Abstract Title: Impact of MSP-prepared Mathematics Specialists on Middle School Instruction and Student Success

MSP Project Name: MSP Institute: Mathematics Specialists in Middle School - DUE-0926537

Author(s): Aimee Ellington, William Haver

Presenter(s): Aimee Ellington, William Haver

120 word summary:

In this session we will summarize the results of two projects funded by National Science Foundation grants to train and study Mathematics Specialists in Virginia's elementary schools and then outline the plan for our current MSP Institute project. The results of our earlier projects are the foundation upon which our current MSP Institute project was based. We will explain what we have learned about the role of Mathematics Specialists in elementary schools and their impact on student achievement in mathematics. We will describe the quantitative and qualitative methods that will be used to study the impact of middle school mathematics specialists on teacher knowledge and beliefs as well as student achievement.

- Section 1: **Questions for dialogue at the MSP LNC**.
  The overall goal of the MSP Institute: Mathematics Specialists in Middle School project is to prepare middle school teachers to serve as Mathematics Specialists/coaches in middle schools. In this role, they work with classroom teachers to improve mathematics instruction and student success in middle school mathematics. Our major question is whether or not Mathematics Specialists, serving as providers of in-school mathematics professional development can achieve these results.

- Section 2: **Conceptual framework**.

  Definition of Student Success: Our definition of student success is that large numbers of students develop: a deep understanding of 6-8 mathematics, strong computational skills, good communication skills, and the ability to think creatively about mathematical ideas.

  Our program is designed to prepare our participants to work as teacher/leaders or Mathematics Specialists who will help all of the teachers in their school enable their students to be successful. As a surrogate to this definition of student learning we are using the high stakes Virginia Standards of Learning tests which are administered to all Virginia students in grades 6, 7, and 8 at the end of each school year. While the tests are a far from perfect measure of our definition of student success they have a number of advantages: they are used by the state in measuring student and school access; the project has access to all scores (over 24,500 students tests scores were used in our previous study); they are given to all students in Virginia. Our case study research further determines the extent to which students develop their mathematical thinking.

  Previous Results:
  Although only anecdotal results are available on the impact of Mathematics Specialists at the Middle School level, the leaders of this MSP project have been involved in earlier

work at the K-5 level that have demonstrated remarkable impact. Much of this work is described in a paper to appear in *The Elementary School Journal* by P. Campbell and N. Malkus entitled *The Impact of Elementary Mathematics Coaches on Student Achievement*.

Since 2004, the National Science Foundation has supported a rigorous research and policy study incorporating Mathematics Specialist preparation programs and randomly selected treatment and control elementary (K-5) schools (NSF grants ESI -0353360 and EHR-0412324). Grant-supported trained specialists were placed in randomly selected treatment schools as on-site coaches to determine the effectiveness of a school-based Mathematics Specialists program. A major finding of these projects is that over time Mathematics Specialists help classroom teachers develop more effective teaching practices that positively affect student learning and achievement.

The study involved over 24,500 student test scores drawn from Grades 3, 4, and 5 in 36 schools across 5 Virginia school divisions over a 3-year period. Analyses revealed that over time Mathematics Specialists have a statistically significant positive influence on student achievement in all three grades. Compared to control schools:

- The increase in scores for third-grade students in schools with a trained Mathematics Specialist was on average of nearly 10 points higher on Virginia's Standards of Learning mathematics tests during the specialist's second year and over 16 points higher during the specialist's third year.

- The increase in scores for fourth-grade students in schools with a trained Mathematics Specialist averaged a statistically significant 15 points higher on Virginia's Standards of Learning mathematics tests during the specialist's second year and over 13 points higher during the specialist's third year.

- The increase in scores for fifth-grade students in schools with a trained Mathematics Specialist was also statistically significant, an average of over 19 points higher on Virginia's Standards of Learning mathematics tests during the specialist's second year and over 20 points higher during the specialist's third year.

- Policy leaders and principals in research school divisions had unanimous confidence in the in-school coaching model, and all were eager to implement it in all elementary and middle schools.

At a more conceptual level, case studies conducted of six participants in the MSP program is described in five submitted research papers written by Joy Whitenack and Aimee Ellington and revealed the following:

- The course experiences provided opportunities for Specialists (1) to make changes in their beliefs about teaching and learning mathematics, (2) to develop new mathematical understandings, and (3) to develop ways to use their mathematical understandings to support student and teacher learning.

- Specialists had numerous opportunities to make connections between mathematical and pedagogical content knowledge during the courses. They

continued to make these connections working with teachers and students after completion of coursework.

- The school building principal played the very important and necessary role of supporting and sustaining the K-5 Specialist's effectiveness in the school building. Specialists with principals who understood the breadth of their responsibilities and supported their work with teachers had more opportunities to affect the work of teachers and students.

In addition, policy research interviews with the 12 school district policy leaders representing 3 cities and 2 counties and including 1 school board member, 3 district superintendents and 4 superintendents (or deputies or directors) for instruction, revealed the following:

- Leaders interviewed were unanimous in their confidence about the grant's in-school coaching model and their desire to implement it in all elementary and middle schools.

- A superintendent reported that the division's evaluation department found that SOL pass rates in schools having a Specialist for two years increased by 14 points; schools without a Specialist saw a 1-point increase.

- One superintendent noted "there is also the need and desire to improve the mathematical abilities of average students to prepare them for advanced courses. Employing Mathematics Specialists is not just a remedial program."

- The Virginia State School Board has recommended that all school systems employ one Mathematics Specialist for each 1000 students in grades K-8. However, the state legislature has not yet passed legislation providing the matching funds to the school systems, as required under state law for this mandate to be implemented.

Hypothesis:
Our hypothesis is that similar gains in instructional practice and student achievement will occur at the Middle School level when MSP-prepared Mathematics Specialists are deployed to provide full-time in-school professional development.

- Section 3: **Explanatory framework**. This section should describe what you are finding, or are set up to learn, about student success, and how it is informing, or will inform, your MSP work.

Research:
The research component is led by Aimee Ellington and Joy Whitenack of VCU. It will evaluate the effectiveness of Mathematics Specialists through a mixed methods design using qualitative methods including case studies and a randomized control-treatment trial.

- Using a pretest/posttest design, we will evaluate the change in mathematical content knowledge, knowledge for mathematics teaching, pedagogical content knowledge, and beliefs about teaching and learning mathematics.

- Through a treatment/control design, twelve participants will serve as full-time Mathematics Specialists in randomly selected treatment schools. Student data from SOL achievement tests and teacher beliefs will be used to determine the effect of these Specialists in the schools when compared with control schools.

- From the twelve participants in treatment schools, three Specialists will be chosen to build case studies about their experiences in the school buildings.

Through this study we are addressing the following research questions:

- What is the nature of and duration of the daily professional activity of Mathematics Specialists in middle schools? What is the impact of the Specialist's activities on student achievement and teachers' beliefs?

- Is the Mathematics Specialist preparation program effective in supporting the participants in their development of the skills necessary to be a Mathematics Specialist in a middle school?

- What is the nature of the coaching relationship between teachers and Mathematics Specialists? What is the focus of those coaching practices and their impact on instruction?

As indicated earlier, to evaluate student achievement and teacher beliefs, twelve pairs of schools will be identified, with the schools within each pair having a similar prior tradition of mathematics achievement and serving a demographically similar population of students. Within each pair, schools will be randomly assigned to one of two categories: Treatment (Mathematics Specialist placed in fall 2012) and Control (No Mathematics Specialist prior to fall 2014).

Student data from SOL achievement tests and data from assessment of teacher beliefs will be analyzed each year once the Specialist has been placed in the school. These data will allow us to determine change over time and to determine the difference in the results from treatment and control schools. The analysis of student achievement data will be conducted using a nested factorial design. This design has nested and crossed factors. Specifically, in this 2-level hierarchical model, the year that the achievement data is collected is crossed with (1) treatment (specialist or control) and (2) school. Teacher is nested within school. The data for analysis will be collected from classrooms with teachers who have been in the same school building for both years. Because schools and teachers are not randomly assigned populations of students for instruction and because not all teachers have identical prior professional backgrounds, student demographic data and teacher certification data will be used as control variables.

The Specialists will record their activities daily through a website survey instrument. This data will provide a record of the nature and proportion of their daily professional activity of the Specialists over time. They will record their coaching activities when working with individual teachers as well as the other professional development activities in which they engage including grade level and vertical team meetings. They will record their involvement in creating, administering, and analyzing assessment instruments. They will document the amount of time spent on each activity. For coaching and professional development activities, they will indicate the mathematical content and the instructional issues addressed during these activities.

In addition, we will make observations of the case study participants' professional activities in their respective school buildings. To better understand the support that is offered at the school building or district level, we will also interview the principals and other key personnel who work collaboratively with the case study participants. By coordinating the quantitative data with the case studies, we will be able to document the exact nature of the Specialists' daily work and how particular course activities contributed in part to their effectiveness.

Throughout our work in Virginia we have recognized that research results alone do not determine practice. Therefore, the project includes a Policy Research Component led by VCU's Commonwealth Educational Policy Institute (CEPI). First, CEPI is assisting project leadership with issues related to policy and regulatory development and implementation including access and communication between local school districts, state education agencies, the state legislature, project investigators, researchers and evaluators.

CEPI will utilize a state-level longitudinal case study approach to collect and analyze policy, legislative, regulatory, and funding issues related to the establishment of the Mathematics Specialists Initiative. This study will include analytical components involving political support, funding mechanisms, training expectations, costs and benefit analyses, and implementation issues.

CEPI will design appropriate data collection for local district policy and implementation issues regarding personnel selection, recruitment, job description development, and Specialist/classroom teacher interaction. Impact of Specialists upon district instructional services, support systems and professional development will be analyzed. The final report will include corroborative data from survey, interviews with principals and participants, and polling to support/refute preliminary policy, regulatory and implementation issue findings.

As described earlier, extensive quantitative, qualitative and policy research has been conducted by the same researchers on the preparation and implementation of Mathematics Specialists in K-5 schools. So we will not only be able to measure the absolute benefits of the preparation of Specialists and of their impact on schools, but also compare the impact of the middle school program with that of the K-5 Mathematics Specialists initiative.

Change to Current Project:
There are two key areas where we have made changes to our current project based on what we learned from our previous NSF supported mathematics specialist projects. First, we know that in order for a mathematics specialist to be effective in the school building, the principal must be in full support of his/her work. A school's mathematics program is most effective when the principal and the mathematics specialist work collaboratively to design and implement the program. Therefore, as part of the current project, we are offering a series of workshops for principals who will have mathematics specialist in their school buildings. These workshops are designed to inform principals on the role that mathematics specialists have been trained to play in the school buildings. As a part of the case study research we will study the impact of these workshops on the collaboration between principals and specialists. Second, we have made a change to our data collection system for the current project. In our previous project, mathematics specialist collected data on their daily activities using a Personal

Digital Assistant (PDA). Many specialists had difficulty transmitting the data they recorded on the PDA due their school firewalls. Based on these technical issues and also due to advances in technology in the last five years, we are planning to use a web-based survey format for collecting data on the daily work of the specialists in the school buildings. They will record their work through a series of "point and click" menus in which they select the activities they performed throughout the day (i.e. coached a teacher, delivered professional development, etc.) through a web-based survey instrument. This will be something they can do from any computer connected to the internet, either at work or at home.

Key Insights:
The research results, particularly the treatment/control research, are absolutely critical as policy decisions are made at the school system and state level. The importance of this data for making policy decisions cannot be over estimated.