The Impact of Mathematics Specialists in Virginia
Dr. William Haver
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A growing number of elementary schools in Virginia have been making extensive use of Mathematics Specialists as a tool to enable many more students to be successful in learning mathematics.

As we use the term in Virginia, a Mathematics Specialist is based in an elementary school in order to support the professional growth of teachers and promote excellent mathematics instruction and student learning. Mathematics Specialists are responsible for strengthening classroom teachers' understanding of mathematics content and helping teachers develop more effective mathematics teaching practices. Typically they collaborate with individual teachers through co-planning, co-teaching, and coaching. The duties of these Mathematics Specialists are described in more detail in the appendix to the materials submitted to the committee entitled *Who are Mathematics Specialists*?

Working in a school building the Mathematics Specialists are helping teachers and schools develop strong programs consistent with the findings and recommendations of the National Math Panel. They

- Implement a school-wide curriculum that is focused and provides coherent progression from year to year.
- Assure that students develop both conceptual understanding and computational fluency.
- Provide professional development so that
    - Teachers know in detail and from a more advanced perspective the mathematics content they are responsible for teaching and the connections of that content to other important mathematics, both prior to and beyond the level they are assigned to teach.
    - Teachers are aware of and can implement effective research-based teaching strategies.

Virginia first began utilizing Lead Mathematics Teachers in the early 1990s. Based on what was learned about the accomplishments and limitations of classroom teachers serving as lead mathematics teachers, the mathematics community studied the use of Mathematics Specialists in other states.

The first full-time, school-based coaches were placed in Virginia schools about ten years ago. The impact of these Specialists on instructional practice and student achievement was marked. Mathematics supervisors, principals and teachers reported on the major difference that the Specialists made in teachers' attitudes and approaches

to teaching mathematics. Major improvements in student performance on standardized tests were reported. For example, in one school system with three elementary schools a full-time coach was employed in one school; a year later, that school became fully accredited for the first time. This process was repeated each year for the next two years in the division's other two elementary schools. In a larger inner city system that made use of Mathematics Specialists, student achievement increased so that no elementary schools were "unaccredited" or "accredited with warning in mathematics." As a result of these gains the district decided in 2004 to employ coaches in all 35 elementary schools. A special issue, volume 8, of the *Journal of Mathematics and Science: Collaborative Explorations* was published, with support from ExxonMobil, detailing these and other (admittedly anecdotal) experiences. The issue is available on-line on the Virginia Mathematics and Science Coalition home page http://www.vamsc.org/ .

As this strong and striking evidence became available in 2002-03 consensus developed in all components of the mathematics/mathematics education community that

I. The capacity should be developed statewide to appropriately prepare teachers to serve as Mathematics Specialists as resources become available and as school systems make the decision to deploy Specialists.

II. Concurrently conduct high-quality research of the type called for by the National Mathematics Advisory Panel to measure the impact of the preparation program on prospective Mathematics Specialists and the impact of Specialists on teachers they support and on student achievement.

I. Building Capacity

The Virginia Mathematics and Science Coalition identified Mathematics Specialists as the most promising means to improve student achievement in grades k-12. The Coalition appointed a statewide Task Force to develop a consensus on the role of Specialists, the recommended competencies and the preparation program. Critical financial and advisory support has been provided by ExxonMobil.

The Virginia Council of Teachers of Mathematics and the Virginia Council of Mathematics Supervisors both developed and implemented programs to support Mathematics Specialists.

Six universities collaboratively developed and are offering especially designed masters degree programs for Mathematics Specialists. The partners include: Virginia Commonwealth University (VCU), Norfolk State University (NSU), University of Virginia (UVA), Longwood University (LU), George Mason University (GMU), and Virginia Tech (VT). To date approximately 95 degrees have been awarded and 150 teachers are enrolled in degree programs.

The Virginia Board of Education with the concurrence of the governor has approved a Mathematics Specialist endorsement. The Board has also recommended to the State legislature that school systems be required to deploy a Mathematics Specialist for each 1,000 students in grades k-8.

The **State legislature** has supported the concept of Mathematics Specialists. While not acting on the recommendation to require systems to deploy Specialists, the legislature has appropriated funds to partially support the research program described below.

The **Virginia Department of Education** has strongly supported Mathematics Specialists at all stages, including using funds from the United States Department of Education Mathematics and Science Partnership program to prepare Mathematics Specialists. The department also provided access to student scores on standardized tests in support of the research described below.

As a result of this capacity building there are approximately 300 school-based Mathematics Specialists in Virginia.

II. Research

Concurrently, in 2003, the decision was made to seek support to undertake detailed scientific research on Mathematics Specialists. At this time there was interesting, high quality research demonstrating the effectiveness of teachers having the knowledge and skills that Mathematics Specialist programs are designed to develop, but no research with treatment and control groups directly demonstrating the impact of Mathematics Specialists on student learning. As pointed out in the National Mathematics Advisory Panel reports no such results are published to date.

In order to conduct this research and to develop the preparation programs described earlier we submitted competitive proposals to the National Science Foundation. We were successful in this competition and were awarded grants to determine the impact of preparation programs on Mathematics Specialists and the impact of Mathematics Specialists on the teachers they support and on student learning. The awards were made in the summer of 2004. Since then we have developed and refined the preparation programs, offered the programs to prospective Mathematics Specialists, placed Specialists in schools, and conducted the planned research.

One key component of the research centers on 12 triples of schools. Each set of three schools were identified by a participating school system as being comparable demographically and having similar test scores. One school from each triple was randomly chosen and a Mathematics Specialist who had completed the preparation program was placed in each of these Cohort I schools beginning in August 2005; a second school (Cohort II) was randomly selected from each triple and a specialist was placed in each of these schools beginning in August 2007. No Specialists will be

assigned to the third school in each triple throughout the duration of the research project. Detailed information is being analyzed concerning the beliefs of teachers and the academic achievement of students in the treatment and control schools. As a part of the research program, each research subject records what she or he is doing during each period of time by entering data in a PDA. For example, the researcher knows how much time each teacher in the building is being supported by the Specialist.

We are beginning to obtain preliminary results on the Mathematics Specialists' impact on student mathematics achievement scores as measured by SOL tests in Virginia. To assess this, the analysis has accessed data on approximately 6,400 student test scores in each of Grades 3, 4, and 5 from 36 schools over 2 years. Thus, the analysis of 19,407 students SOL scores was done. When compared with students in the control schools, students in schools with Mathematics Specialists performed better on the SOL Mathematics test in **each** of grades 3, 4 and 5. Indeed, in **each** grade their performance was better in **each** subcategory: Number, Number Sense, Computation, Estimation, Measurement, Geometry, Probability and Statistics, and Patterns, Functions, and Algebra.

The greatest difference was observed in grade 4 where the differences were statistically significant and where SOL tests have been most recently introduced. The positive effect of having a coach in the school is approximately

- 87% of the magnitude of the negative effect of limited English proficiency,
- 80% of the magnitude of the negative effect of poverty,
- 43% of the magnitude of the negative effect associated with minority student status on fourth-grade SOL performance.

In grade 3 the results were not statistically significant, but the positive effect was

- 85% of the magnitude of the negative effect of limited English proficiency,
- 52% of the magnitude of the negative effect of poverty,
- 27% of the magnitude of the negative effect associated with minority student status on third-grade SOL performance.

In grade 5 the results were not statistically significant, but the positive effect was

- 42% of the magnitude of the negative effect of limited English proficiency,
- 47% of the magnitude of the negative effect of poverty,
- 31% of the magnitude of the negative effect associated with minority student status on fifth-grade SOL performance.

This analysis has not yet investigated what kinds of activities the Specialists engaged in with particular teachers, nor has it investigated the expected variability in degree and time of support afforded by the Specialists to differing teachers. Inclusion of these data will better specify not only the level of involvement and therefore potential impact of Specialists with individual teachers, but will also characterize more accurately

the degree of treatment afforded to teachers associated with the nested student SOL data.

Because this preliminary analysis of student SOL data has not accessed teacher–specialist data as collected through the PDAs, the current analysis presumes that the impact of a specialist is identical for all teachers and all students in each given grade within a school. This is not the case. From day to day the Specialists vary in terms of the professional development services and instructional support that they engage in and in terms of the teachers with whom they work. It is anticipated that future analysis accessing teacher-level data will be more precise, as this preliminary analysis of the school-level effect of Specialists on student achievement has averaged the teacher effect across all teachers in the schools.

School superintendents of the school systems that are participating in the research were interviewed at the conclusion of the 2006-07 school year. At this point one school in each triple had been assigned a Mathematics Specialist and two had not. According to the report, “they were unanimous in their confidence about the effectiveness of the grant’s in-school coaching model and their desire to implement it in all elementary and middle schools.”

Appendix

Who Are Mathematics Specialists?

Mathematics Specialists are teacher leaders with strong preparation and background in mathematics content, instructional strategies, and school leadership. Based in elementary and middle schools, mathematics specialists are former classroom teachers who are responsible for supporting the professional growth of their colleagues and promoting enhanced mathematics instruction and student learning throughout their schools. They are responsible for strengthening classroom teachers' understanding of mathematics content, and helping teachers develop more effective mathematics teaching practices that allow all students to reach high standards as well as sharing research addressing how students learn mathematics.

The overarching purpose for Mathematics Specialists is to increase the mathematics achievement of all the students in their schools. To do so, they

- Collaborate with individual teachers through co-planning, co-teaching, and coaching;
- Assist administrative and instructional staff in interpreting data and designing approaches to improve student achievement and instruction;
- Ensure that the school curriculum is aligned with state and national standards and their school division's mathematics curriculum;
- Promote teachers' delivery and understanding of the school curriculum through collaborative long-range and short-range planning;
- Facilitate teachers' use of successful, research-based instructional strategies, including differentiated instruction for diverse learners such as those with limited English proficiency or disabilities;
- Work with parent/guardians and community leaders to foster continuing home/school/community partnerships focused on students' learning of mathematics; and
- Collaborate with administrators to provide leadership and vision for a school-wide mathematics program.