

Preparation, Endorsement, and Employment of Mathematics Specialists

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Abstract

For over 30 years, educators have recommended that mathematics specialists be placed in schools to provide teachers with the resources they need to assist their students. To assess whether these recommendations have been realized, a survey was used to gather data from large school districts, the 50 states, and District of Columbia. The outcome of the survey, administered in 2007/2008, suggest that few mathematics specialists are currently working at the school level in many of our large school districts and that few states offer certification or endorsement as a mathematics specialist. While the data offer a partial view of a) the numbers of mathematics specialists practicing in large urban cities and b) the numbers of states certificating or endorsing mathematics specialists, it appears that the perceived potential to strengthen the link between research and practice with school-based mathematics specialists remains unmet. Additional research is needed to learn more about the preparation, endorsement, and employment of mathematics specialists and the belief that mathematics specialists are needed to support students' mathematics achievement.

Preparation, Endorsement, and Employment of Mathematics Specialists

Introduction

For over 30 years, the National Council of Teachers of Mathematics [NCTM] has noted a need for mathematics specialists, particularly at the elementary school level (Dossey, 1984; Fennell, 2006; Lott, 2003; NCTM, 2000). Accordingly, the NCTM standards indicate that “there is an urgent and growing need for mathematics teacher-leaders—Specialists positioned between classroom teachers and administrators who can assist with the improvement of mathematics education” (NCTM, 2000, para. 36).

The NCTM call for more mathematics specialists is supported by research and commentary, as illustrated by a January 2008 search in ERIC. A basic keyword search produced approximately 30 citations using “mathematics specialists” and 21 citations using “mathematics specialist”. From this selection of literature, we note that as early as 1974, Good (1974) reports the outcome of a survey of the State department of Education Science Consultants to index the receptivity to the idea of science and mathematics specialists in elementary schools and states that “Thirty-five respondents indicated that such specialists are desirable for grades 4-6 and would be employed by school systems” (abstract). More recent literature explores, for example, the engagement of mathematics specialists in school reform (Ronau, 1993; Rowan & Campbell, 1995) and the link between teachers’ knowledge of mathematics and student achievement (Hill, Rowan, & Ball, 2005; Papanastasiou & Zembylas, 2006; Price, 2005; Tamargo, 2005).

In contrast, over 450 ERIC citations may be found using the basic keyword for “reading specialists.” Accordingly, Rowan (2005) observes that many schools employ reading specialists but there are relatively few mathematics specialists.

While the reason for this is often given as budget constraints, those budget constraints do not prevent the employment of Reading Specialists. It could be argued that, if mathematics is important in our society, and if Mathematics Specialists can make a difference in student learning, then money or ways of organizing teacher personnel should be found to provide Specialists, just as they are for reading/language arts. (p. 43)

When reviewing national-level data to learn more about *mathematics specialists*, it appears that the employment of *curriculum specialists* in the elementary school may be a common practice. For example findings from the National Assessment of Educational Progress (Hawkins, Stancavage, & Dossey, 1998) suggest that that “teachers of just less than half of fourth- and eighth-grade students reported access to a curriculum specialist to help or advise them in mathematics” (para. 22). In another national-level report using data gathered from the National Assessment of Educational Progress (National Center for Educational Statistics, 2006), it appears that *mathematics specialists* may be placed more frequently in high poverty schools.

“A school’s poverty concentration also led to differences in terms of school characteristics. Fourth-graders in the highest poverty public schools were more likely than their peers in public schools with lower levels of poverty to

have a full-time mathematics specialists and to spend the most amount of class time on mathematics (7 hours or more per week)” (National Center for Education Statistics, 2006, para. 4.)

When viewed from the state level, it appears that some educators have recommended that mathematics specialists be placed in schools. For example, among the goals thought to improve mathematics education in the state of Maryland is that of including mathematics specialists. Found in the 2001 Maryland State Department of Education, Mathematics Commission report is this goal and rationale:

Establish an elementary mathematics specialist certificate.

Rationale: Mathematics is important at every level of schooling. We need to recognize that because of the increasing mathematical sophistication of the curriculum, particularly in grades 3-5, the development of teacher expertise is essential (NCTM, 2000). *The Principles and Standards for School Mathematics* (NCTM, 2000) notes how mathematical content develops on trajectories related to learner development. Teachers need to know how the roots of mathematically sophisticated content areas develop in the early grades (e.g., algebra, reasoning and proof, etc.), and are extended through the upper elementary years and on into middle school. They need a deep, rich understanding of the mathematics content and pedagogy at the elementary level. Such a background is not typical for most elementary classroom teachers. Additionally, if Maryland is sincerely interested in assisting all children in learning mathematics, support is

needed—support for children and support for other teachers. Elementary school mathematics specialists may teach across or within grade levels at the building level (e.g., be responsible for all fourth grade mathematics). They could be responsible for mentoring teachers in mathematics at the building level and beyond. Specialists could help direct the mathematics component of school-wide intervention programs. They should also be valued.” p. 36

When viewed from the district level, it appears that some school systems, such as Howard County Public Schools [HCPS] located in Maryland, have been able to act on the belief that mathematics specialists at all grade levels are needed to increase teachers’ cognitive skills and pedagogical knowledge. In this district of approximately 45,000 students, Wray, Ruehl, and Sammons (2007) report that nearly 1/3 of the 69 elementary, middle, and high schools in HCPS enjoy the support of a mathematics specialist; and, they urge the National Mathematics Panel to consider recommending mathematics specialists at all k-12 levels to respond to the “number of state and national reports focused on improving student learning in mathematics and strengthening teachers’ understanding of mathematical concepts and instructional pedagogy” that have called for “the placement of mathematics specialists in public schools” (p.6).

Although research relating to mathematics specialists may vary depending on grade levels and school context, it is not clear whether states are endorsing mathematics specialists. It is also not clear whether school districts are intending to place mathematics specialists in their schools. This study hopes

explore whether the perceived need for specialists is being address by a) learning more about the current practice of placing mathematics specialists in schools and b) learning whether states are currently certificating (endorsing) mathematics specialists. This information may help to inform the policies and practices that focus on the preparation, retention, advancement, certification, and training of teachers.

What is a mathematics specialist, what do they do, and what training do they need?

A mathematics specialist may be described as a teacher-leader, mathematics content coach, mathematics resource teacher, or other mathematics leader. For this study, the following short definition will be used.

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 excellent teachers who are released from full-time classroom responsibilities so that they can support the professional growth of their colleagues, 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. (Virginia Mathematics and Science Coalition, 2005. p. 1)

Although one may expect that the roles assumed by a mathematics specialist will vary and depend on the needs of each school and district, the work of a mathematics specialist has been clearly outlined by the Virginia Mathematics and Science Coalition through their efforts to ensure that all Commonwealth of Virginia teachers are highly qualified. The following have been identified as the major roles filled by mathematics specialists:

- 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, as well as their school division's mathematics curriculum;

- Promote teachers' delivery and understanding of the school curriculum through collaborative long-rang 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 parents/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 schoolwide mathematics program. (Virginia Mathematics and Science Coalition, 2005. p. 1).

These responsibilities suggest that mathematics specialists will benefit from coursework in pedagogy, data analysis and assessment, curriculum, strategic planning, research methods, special education, communication, and administration. Accordingly, the Virginia Mathematics and Science Coalition (2005), has developed a short description of a mathematics specialists.

A Mathematics Specialist is a teacher in the elementary or middle school who has interest and special preparation in mathematics content, scientifically based research in the teaching and learning of mathematics, diagnostic and assessment methods, and leadership skills.” (Virginia Mathematics and Science Coalition, 2005. p. 3)

In addition, an elementary and middle school endorsement as a mathematics specialist in the Commonwealth of Virginia (2007) requires at least three years of successful classroom teaching experience and 30 semester hours of masters-level coursework that develop competencies in the following areas: understanding of a) the Commonwealth core learning goals, b) mathematics content, c) teaching pedagogy, d) major curriculum studies and trends, e) leadership skills, f) technology, g) assessment, h) evaluation, and i) reading and writing.

Of particular interest is the recent work of Reys and Fennell (2003), who have noted various models used in international and national settings to develop

a case for mathematics specialists in the elementary school. Reys and Fennell note that a teacher specialist should be an experienced elementary school teacher. In addition to knowledge of mathematics content and pedagogy, Reys and Fennell note that the mathematics specialist should a) be able to lead, b) be accepted by other teachers, c) work with students, parents, and the community, and d) have an interest in being a mathematics specialist.

Survey Questions

Although the Commonwealth of Virginia has moved toward the endorsement of mathematics specialists in elementary and middle schools, it is not clear whether other states have similar endorsements. Do large school districts place mathematics specialists in their schools? Have large school districts developed specific job descriptions for these special mathematics teachers? Where do mathematics specialists get training and experience? If mathematics teachers acquire training as a mathematics specialist, will they be able to find a suitable position?

Apparently there has been no recent survey of mathematics specialists to follow up on the work of Good (1974). There does not appear to be a set of data available to help describe the preparation, endorsement, or employment of mathematics specialists. These questions, then, are the focus of this exploratory survey research that hopes to learn whether the various recommendations to include mathematics in today's schools are being realized:

- How many mathematics specialists are working in our large U.S. school districts and at what level are they working?
- Which of the U.S. States, including the District of Columbia, endorse mathematics specialists and at what grade level?
- If states are not endorsing mathematics specialists, is the state considering endorsement?

Survey

On the 23rd of October of 2007, a single-paged letter was mailed to the directors of the mathematics departments of 60 of the nation's largest school districts using the list of largest 100 school districts published by the National Center for Educational Statistics (n.d.). And, on the 25th of October, a letter was mailed to the directors of the mathematics departments of the 50 states including the District of Columbia. The letters requested responses to a set of questions and indicated that the goal of researcher was to support discussions among mathematics educators and offer recommendations for the design of courses that prepare mathematics specialists. The mathematics directors were asked to complete the questions posed in the letter and return the letter to the researcher in an enclosed stamped envelope. In the letter, the directors were a) provided a definition of a mathematics specialists, b) asked to share a copy of their district's position description or State certification requirements, c) invited to indicate whether they would be willing to answer additional questions or request a

summary of the data, and d) told that no individual or school system-level data would be reported. The questions posed are shown in figures 1 and 2 below.

Figure 1

School District Questions

Approximately how many mathematics specialists does your district employ in the k-12 schools setting? ___hs + ___ms + ___es + ___other = _____TOTAL

Approximately how many mathematics specialists does your district employ in the k-12 administrative setting? _____TOTAL

Does your state offer a mathematics specialist certificate (or license)? _____ For what grade levels? _____

If your state does not offer a mathematics specialist certificate, is this certificate being considered? _____

Figure 2

State Questions

Does your state offer a mathematics specialists certificate (or license) to mathematics teacher leaders? _____ For what grade levels? _____

What are the certification requirements? (Please attach information.)

How many persons hold this certificate? _____

If your state does not offer a mathematics specialist certificate, is this certificate being considered? _____

It was expected that the analysis of response data would provide a very restricted, but initially descriptive view of the current practice of placing and

certificating mathematics specialists. Limitations included a) no plan to follow-up with non-respondents, b) incomplete set of respondents based on the inability to direct the letter to a specific person rather than a department, c) recognition that district- and state-level agencies are very busy, and d) data that may need to be validated. However, it was expected that the data gathered would provide a preview of the practice of preparing and placing mathematics specialists and serve as a prototype for other research and more formal discussions or recommendations.

Analysis

School District Data

Data were received from 19 of the 60 school districts for a return rate of about 33%. Thirteen of the 50 states were represented by the respondents (AZ, CA, CO, FL, GA, KY, MD, NM, TN, TX, UT, VA, WI). Responding districts ranged in size from nearly 55,000 students to nearly 370,000 students with a mean number of students nearly 104,000. The mean number of schools in the responding districts was 136. The mean number of mathematics specialists placed in “high”, “middle”, “elementary”, and “other” levels was 6, 7, 19, and 2, respectively. The mean total for each district was 30. The mean numbers of mathematics specialists placed in the administrative offices was 6.

When districts completed the form, various terms such as *math resource teacher, instructional coach, instructional staff developer, mathematics curriculum leader, mathematics mentor specialist, mathematics content coaches,*

middle-grade (high, or elementary) mathematics facilitator, and mathematics program planner were used to describe a *mathematics specialist*. There were indications of the variety of duties assumed by these specialists. For instance, in one district the specialist provides coaching in reading and writing, in addition to mathematics coaching. In another district, the specialist is in the schools four days and in the central office one day a week. In some districts the number of mathematics specialists was evenly distributed among elementary, middle, and high schools. In others districts, there were more specialists placed in middle or elementary schools.

Eight districts provided position descriptions for the mathematics specialist. Included among the tasks described in the position description are these: conduct action research, develop assessments, evaluate materials, knowledge of major research relating to mathematics teaching and learning, appropriate use of assessment data, work with colleges to design professional experiences, disseminate research-based strategies, develop and edit practice tests and final exams, and program evaluation.

State-Level Data

Data were initially received from 28 States including the District of Columbia for a return rate of approximately 55% (28/51). To improve the response rate, the researcher acquired a mailing list (e-mail and US mail) from the Association of State Supervisors of Mathematics [ASSM] and invited responses from non-responding states in mid-February. At the end of February 2008, responses were received from 78% (40/51).

Seven of the 40 responding states, California, Minnesota, Ohio, Oregon, South Dakota, Texas, and Virginia, indicate that they certify mathematics specialists. California offers a kindergarten through 12 and adult learners mathematics specialist instruction credential. Minnesota offers a mathematics specialist certificate for grades 5-12. Ohio offers a primary through grade six mathematics specialist endorsement; Virginia, elementary and middle school certification. South Dakota and Texas offers a mathematics specialist certificate for all grades and Texas indicates that 169 persons hold the certificate. Virginia and South Dakota indicates that their certification programs are new and that currently no teachers are certificated in this area.

States indicating that the certification of mathematics specialists is being considered include Idaho, Kentucky, Louisiana, Michigan, New York, and West Virginia. Oklahoma indicates that they are seeking funding from the state and that teachers are requesting this endorsement. Connecticut indicates that they have received a grant to train coaches.

A number of states have certification/endorsement policies or position descriptions for teachers who serve in the role of teacher leaders or mathematics specialists. Nine states provided documents (Arizona, Maine, Minnesota, Nevada, Ohio, Oregon, South Dakota, Texas, and Virginia) describing their certification requirements. These documents are varied in format and content, so it is difficult to compare or contrast their major features. However, many may be found electronically, such as Virginia's requirements and certification documentation (Virginia Department of Education, 2007).

Other states that responded to the survey describe practices that provide mathematics specialists without the need to develop certification policy. For example, the District of Columbia indicates that they hire “numeracy coaches”; North Dakota indicates that they consider a MS degree as a specialist.

Summary and Discussion

The attempt to answer the research questions by surveying district- and state-level mathematics directors, offers a limited view of the numbers of mathematics specialists working in our large U.S. school districts and the numbers of states that endorse mathematics specialists. Of interest, however, is the district-level estimate of a mean of fewer than 30 mathematics specialists working in the various grade-level bands of large school districts.

There is evidence that some states are moving toward certification of mathematics specialists. Currently, seven of the 40 responding states offer certification or endorsement as a mathematic specialist. Five other responding states indicate that they are considering certification or endorsement as a mathematics specialist. Two additional states indicate that they anticipate options for preparing mathematics specialists based on the availability of funding.

Additional district-level data may be gathered with the help of various agencies and additional state-level data may be gathered and validated with the assistance of the Association of State Supervisors of Mathematics [ASSM] or other professional organizations including the Association of Mathematics Teacher Educators [AMTE]. Without a more focused study it will be impossible

to index any trends relating to the placement of mathematics specialists in the classroom as has been recommended for so many years.

Although there is little research available on the practice of including mathematics specialists in our schools, it appears that the role of today's mathematics teacher has expanded to require more administrative, research-based, policy, and assessment skills than previously expected. Current research on teacher leadership in mathematics education suggest that this relatively new construct needs more definition (Yow, 2007) and more expansive descriptions of the roles assumed by school-based mathematics specialists. Based on the recent presentations on coaching, teacher preparation and mathematics specialists at the 2008 annual AMTE meeting (see, <http://www.amte.net/2007%20Conference%20Program.pdf>), it appears that some schools of education are beginning to change and adapt existing curriculum so that k-12 teachers and their students may be supported by trained mathematics specialists.

Should increased attention be placed on the preparation, endorsement, and employment of mathematics specialists, one may ask, "Are there a sufficient number of mathematics educators to do the training?" The good news is that there are recent recommendations that doctoral programs increase coursework in research methods and measurement, skill areas assumed to be valuable to a mathematics specialist (Hines, Hess, Hibbard, deGil, Andryc, & Kromrey, 2007). However, some researchers note that there are an insufficient number of doctoral-level mathematics educators being produced to meet current needs

(Teuscher, D. Nevels, N. & Ulrich, C., 2007). Other resources may be unavailable to encourage mathematics teachers to become mathematics specialists.

Without expanding on the various and related issues presented in this paper, it appears that additional research is needed to understand the potential for school-based, K-12 mathematics specialists to support student mathematics achievement. In particular, research may be able to reveal whether there are any advantages and disadvantages of certifying mathematics specialists and/or placing mathematics specialists in all K-12 grades. Work also needs to be done to identify whether mathematics teachers are willing to accept assistance from a mathematics specialist and whether there are sufficient resources to ensure the success of mathematics specialists that are assigned to schools. For it appears that the 30-year recommendation for mathematics specialists (teacher-leaders) has not yet been realized.

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