggle to try to teach a class to kids where either I’m teaching down or I’m teaching up. There was no middle ground that I could find with them.

All kids, yes, in the eighth grade should get algebra, but how they get it and when they get it should be different. Some form of algebra—and even using the same algebra book. [The kids who need more help] should have pre-algebra half the year and algebra the other half.

Thoughts about Extra Supports for Students

Teachers talked about the kinds of extra supports students needed in order to be successful in algebra. One said that more in-class tutors were needed for Cambodian and Spanish speaking students. Three mentioned the need for a strong functioning extra-help elective-replacement CATAMA Lab, an option that was fully functional in only one of the three schools. One teacher talked about the “breakfast club” she ran every morning in her room (with no extra compensation) where students could eat breakfast and get tutoring help in algebra. She felt that students who took advantage of this opportunity were definitely helped by it. Another pointed out that the CATAMA Lab assisted students with moderately low skills, but there was little extra help for students with very low skills.

There is very little support for the very low-level math student. Everybody seems to be focusing on that group that falls right ‘below basic,’ and the real low-level students have no real support. And they do need small group settings—almost one-on-one.

During the second half of the year, the School District funded early morning, after school, Saturday programs and summer programs for students at-risk of not being promoted to the ninth grade. Six of the ten algebra teachers taught in these programs. They agreed that the individual tutoring before and after school provided significant support for students but they were less sanguine about the impact of the hastily-organized Saturday classes where the curriculum was not closely tied to work in the regular classes.

Some of the ones who came to tutoring in the morning--there were some who were the borderline students who could do algebra, but they can’t do it in a class with all the kids, so they would come to me in the morning ... They came and they said ‘I can’t understand this, can you explain this one part to me?’ And seeing them learn and actually teach other kids in the class ... that was very big [for me] ... It was tiring to come in at 7:00 in the morning but it did justice and it did do a benefit to the kids that usually come.

The Saturday classes need to be better organized. The kids are at different levels. The first day I had 25 in algebra and all but two kept coming. They were all over the place. I didn’t know what to do. Their teachers were at different places in the book. They kids needed one-on-one help. I don’t know if the classes helped. I focused on ‘power skills’ [empowering students to change certain behaviors such as study skills]. They need to change their behavior.

I basically did problem-solving on Saturday. [It helped] some of my kids fine but other kids, you know, you could stand on your head all day long and it doesn’t seem like anything’s going to help them. The ones who were making progress came. The other ones didn’t. So it really wasn’t a great turnout.

The extended day clarified a lot of things [for the students] because this one teacher couldn’t communicate with the kids and those poor kids got no algebra. They all came to the afternoon class. I had a nice session with them because they were my old students and they used to say, ‘Mister, we don’t have any algebra. We don’t know what this is.’

[The teacher was subsequently removed from the school and other teachers took the students.]

I'm not so sure what the Saturday program accomplished.

Assessments of the Support from the Talent Development Initiative

The Talent Development middle school effort provided teachers the opportunity to take 38 hours of professional development sessions for which they could either get graduate course credit from St. Joseph's University or a monetary stipend. In addition, a teacher on special assignment from the School District provided in-class coaching on content and pedagogy and assistance with materials. The teachers were unstinting in their praise for this support:

[The coach] is a lifesaver. I can't say enough about her.

[The coach] has been great. She gets the answers and the resources.

She is really good as a leader, as a helper ... She's not hard on you in saying 'Well, this is the way it has to be done. I want it done this way.' She understands those who have experience and who can run and get everything tied together. There's other [less experienced] teachers here that need direction, and she's very good with that ... She says the purpose of the text is to have a structure for people who may not be as creative as people such as my colleague and myself, because we really do things out of the ordinary.

The Saturday professional development classes are really instrumental in understanding the text. [The coach] is fantastic.

One of the teachers voiced her assessment about the role Johns Hopkins University's team has played in whole school reform at her school:

I look at Johns Hopkins as being for the past five years a crutch and a glue that puts the puzzle pieces together for us because before they came to this school, we had a goal, we had visions and we knew where we wanted to go. But we didn't know how to get there. We couldn't put the pieces together and keep them there. They were always changing every year. They came in and put those puzzle pieces together, glued it for us, and now we seem to be smooth sailing.

All but two of the teachers were satisfied with the UCSMP Algebra textbook. The two who were not enthusiastic felt that the book was difficult for the students and, at first, seemed too disconnected in its presentation of topics. Most of the teachers wanted to use the book as a resource, supplementing it with other materials. One teacher thought more repetition needed to be built into the book. Another wanted more problems and a wider range of problems included in the book for student practice. One recommended that a course guide and supplemental materials be added. A teacher articulated her general view of use of the text:

Yes, I'm satisfied using the text. The text allows you to be more creative if you so desire. You can use algebra tiles and other hands-on materials and activities. But if you aren't experienced enough teaching algebra, then the textbook is quite handy. Again, an experienced teacher who is a secondary certified algebra teacher is, in my opinion, the only one who can come in without a textbook. But I still think kids need that book as a resource regardless. There are students who need to be able to read it as well as listen to it as well as write it in order to learn.

Recommendations for Program Refinements

A number of recommendations for program modifications emerged from these interviews with teachers, refinements that would intensify implementation of the algebra for all effort:

- Teachers believe that students are significantly more likely to be successful in algebra if they had the same math teacher for seventh and eighth grades (and sometimes for sixth grade). Seven of the ten teachers had experience with such "looping" and heartily endorsed this practice. Their views on this subject were so strong that administrators would be well advised to implement looping on a regular basis.
- Cluster offices need to give very high priority to articulation between school levels on issues related to the math curriculum and information on student experiences in math courses. The eighth grade algebra teachers did not know the ninth grade math teachers, the nature of the ninth grade algebra course, and their students' grades in the ninth grade math courses. Data on student outcomes needed to be shared across grades and schools.
- Extra-help opportunities, particularly those that give students one-on-one tutoring, need to be maintained and expanded. More effective CATAMA labs (extra-help math labs in the middle schools operated during school hours) need to be more fully developed, before and after school tutoring needs to be maintained, and Saturday courses should be carefully crafted to be more tightly aligned with school-day course content and assignments.
- The algebra teachers felt strongly that principals should be forceful in encouraging math teachers to attend the Talent Development math professional development training sessions aimed at acquainting them with the text and the curriculum. They argued that when teachers did not participate in such professional development, their students' performance suffered noticeably when they moved into eighth grade algebra.
- Several teachers thought that the schools themselves or their cluster office should generate report cards rather than forwarding grades to central office staff where report cards were created. The centralized process meant that the final marking period ended 10 or 11 days before the end of school, thus wasting significant instructional time.
- Some of the teachers talked about the need for subject-area meetings among the teachers in the middle schools so that it would be easier to coordinate and plan instruction and to

share ideas. Teachers meet with their inter-disciplinary small learning communities regularly but rarely meet by subject area. It was clear from the interviews, for example, that some teachers were successful in getting their students to do the algebra homework while others despaired of doing so. Sharing of subject-specific strategies on this and other matters seems vital for student success.

To summarize, the eighth grade teachers spearheading the algebra for all effort in three middle schools think the strategy is feasible and point to modest success in the first full year of operation. They all want to continue teaching algebra to eighth graders. They acknowledged the weaknesses in many students' preparation, the substantial proportion who passed the course without demonstrating proficiency in the subject, and the difficulty many would have in passing algebra in the ninth grade. They did not, however, want to jettison the notion of requiring algebra in eighth grade but instead outlined steps that would intensify implementation of the effort.