

MATHEMATICS TEACHER LEADERS PREPARATION, MENTORSHIP, AND SERVICE: COMMUNITIES OF PRACTICE THROUGH ONLINE MODALITIES

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ABSTRACT

This article is a preface to a special issue of the *Journal of Mathematics and Science: Collaborative Explorations* which features articles that describe (a) online components of mathematics specialist preparation and mentoring programs, (b) the mentoring and support of teachers preparing to serve as mathematics teacher leaders, and (c) the subsequent service of mathematics specialists in leadership roles. This preface describes the context within which the described online activities took place, provides a common glossary of terms that will be used consistently across all the articles, and briefly introduces each of the fourteen papers that constitute the special issue.

KEYWORDS

mathematics specialist, mathematics teacher leaders, online professional development, online mentoring

This special issue of the *Journal of Mathematics and Science: Collaborative Explorations* features articles that describe (a) online components of mathematics specialist preparation and mentoring programs, (b) the mentoring and support of teachers preparing to serve as mathematics teacher leaders, and (c) the subsequent service of mathematics specialists in leadership roles. This preface describes the context within which the described online activities took place, provides a common glossary of terms that will be used consistently across all the articles, and briefly introduces each of the fourteen papers that constitute the special issue.

Mathematics Specialists

Similar to the approach taken by McGatha and Rigelman (2017), throughout this special issue, the term *mathematics specialist* will refer to individuals in PK–12 schools who serve as mathematics coaches or program leaders. Indeed, the preparation programs described in this issue are primarily designed to prepare teachers to serve as mathematics coaches or program leaders. However, program graduates may and do, at the discretion of their school systems, serve in one or more of the following roles: mathematics teacher, mathematics interventionist, and mathematics coach or program leader.

Research on the Impact of Mathematics Specialists

While a large portion of the research on mathematics specialists has focused on the various mathematics specialist roles and responsibilities (e.g., Mudzimiri et al., 2014), researchers have investigated several areas in which the work of the mathematics specialist is important including (a) the exploration of the mathematics specialist’s relationship with and work with teachers (Chval et al. 2010; Gibbons & Cobb, 2012; Marsh et al., 2010; Polly, 2012; Race et al., 2002); (b) the knowledge and ongoing support required of the mathematics specialist (Baldinger, 2014; Bitto, 2015; de Araujo et al., 2017; Fennell et al., 2017; Shaughnessey et al., 2017; Sutton et al., 2011); (c) the preparation of teachers to serve in these roles (Baker et al., 2018; Myers et al., 2020); and (d) the design of the online learning environment (Baker & Hjalmarson, 2019). Furthermore, research has also explored the impact of mathematics specialists on teachers and students (Baker et al., 2017; Balfanz et al., 2006; Campbell et al., 2017; Markworth, 2017; Polly, 2012; Race et al., 2002).

In Virginia, several large-scale studies have been conducted on the impact of mathematics specialists in K–8 schools. In a three-year, randomized, control study, Campbell and Malkus (2010; 2011) found that over time mathematics specialists had a significant positive influence on student achievement in third, fourth, and fifth grades. The impact was evident after two years on the job with the increase in scores for students in schools with a trained mathematics specialist on average ten or more points higher on mathematics achievement tests when compared to students in schools without a specialist. Additionally, a two-year study explored the relationships among mathematics specialists, classroom teachers, and the building administrators in order to develop a deeper understanding of the processes that influence continuous improvement of K–8 mathematics achievement and effective mathematics teaching in school settings. Ellington et al. (2017) found that being highly engaged with the mathematics specialist had a significant impact on middle school teacher beliefs about how students learn mathematics and on student achievement. Over time, highly engaged teachers developed an understanding that students should work through ideas to make sense of them in order to develop

a deep understanding of mathematical concepts. With respect to student achievement, in grades six and seven, students of teachers who were highly engaged with the specialist performed significantly better on achievement tests than students of teachers who were not highly engaged.

Online Professional Development for Teachers

Online learning is an effective mode for delivering graduate and professional education. The benefits of online learning are well documented with respect to accessibility, efficacy, cost effectiveness, learner flexibility, and interactivity (e.g., Sinclair et al., 2016). Online communities of practice promote and deepen teacher reflective practice (Hough et al., 2004; Stiler & Philleo, 2003), afford opportunities for teachers to share their expertise and develop collegial, long lasting relationships (Hanson-Smith, 2006; Paulus & Scherff, 2008), enable educators to collaborate and integrate educational theory into their practice (Dibbon & Stevens, 2008), and increase teachers' self-efficacy (Vavasseur & MacGreor, 2008). Dede et al. (2009) assert that teachers need access to professional development experiences that capitalize on “powerful resources often not available locally, and that can create an evolutionary path toward providing real-time, ongoing, work-embedded support” (p. 9).

Virginia Mathematics Specialist Add-On Endorsement

The K–8 Mathematics Specialist endorsement in Virginia requires that individuals be fully licensed teachers with at least three years' experience. To meet these requirements, candidates complete a master's degree that aligns with the national preparation standards for mathematics specialists (Association of Mathematics Teacher Educators, 2013; National Council of Teachers of Mathematics, 2012) and includes opportunities for candidates to develop a deep understanding of (a) K–8 mathematics in areas such as number and operations, rational numbers, geometry, algebra and functions, and probability and statistics; (b) pedagogical content knowledge across the K–8 curriculum; and (c) leadership and coaching skills needed for working with teachers. Master's level programs have been developed at a number of different universities across the state and are approved by the Virginia Department of Education. At most institutions, teachers who have previously earned a masters' degree in a related area can earn the add-on endorsement by completing only the mathematics and leadership courses necessary to meet the endorsement requirements that were not satisfied by prior course work.

Transition to Online Mathematics Specialist Preparation Programs

In Virginia, the initial mathematics specialist preparation programs were taught in a face-to-face format and fully engaged candidates in in-depth discussions of mathematical ideas to prepare them for work as mathematics coaches. Virginia Commonwealth University began to offer a blended program in 2010 and then, with support from a National Science Foundation Noyce grant that is also funding this special issue, offered fully online courses to its first cohort beginning in 2017. Many of the instructors for courses in this cohort had participated in or been candidates in face-to-face mathematics specialist preparation programs. George Mason University's program has also offered an online hybrid format since 2010 and added a fully synchronous online format in 2017, so the instructors in that program have significant experience

with online instruction. The Longwood University program has been offered through a hybrid format for approximately 10 years.

Synchronous Online Learning Environment

Each of the courses described in this special issue have significant synchronous learning components, during which all candidates are online concurrently. The online synchronous format permits lively whole group discussions. Candidates are also regularly placed in virtual breakout rooms where they can discuss the mathematical ideas under study in small groups.

Asynchronous Online Learning Environment

Some components of the courses are offered in an asynchronous format during which candidates complete assignments on their own time away from the synchronous learning environment. An example of this type of assignment is an assigned reading in which candidates respond to prompts in a discussion board or some other virtual medium, and their responses are subsequently read and responded to by other candidates as well as the course instructors. Select portions of the mathematics specialist courses described in this special issue involve this format.

Co-Authors of Papers

All of the papers in this special issue are co-authored. These teams typically consist of individuals who are endorsed mathematics specialists, school administrators, full-time university mathematics educators, or university mathematicians.

Terminology

- **Instructor** — This term refers to any individual who teaches or co-teaches a mathematics or leadership course in a mathematics specialist preparation program.
- **Candidate** — This term refers to any K–12 teacher who is or was enrolled in a mathematics specialist preparation program.
- **Teacher** — This term describes any PK–12 school personnel who is primarily responsible for educating PK–12 students.
- **Student** — This term refers to any PK–12 student in both public and private settings.

JMSCE Special Issue Articles

The papers in the special issue describe transitioning from face-to-face to online learning environments, challenges and benefits of an online mathematics specialist preparation program, mentoring new mathematics coaches or on-going mentoring programs, using online tools to coach teachers; and specialists developing partnerships with principals.

Online versus In-person Mathematics Instruction: A Comparison of Two Instructional Models explores the differences between online and traditional in-person teaching and learning modalities. The authors describe the preparation for and teaching of online mathematics, focusing on establishing norms and the use of technology. By identifying key

similarities and differences between instructional modalities and by reflecting on successes and challenges, a vision of online teaching and learning for mathematics courses emerges that can be effective, inclusive, and relational.

Connected at a Distance: Experiences and Efforts Within a Synchronous, Online Mathematics Specialist Program describes the purposeful opportunities that were provided throughout a mathematics specialist preparation program for candidates to make ongoing personal and professional connections with each other. Based on the idea that learning is a social construct, instructors and candidates worked to form and sustain an online learning community. The authors share ways that intentional connectedness can be extended to other educational contexts.

Instructor Perspectives: Transitioning from Face-to-Face to an Online or Hybrid Graduate Level Mathematics Education Course shares reflections and lessons learned from instructors at three different institutions as they made the transition from face-to-face to online or hybrid instructional models. The authors share their experiences in constructing lessons and facilitating class sessions. They describe their personal and professional growth through the experience and share takeaways for institutions planning to develop online professional development programs for teachers.

Transitioning a Mathematics Specialist Preparation Program into an Interactive Online Program: Insights from the Developer and Candidate Perspectives describes how an entire preparation program transitioned from a set of face-to-face courses to an entirely online instructional format. Both the instructor and the candidate perspectives on the changes that were made are shared. The paper states that the goal was to use online tools and remote instruction for all aspects of the program while at the same time maintaining the highly interactive nature and the rigorous instruction that the face-to-face preparation program was known for.

Developing Equity-Centered Leadership Knowledge and Skills via Lesson Study in an Online Mathematics Specialist Program describes coursework within a synchronous online mathematics specialist program that enhanced candidates' leadership knowledge and provided structures that addressed issues of equity and access. The paper focuses on an online assignment grounded in Lesson Study that played a pivotal role in helping candidates develop equity-centered leadership and instructional practices. The experiences shared by course instructors and recent program alumni support the broader goal of achieving a cohesive vision for the teaching and learning of K–8 mathematics, while promoting equitable practices in school-based work.

Learning to Anticipate in an Online Class: Perspectives of an Instructor and a Mathematics Specialist Candidate features the practice of anticipating how a learner will approach an activity from two perspectives: a course instructor and a mathematics specialist candidate. The authors note that learning to anticipate was one skill that helped to develop a rich community of learners that provided opportunities for everyone to grow through their interactions with and reflections on course content.

Mathematical Representations in a Synchronous Online Mathematics Specialist Preparation Program addresses the possible concerns of compromising quality pedagogy for convenience when designing synchronous online courses. In addition to maintaining rich discussion and student collaboration in an online environment, mathematics content courses include the additional challenge of incorporating problem-solving with multiple representations. This paper focuses on how these mathematical representations emerge and develop during a synchronous online course for mathematics specialists.

Team Teaching for Discourse: Perspectives of Instructors and a Student in an Online Probability and Statistics Course for Preparing Mathematics Specialists describes the interactions of and reflections from three course instructors and a mathematics specialist candidate during the planning and enactment of a Probability and Statistics course for mathematics specialists. The authors discuss the strengths of discourse in the planning stage as a way to create and sustain a sense of community and share multiple perspectives in an online course. They share how the experiences of a diverse team were crucial to successful implementation of a team-teaching approach to instruction.

Equity and Access: Empowering Change Agents shares how mathematics specialists are uniquely situated to contribute to the creation of access and equity for all learners by addressing three target areas with their mathematics teachers and administrators. Three possible obstacles to access and equity are: beliefs and expectations, curriculum and instruction, and intervention. Mathematics specialists can be prepared to address these obstacles through their preparation in leadership courses that are intentionally designed to help them practice negotiating the role of change agent.

The Role of a Mathematics Content-Focused Coaching Project in Preparing Mathematics Specialist Candidates to Coach describes the mathematics content-focused coaching process from the perspective of mathematics specialists in their work with teachers. In particular, the paper outlines effective strategies and techniques used by the mathematics specialists as they work with teachers and focus on mathematics and student learning. The authors share an activity that provides novice mathematics specialists with the opportunity to reflect on all aspects of the coaching cycle. They share ways in which this reflective activity can be used to support learning.

Online Education: Transferring Personal Experiences to Professional Development describes how participation in a mathematics specialist preparation program helped prepare one mathematics teacher leader to develop and offer online professional development for teachers. The paper highlights the importance of building relationships and using high-quality mathematical tasks in online professional development. This case study provides evidence that exposure to online learning environments as a learner can help lower the barrier of entry for planning and providing online learning experiences as a mathematics specialist.

Virtual Mentorship of Teacher Leaders: The Ripple Effect describes a monthly online mentoring program for novice mathematics specialists. Two mathematics specialists serving as mentors and two candidates participating in the mentoring program share their thoughts and ideas on the support provided through online mentoring. The authors discuss the benefits and constraints of mentoring in an online environment and ways this particular program can be a model for other virtual mentoring programs.

Providing Job-Embedded Professional Development for Mathematics Specialists highlights the importance of providing job-embedded professional development for mathematics specialists. Just as mathematics specialists provide coaching to teachers to help with their professional growth, similar opportunities for the growth must be identified for mathematics specialists. This paper identifies purposes of professional development for coaching to include supporting growth in content knowledge, pedagogical expertise, coaching skills, professionalism, and leadership. The authors advocate for a virtual network of mathematics specialists in similar positions.

A Relationship Built to Impact Instruction: Developing and Sustaining Productive Partnerships between Mathematics Specialists and Principals emphasizes the importance of

a strong relationship between the mathematics specialist and school administrators to the success of the mathematics specialist's work in the school building. The authors share examples of partnerships that are based on a shared vision for mathematics instruction and describe the impact on student mathematics achievement. The authors share examples from prior to the COVID-19 pandemic as well as examples of successful partnerships during the pandemic that required brainstorming and creativity on the part of teachers, mathematics specialists, and administrators.

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