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The Need for Research into Elementary Mathematics Specialist Preparation

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Abstract

The continued concern for the mathematical preparation of elementary teachers has kept discussions of elementary mathematics specialists (EMS) a vital part of many mathematical reforms. With over half the states providing or in the process of developing EMS certifications, a closer examination of the ways in which EMS are prepared is needed. In this paper, I explore several types of EMS, the current state of EMS preparation, and literature related to EMS. I then discuss the potential constraints associated with preparing EMS. I close with a discussion of future avenues of research related to EMS preparation and a call for more research in this area.

Introduction

In a recent national survey, 57% of elementary teachers indicated they completed one or two college mathematics courses in the areas of number and operations, algebra, geometry, probability, and/or statistics. Thirty two percent reported taking three or four of these courses and only 10% completed courses in each of these five areas (Banilower et al., 2013). These data suggest elementary teachers are not likely to have received the 12 hours of specialized mathematics coursework recommended in the 2012 report by the Conference Board of the Mathematical Sciences (CBMS), *The Mathematical Education of Teachers II*. The limited mathematical preparation of elementary teachers in teacher education programs has contributed to calls for the development and use of elementary mathematics specialists (EMS) in American schools. EMS can be defined as "teachers with particular knowledge, interest, and expertise in mathematics content and pedagogy" (Reys & Fennell, 2003, p. 278) and can serve in a number of roles, from coaches to content specialists, at the school or district level.

Over two decades ago, the authors of the National Research Council's (NRC, 1989) document on the state of mathematics education, *Everybody Counts*, suggested that the U.S. continues to adhere to a generalist model of elementary teachers despite evidence that this is not the most effective model for student learning. The report discussed the need for specialized mathematics teachers in the elementary grades. More recently, Fennell (2011), former president of the National Council of Teachers of Mathematics (NCTM) and project investigator of the Elementary Mathematics Specialists and Teacher Leaders Project, wrote about the history of EMS.

> Elementary mathematics specialists are becoming the school or district level 'transition agents' for the Common Core State Standards for Mathematics. Mathematics specialists at the elementary school level are becoming increasingly important as we acknowledge the complexities of elementary mathematics teaching and learning. (p. 52)

Despite the growing support for EMS, the movement to formalized programs of study for such professionals is a recent phenomenon. Currently, 21 states have certification programs for EMS or are in the final stages of approving

such a program. An additional eight states are in the process of creating such certifications (EMS & Teacher Leader Project, 2015).

This relatively recent trend toward the use of EMS is in response to a confluence of changes in the educational landscape in the United States. The emergence of EMS has created a need to understand and research the role, impact, and preparation of EMS in the United States. In this paper, I explore two types of EMS along with the current state of EMS preparation in the United States. I then discuss the potential constraints associated with preparing EMS. I close with a discussion of future avenues of research related to the preparation of EMS.

Why EMS?

Certainly, many of the concerns that framed early calls for EMS still exist today. For example, in 1989 the authors of *Everybody Counts* wrote, "Too often, elementary teachers take only one course in mathematics, approaching it with trepidation and leaving it with relief. Such experiences leave many elementary teachers totally unprepared to inspire children with confidence in their own mathematical abilities" (NRC, p. 64). Though this statement was made over twenty years ago, the data aligns with the aforementioned study by Banilower and colleagues (2013) who found that more than half of elementary teachers surveyed completed only one or two mathematics classes in college. The continued concern for the mathematical preparation of elementary teachers has kept discussions of EMS a vital part of many mathematical reforms.

Past NCTM president Linda Gojak (2013) discussed reasons that the mathematics education community should continue to advocate for the use of EMS in schools. Three of her reasons centered on issues involving the amount of time and knowledge, both pedagogical and mathematical, necessary to help children develop deep understandings of mathematics. She specified that EMS are needed to help meet the needs of diverse learners and noted that the heterogeneous nature of elementary classrooms necessitates great content area expertise. Gojak also countered the common arguments of EMS being too costly and concern over elementary children taught by multiple teachers: "The reality is that most children are under the care of multiple adults" (para. 5) and "schools that have adopted a modified departmentalization structure have done so with little or no additional cost" (para. 8). Finally, she indicated that EMS could help to increase the impact of professional learning communities by supporting teachers in professional development focused on the teachers' interests and roles.

In addition to Gojak's (2013) arguments, two points central to the current climate of mathematics education highlight the need to carefully examine the responsibilities and training of EMS in schools. First, mathematics teaching must improve if students are to increase their learning outcomes in mathematics. Ball and colleagues (2005) emphasized this point stating, "Little improvement (in student mathematics achievement) is possible without direct attention to the practice of teaching" (p. 14). In terms of the mathematics described in the Common Core State Standards for Mathematics (CCSSM) (Common Core State Standards Initiative [CCSSI], 2010), successful implementation requires that elementary teachers acquire additional mathematics knowledge, skills, and practices, as well as increase their capacity to more effectively use what they know and can do (CBMS, 2012).

Second, efforts to improve mathematics teaching at the elementary level will require a consideration of changes to the mathematical preparation of teachers (Reys & Fennell, 2003). There is evidence that many practicing elementary teachers are not adequately prepared to meet the demands for increasing student achievement in mathematics (Ball, 1990; CBMS, 2012). Publications from the NCTM (2000), the Association of Mathematics Teacher Educators (AMTE, 2013), the National Mathematics Advisory Panel (2008), and the NRC (1989) emphasized that most elementary teachers are generalists and, as such, are expected to teach all core subjects. Thus, many teachers never develop the in-depth knowledge and skills required to effectively teach elementary mathematics. In fact, the *2012 National Survey of Science and Mathematics Education* (Banilower et al., 2013) documented that although 77% of elementary teachers surveyed felt very well prepared to teach number and operations, only 56%, 54%, and 46% thought the same in regard to measurement, geometry, and early algebra, respectively. In addressing this dilemma, Wu (2009) specified a problem of scale and suggested a different approach.

> Given that there are over two million elementary teachers, the problem of raising the mathematical proficiency of all elementary teachers is so enormous as to be beyond comprehension. A viable alternative is to produce a much smaller corps of mathematics teachers with strong content knowledge who would be solely in

> charge of teaching mathematics at least beginning in grade 4. (p. 14)

The idea of preparing a cadre of EMS to help improve the mathematics education of elementary students is one that has been embraced by a number of states; however the preparation of these specialists and the role they fill in schools varies greatly.

How are EMS utilized?

Though the *Standards for Elementary Mathematics Specialists* (AMTE, 2013) detailed the training EMS should receive, these standards also discussed the wide range of roles to which such training may lead dependent upon the specific needs of the locations at which specialists are employed. Similarly, the mathematics education literature provides accounts of a number of different EMS models including mathematics coaches, teacher leaders, specialized content teachers (as referenced by Wu (2009)), and mathematics intervention specialists, or pull-out instructors, for special needs students (National Mathematics Advisory Panel, 2008). Though the names and responsibilities of these positions may vary from state to state or even district to district, in the following section I discuss characteristics of these broader categories found in the mathematics education literature.

In a 2009 research brief for NCTM, McGatha wrote of two categories of what I refer to as EMS—mathematics coaches and mathematics specialists. She defined the two groups according to the population with which they primarily worked. Mathematics coaches are the most common type of EMS and work primarily with teachers, whereas mathematics specialists typically work directly with students (National Mathematics Advisory Panel, 2008). For clarity, I have defined mathematics coaches as EMS who work directly with teachers. I refer to EMS who work with students as specialized mathematics teachers. It is important to note that in each case, mathematics coaches and specialized mathematics teachers, I am referring to EMS as teachers who have specialization in elementary mathematics. Therefore, it is possible that a teacher might serve in a role with duties similar to that of a mathematics coach or a specialized mathematics teacher but might do so without having "particular knowledge, interest, and expertise" (Reys & Fennell, 2003, p. 278). Under the definitions used in this paper, these teachers are not included in these categories.

Even with these distinctions between mathematics coaches and specialized mathematics teachers, there remains ambiguity in the role of EMS because many research studies and school districts have used the term to refer to positions that carry with them a number of different responsibilities (Campbell & Malkus, 2011; Olson & Barrett, 2004). In discussing the differences among EMS, the National Mathematics Advisory Panel wrote, "There is considerable blurring across types and roles" (2008, p. 43). In the following sections I discuss the distinction between these two roles.

Mathematics Coaches

Mathematics coaches are typically school-based specialists who are chiefly tasked with supporting teachers in improving their mathematics instruction. Mathematics coaches may be employed in elementary, middle, high schools, or at the district level to support multiple grades. Though mathematics coaches may retain some or all of their teaching responsibilities, it is more common for their full-time responsibility to be that of supporting teachers (National Mathematics Advisory Panel, 2008).

> Whether termed a specialist, coach, support teacher, or teacher leader, in many school districts today the intent is to place a highly knowledgeable teacher, who frequently does not have responsibility for the instruction of a classroom of students, in a school in order to advance instructional and programmatic change across the whole school. (Campbell & Malkus, 2011, p. 432)

In many instances, mathematics coaches may serve as the main source of mathematical professional development to fellow teachers. Russo (2004) remarked on the close alignment of school-based coaching with the recommendations for effective professional development set forth by the National Staff Development Council. Further, teachers may give mathematics coaches a more favorable reception than outside professional developers (Russo, 2004). Despite the potential for the use of coaches to provide teacher development, there exist several potential barriers to the widespread adoption of mathematics coaching nationwide.

One such barrier is the availability of training for teachers to become mathematics coaches, although in recent years there has been an increase in programs that provide such training (EMS & Teacher Leader Project, 2015). Another potential obstacle is that the creation of such positions requires additional personnel and can therefore be expensive. Alternatively, using EMS-certified professionals as

classroom teachers with the primary responsibility of providing mathematics instruction to multiple groups of students may be accomplished with current staffing levels (National Mathematics Advisory Panel, 2008).

Specialized Mathematics Teachers

A number of stakeholders in the mathematics education community have recommended the use of specialized mathematics teachers in elementary schools (AMTE, 2010, 2013; CBMS, 2012; NCTM, 2000; NRC, 1989, 2001). Specialized mathematics teachers have received particular preparation for their role teaching elementary mathematics. In some instances, teachers may be selected by administrators to departmentalize or volunteer to teach mathematics. These teachers may be referred to as elementary mathematics teachers or departmentalized teachers; however, in order to make a distinction among these teachers and teachers with specific preparation, I reserve the use of the term specialized mathematics teachers to those with particular training as EMS.

The use of specialized mathematics teachers as content specific teachers continues to gain support (e.g., Fennell, 2011; Gojak, 2013), perhaps in part because many schools have managed to identify a mathematics specialist without hiring additional professionals through departmentalization. By reorganizing the staffing assignments of current teachers at a particular grade level such that one teacher is responsible for mathematics while another is responsible for other content area(s), it is possible for such a model to be cost neutral (Reys & Fennell, 2003). Under this model, a teacher is responsible for delivering only mathematics (or commonly mathematics and science) content as opposed to the traditional generalist model. Despite calls for the use of specialized mathematics teachers, most elementary schools have yet to adopt a departmentalized structure (Fennell, 2011; Gojak, 2013; NRC, 1989).

In addition to content teachers, specialized mathematics teachers may also serve as mathematics intervention specialists, commonly referred to as pull-out instructors. Pull-out instructors are primarily concerned with addressing the needs of particular learners. These teachers may have a secondary area of specialty such as teaching English language learners or special education students. Pull-out instructors may work with students in a resource room setting or might visit different classes throughout the week as they support special needs students in the regular classroom setting. Although not as cost effective as the previously mentioned model, pull-out instructors may allow for more specialized expertise and personalized learning experiences for students.

Research on EMS

Despite the wide array of uses and the proliferation of credentialed EMS programs (Campbell & Malkus, 2011; EMS & Teacher Leader Project, 2015; Reys & Fennell, 2003), research regarding the impact of such positions on student achievement and teacher instruction is still sparse (Campbell & Malkus, 2011; Fennell, 2011). Further, little research exists on the effectiveness of particular EMS preparation programs. In this section, I discuss the extant literature related to EMS.

In reviewing literature related to EMS, the majority of studies located focused on mathematics coaching rather than specialized mathematics teachers, though the total number of articles was quite small. In 2009, McGatha noted just seven studies examining the impact of mathematics coaching. Although several other studies have been published in the ensuing years (e.g., Brosnan & Erchick, 2010; Campbell & Malkus, 2011), there is still a dearth of empirical evidence specifically detailing the impact of mathematics coaches.

Many existing studies examining the impact of mathematics coaches do so with regard to student achievement. Campbell and Malkus (2011) conducted the most comprehensive study to date focusing directly on the impact of mathematics coaches on student achievement. In their study, they utilized a randomized control methodology to examine mathematics coaches who had received extensive preparation in five school districts in Virginia. The authors found that although there were no significant gains in student achievement during the first year of a school wide coaching initiative, there were learning gains in the subsequent years. The authors suggested the reason for these findings. "A coach's positive effect on student achievement develops over time as a knowledgeable coach and the instructional and administrative staffs in the assigned school learn and work together" (p. 451). The authors also cautioned against generalizing the study's results to coaches with less expertise than those in the study.

Similarly, a study by Brosnan and Erchick (2010) also found a positive relationship between student achievement and their Mathematics Coaching Program. The

Mathematics Coaching Program was a school-based program in which teachers worked with a mathematics coach to plan and implement lessons. The authors claimed, "These results fully position us to challenge traditional views on teacher development approaches and argue that providing teachers with information is not sufficient to improve practice" (p. 1367). The results were consistent with those from Campbell and Malkus (2011) and also aligned with literature on effective professional development (Borko, 2004).

Some instances evidencing the impact of mathematics coaches more broadly are found within studies focused on large-scale reform efforts in which mathematics coaches play only one part of a larger professional development project. In a study by Ferrini-Mundy and Johnson (1997), the researchers found that a key aspect of the successful reform efforts of a large-scale professional development program was the presence of mathematics coaches at the schools. These coaches "helped spread ideas, facilitate communications among teachers, plan and initiate staff development, and address political problems with administrators and community members" (p. 119). The authors indicated that this was not evidence for the employment of mathematics coaches, but rather a critical piece in the particular context in which the study was conducted. Similar findings reporting the important role mathematics coaches play in larger professional development efforts were evidenced in other studies (e.g., Balfanz, Maclyer, & Byrnes, 2006; Campbell, 1996; Foster & Noyce, 2004).

Another area in which several recent studies have focused is on the particular skills and strategies mathematics coaches employ. Several articles investigating this aspect came from the Examining Mathematics Coaching Project (Barlow, Burroughs, Harmon, Sutton, & Yopp, 2014; Sutton, Burroughs, & Yopp, 2011; Yopp, Barlow, Sutton, Burroughs, 2014). These studies have provided greater insight into the ways in which mathematics coaches' views impact their practice (Barlow et al., 2014), uncovered a lack of consistency of coaches' assessments of coaching skills (Yopp et al., 2014), and attempted to define the domains of content knowledge needed for mathematics coaches (Sutton et al., 2011). Further study in this area is important in developing a knowledge base of coaching skills and knowledge upon which to develop and improve EMS preparation programs.

Despite the limited amount of empirical research dedicated to coaches, McGatha (2009) explained, "Substantial anecdotal evidence from programs throughout the United States indicates that coaching can be effective in teaching and learning" (para. 10). This anecdotal evidence may be part of the reason for the continued growth of interest in and preparation of mathematics coaches. Although the aforementioned studies provide some evidence regarding the positive impact of school or district-based mathematics coaches, little is known about the impact of mathematics coaches on important indicators such as teacher retention, teacher satisfaction, and teacher recruitment, a point I return to in a later section.

The research is also limited regarding the impact of assigning well-prepared elementary teachers to specialized teaching roles; that is, with greater responsibilities for teaching mathematics within their schools. Although little evidence of the impact of specialized mathematics teachers exists, some elementary schools have reorganized (departmentalized) to allow teachers to specialize in teaching a particular subject (Fennell, 2011; Gerretson, Bosnick, & Schofield, 2008). It is not generally the case, however, that elementary teachers are assigned (or choose) to teach mathematics because of their mathematical content knowledge and pedagogical expertise in teaching mathematics or because they have been credentialed as an EMS. Rather, teachers may take on or be selected for these roles for a number of reasons such as their interest in mathematics (Gerretson et al., 2008).

In 2009, McGatha noted, "Research on the effects of mathematics specialists (those who work directly with students) is virtually nonexistent" (para 2). In the same year, the report of the National Mathematics Advisory Panel (2008) found that of the 114 articles they examined, only one (McGrath & Rust, 2002) examined the impact of mathematics specialists on student achievement. This article found no difference in mathematics gain scores for those students in classes with mathematics specialists as opposed to those students in a traditional classroom structure. It is worth noting, however, that the study was limited to a single district and there was no description of the mathematics teachers' preparation, therefore it is unclear if the teachers received additional training as EMS. In light of the lack of research, the National Mathematics Advisory Panel (2008) called for research on this model.

> The Panel recommends that research be conducted on the use of full-time mathematics teachers in elementary schools. These would be teachers with strong knowledge of mathematics who would teach mathematics full-time to several classrooms of students, rather than teaching many subjects to one class, as is typical of most elementary classrooms. This recommendation for research is based on the Panel's findings about the importance of teachers' mathematical knowledge. The use of teachers who have specialized in elementary mathematics teaching could be a practical alternative to increasing all elementary teachers' content knowledge (a problem of huge scale) by focusing the need for expertise on fewer teachers. (p. 44)

Research is needed to investigate the impact of assigning well-prepared specialized mathematics teachers to mathematics teaching roles.

Research is also needed on effective ways to prepare EMS. In reviewing the literature on EMS, I found no empirical investigations into particular preparation programs for EMS. Instead, there exists anecdotal records highlighting particular professional development activities aimed at EMS (e.g., Bastable & Lester, 2005), studies examining teachers' personal transitions from teacher to mathematics coach (e.g., Chval et al., 2010), and papers that characterized the skills needed for coaching (e.g., Feger, Woleck, & Hickman, 2004; Sutton et al., 2011). It is crucial to examine particular programs for EMS preparation to ensure the programs are aligning with the needs and responsibilities of these individuals and to understand the types of experiences that adequately prepare EMS for their future roles. Many questions surrounding EMS preparation exist such as: Are formal classes designed to prepare EMS an effective means of EMS preparation? Is it sufficient to identify effective teachers and assign them to an EMS role? Answers to questions such as these are needed to understand best practices for EMS preparation. In the closing section, I further discuss needs for future research along this particular avenue. I next turn to the preparation of EMS.

Preparation of EMS Professionals

Commonly, administrators select EMS in light of their reputation as effective teachers. Chval and colleagues (2010) discussed this particular model stating, "Too often we assume that effective teachers will be effective coaches and these teachers need little support as they transition into their new roles as mathematics coaches" (p. 192). Though selecting accomplished teachers to serve in the role of EMS is still common, many states have set forth formalized approaches to preparing EMS. Some of these EMS certification programs are endorsements teacher candidates receive as a part of initial certification programs. More commonly, state-level EMS certification requires graduate level study and is delivered through either a graduate certificate or masters program (EMS & Teacher Leader Project, 2015).

The state guidelines/requirements for EMS certification vary; however, many states have recently created certifications that closely align with the AMTE EMS standards (2013) (EMS & Teacher Leader Project, 2015). Across states, EMS certification requirements vary according to the prerequisites for entering such programs (e.g., years of teaching experience and certification levels) as well as the number of credit hours required for program completion. For example, teachers seeking EMS certification in Missouri must have a teaching certificate and two years of teaching experience. In Michigan, however, the EMS program is offered as part of the initial licensure process wherein teachers are endorsed as EMS upon completing specified competencies through initial teacher certification coursework and passing an exam in elementary mathematics. Many of the state certification programs focus heavily on mathematics content but also include coursework in areas such as leadership, assessment, and pedagogy (EMS & Teacher Leader Project, 2015).

Regardless of whether a particular state grants EMS certification, some university-based teacher education programs have addressed the issue of elementary content competence by allowing elementary education majors to choose a content concentration or major area (e.g., Indiana University, 2015; Kansas State University, 2015; University of Michigan, 2015). These concentration areas may require additional content courses beyond those taken by all elementary education majors. However, the addition of classes may not adequately address the need for a deeper knowledge of knowledge for teaching. Battista (1994) noted that simply taking more mathematics courses may not enhance the knowledge and skills needed by elementary teachers.

> The additional mathematics that [elementary] teachers take must be taught properly. That is, it must be taught as sense making. Unfortunately, most university mathematics courses reinforce rather than debunk the view

> of mathematics as a set of procedures to be memorized. Because such courses simply perpetuate the mathematical mis-education that occurs in grades K-12, requiring teachers to take more of them will do little to solve the problems. (p. 468)

Instead, what is needed are courses that focus on the mathematics that elementary teachers will teach from an advanced perspective. As noted in the *Mathematics Education for Teachers II* report (CBMS, 2012):

> Like many undergraduates, future elementary teachers may enter college with only a superficial knowledge of K-12 mathematics, including the mathematics that they intend to teach. For example, they may not know rationales for computations with fractions or the role of place value in base-ten algorithms, and may not have the opportunity to learn them as undergraduates. (p. 4)

To address this issue, this report recommended that prospective teachers take a minimum of 12 hours of mathematics courses that foster a deep understanding of the mathematics they will teach. These courses should focus not only on the fundamental ideas of elementary mathematics, but also on the early childhood precursors and middle school successors so that teachers can better understand the vertical alignment of the elementary mathematics curriculum. Further, these courses, and any professional development experiences, should develop the habits of mind of a mathematical thinker and problem solver, including reasoning and explaining, modeling, seeing structure, and generalizing.

Although these goals are important for all teachers at the elementary level, additional competencies are needed for teachers who specialize in mathematics. The AMTE *Standards for Elementary Mathematics Specialists* (2013) provided guidelines for EMS credentialing, including a minimum of 24 hours of coursework, organized in three areas: content knowledge for teaching mathematics, pedagogical content knowledge for teaching mathematics, and leadership knowledge and skills. The content knowledge for teaching mathematics includes courses focused on a deep understanding of the K-8 mathematics curriculum as well as specialized content knowledge for teachers. The pedagogical knowledge includes attention to research and practice related to learners and learning, teaching, curriculum, and assessment. Finally, the leadership component focuses on skills needed for EMS to support their colleagues' development.

In addition to this coursework, the recommended program includes supervised mathematics teaching practicum experiences in which prospective EMS acquire experience working with a range of students and adult learners, including elementary students (e.g., primary, intermediate, struggling, gifted, English language learners) and elementary school teachers, both novice and experienced, in a variety of professional development settings. Though there continues to be growing interest and action toward the use of EMS professionals, there continues to be a need for research involving EMS.

Avenues for Further Research

As previously discussed, there is a great need for research on EMS. The question of whether or not particular models of EMS positively impact teacher instruction and student learning in different ways or to differing degrees remains unanswered because, unfortunately, evidence related to this question is practically nonexistent. Though student achievement is certainly one component by which we might measure the impact of EMS, future examinations of EMS impact must move beyond student achievement to other important indicators or effectiveness such as teacher retention, teacher job satisfaction, and recruitment of high quality teachers. Understanding outcomes such as these may help to better inform policy. For example, teacher retention, particularly in high needs schools, is a difficult and costly problem (Luekens, Lyter, & Fox, 2004). If EMS are more likely to be satisfied and remain in these schools, policy makers may be more likely to make investments in hiring and preparing EMS.

Some insights on the impact of EMS might be gleaned from studies that identified characteristics of effective professional development or other studies more generally examining the characteristics of effective content coaching. It is important to better understand the impact of elementary mathematics specialists, including pull-out instructors and mathematics coaches. Further, the field must examine whether one model is more effective at improving student achievement or influencing other measures of teacher impact such as teacher retention. Mathematics educators must move beyond anecdotal evidence if they are to better inform practice and policy. Large scale, empirical studies

could help make the case for the preparation and hiring of EMS, an issue that is of particular importance in light of the substantial changes that will result from the implementation of the CCSSM.

Similarly, research on effective programs focused on the preparation of EMS is needed. As the number of EMS preparation programs continues to rise, it is important that the mathematics education community study the variations among the programs' approaches to EMS preparation. What types of courses are needed to prepare EMS? Are different preparations required for specialized mathematics teachers and mathematics coaches? Are field-based experiences more effective for preparing EMS than traditional courses? Is being a master teacher sufficient or are specialized programs focusing on developing additional mathematics competency for teaching needed? This issue was raised in the National Mathematics Panel Report (2008).

> Given the paucity of evidence that general teacher certification has a positive effect on student achievement, it may seem counterintuitive to think that the use of elementary mathematics specialists would have positive effects. It is likely, however, that if the use of elementary math specialists is to have a positive effect, it will be because the training of specialists develops, in a more focused way, the specialized mathematical knowledge for teaching shown to have effects on student achievement. This suggests that policies and programs for elementary math specialist need to be developed in tandem with research that attempts to uncover those aspects of teacher knowledge and understanding most strongly related to student learning. (Ball et al., 2008, p. 5-56)

In other words, if specialized programs are beneficial, what are effective methods for delivering these programs and what content is of particular significance? Though districts and universities continue to invest in EMS preparation, it is done so without evidence as to what constitutes an effective program. Understanding the aspects of effective EMS preparation is crucial to the future success of such programs.

The community of mathematics educators is a vital component of the future success of EMS preparation and impact. Mathematics educators should critically examine EMS programs and the impact of EMS on student learning in order to continue to improve existing models and advocate for changes to state and local policy regarding EMS. Further, because many states already offer certification for EMS and many schools and districts employ EMS, it is necessary to begin to bridge current practice and research. As new mathematics educators take on research in this area, it is important that those already involved in the work of EMS use the research to inform practice. Thus, new studies regarding EMS must be accessible to not only institutions that prepare EMS, but also to school and district level personnel in order to align the use of EMS to evidenced best practices.

With the transition to CCSSM by a majority of U.S. schools, the utilization of EMS seems a promising component of successful implementation. This move also provides opportunities for rich avenues of research into EMS and their involvement in reform efforts and student learning. These opportunities will hopefully begin to span research and practice as the field comes to better understand best practices for EMS preparation and the impact EMS may have on student learning. ✪

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