

DEVELOPING EQUITY-CENTERED LEADERSHIP KNOWLEDGE AND SKILLS VIA LESSON STUDY IN AN ONLINE MATHEMATICS SPECIALIST PROGRAM

Courtney K. Baker
George Mason University
cbaker@gmu.edu

Spencer Jamieson
Fairfax County Public Schools
tsjamieson@fcps.edu

Adrienne Paul
St. Albans School
APaul@stalbansschool.org

Scarlett Kibler
Frederick County Public Schools
kiblers@fcpsk12.net

Alyson Eaglen
Loudoun County Public Schools
Alyson.Eaglen@lcps.org

Tammy Kraft
George Mason University
tkraft2@gmu.edu

ABSTRACT

This paper highlights how coursework within a synchronous online mathematics specialist program enhanced candidates' leadership knowledge and provided structures that addressed issues of equity and access. A focus on one online assignment grounded in Lesson Study played a pivotal role in developing equity-centered leadership and instructional practices. Program instructors and recent alumni illuminate how designing, implementing, and reflecting on the Lesson Study experience served as a cornerstone for advancing their mathematics instruction in the following ways: (a) as instructors designing an online leadership course, (b) as learners within an online environment, and (c) as educators within their K–8 school settings. The description of these experiences supports the broader mathematics education community's goal of achieving a cohesive vision for the teaching and learning of mathematics, while promoting equitable practices in school-based work.

KEYWORDS

mathematics specialist, teacher leader, online learning, Lesson Study, equity, agency

Educators across the nation are working towards the creation of equitable mathematics instruction in which every child has access to a “powerful learning environment” (National Council of Teachers of Mathematics [NCTM], 2020, p. 1). Equitable mathematics instruction should be designed in a manner that promotes “access and attainment for all students” (NCTM, 2000, p.12). It should be responsive to individual student needs and integrate student background knowledge and experiences (NCTM, 2020; NCTM, 2014) so that students can develop mathematical agency and actively demonstrate the knowledge and skills they possess instead of passively receiving information (Berry, 2016; Lawler, 2012). However, to achieve this vision, a transformation of our current instructional practices is essential, and systematic support is required (National Council of Supervisors of Mathematics & TODOS, 2016). Mathematics specialists are one way in which this reconceptualization can occur.

The Mason Mathematics Specialist Program

Over the past 15 years, it has been the goal of George Mason University’s (Mason’s) Mathematics Specialist Program to support the initial preparation and professional development of mathematics specialists. As the program transitioned to a fully synchronous online program, multiple benefits have emerged. For instance, as Mason’s program has expanded beyond Virginia into other states along the East Coast and across international boundaries, the candidate population has diversified, leading to an increase in divergent thinking. Additionally, the online platform has amplified shared ownership in our learning communities and has become a model for enhancing instructional opportunities via technology (Baker & Hjalmarson, 2019). However, most importantly, candidates have implemented equity-centered instructional shifts within their K–8 school settings. This paper speaks to one key assignment, which serves as such a model, the Online Lesson Study Assignment.

The Online Lesson Study Assignment: Instructors’ Perspective

While there are many variations of lesson study throughout the United States, when designing the original Lesson Study Assignment, Mason instructors drew upon the Lewis and Hurd (2011) model. This model allowed for developing a professional learning community that values participants, emphasizing research-informed teaching and responding to individual student needs by integrating student background knowledge and experiences. In the transition to a synchronous online format, instructors were able to uphold and enhance the lesson study components we valued while allowing the candidates to implement these lessons in a face-to-face context. Candidates continued to create task-based lesson plans that promoted engaging students in learning and doing mathematics aligned with national and state standards (NCTM, 2000; National Governor’s Association Center & Council of Chief State School Officers, 2010; Virginia Department of Education, 2016). However, the work of examining learning progressions and research-informed curricular resources now occurred in virtual breakout rooms using interactive tools such as Google Docs and Google Slides. Instructors integrated video recordings of the implemented lessons into the assignment so that lesson study teams could collaboratively reflect on and adapt the lesson for future implementations. Furthermore, Courtney and Spencer [instructors/authors] increased the emphasis on equitable instruction (NCTM, 2014, 2020) by asking candidates to utilize resources and strategies to promote students’ mathematical agency. Designing online, collaborative, research-informed lessons

centered on equitable teaching afforded candidates multiple opportunities to ensure all students have equitable access to powerful mathematical learning while developing valuable leadership skills required to shift mathematics instructional practices.

Candidates' Online Experiences & Perspectives: Adrienne, Alyson, and Scarlett's Stories

In the following sections, three Mathematics Specialist Program alumni, Adrienne, Alyson, and Scarlett, describe their experiences with the Online Lesson Study Assignment and how the assignment influenced their teaching and leadership practice. The themes common across their learning and design experiences are presented first, followed by stories of their unique implementation experiences (see Table 1).

Table 1

Candidates' Online Lesson Study Assignment Implementation Summaries

Candidate	Lesson title	Grade(s)	Mathematics topic	Research goals
Adrienne	“Array-bow of Color”	4 th & 5 th	Multiplication within 1000	Explore strategies and representations
Alyson	Promoting problem solving	4 th & 5 th	Decimals and decimal operations	Integrate multiple representations
Scarlett	Inventive strategies for subtraction	4 th	Subtraction word problems	Examine students' conceptualization

Designing Equitable In-Person Learning Experiences in a Synchronous Online Cohort

Even though we (Adrienne, Alyson, and Scarlett [alumni/authors]) participated in different lesson study groups, we each worked “to challenge and build one another’s knowledge of subject matter and of student thinking” (Lewis & Hurd, 2011, p. 3). We participated in several preliminary discussions and activities to develop respectful and collaborative relationships. We established group norms and roles, shared our individual mathematics instructional goals, listened to each other’s project ideas, and wrestled with how we could address our individual goals while also meeting the group’s needs.

Following the requirements of the Online Lesson Study Assignment, we discussed our different instructional styles and classroom experiences, which provided insight into who we are as educators and how to meet students’ instructional needs during the collaborative lesson. We ensured each group member felt heard and valued through our lesson study log, to which we all had online editing access. This afforded us the ability to record our thoughts, questions, sources, and lesson ideas in real time. By identifying commonalities and sharing strengths and weaknesses, we established a level of accountability and commitment to the lesson study cycle process.

Our prior knowledge and pedagogical strategies began to coalesce during the lesson creation and development stage. Each of our lesson study groups began by having common, broad goals in mind: (a) to probe students through problem-solving activities, (b) to ask purposeful questions to deepen their learning, and (c) to help students connect mathematical tasks to real-world contexts. These goals guided the creation of student-centered lessons and built on our collective knowledge of mathematics content and pedagogy. Because we were

separated by physical distance, the online learning platform allowed us to stay connected, learn from one another's contexts, and discuss the required research readings. It became apparent how imperative it was to listen to and honor each of our voices to make this experience purposeful and meaningful for all.

While the lesson study exposed our pedagogical practices and how students responded to our carefully planned lesson, we felt the greatest learning opportunities came from the intense reflection process in which we engaged independently and as a group. The process of reviewing artifacts, such as student work, built systemic knowledge about and for teaching and learning (Lewis & Hurd, 2011). Through the collaborative examination of student work, we experienced a joint investment and insight that led to further refinement of teaching pedagogies that influenced our broader understandings of teaching and learning mathematics.

One of the most valuable parts of our online lesson study experience was the recorded video component. The videos generated discussion, illuminated missed instructional opportunities, and prompted reflection that helped the teams make lesson improvements for subsequent implementations. Watching a video of one's teaching and sharing it for discussion with colleagues is an incredibly vulnerable act. For example, Alyson's reflection on her examination of the lesson video speaks to the importance of this element of the assignment.

I found that watching and sharing the video of my own teaching was scary, humbling, and empowering. It's one thing to be observed in real-time. It's another thing to examine a video of your teaching. However, I knew that my team and I had created the plan together and it was our lesson even though I was the one teaching it. (A. Eaglen, personal communication)

Alyson's reflection further accentuates the need to build trust and develop community with lesson study team members prior to the lesson's execution. The honest feedback we received from our lesson study teams provided us with the opportunity to reflect on and grow our pedagogical practice.

Developing an Equitable Leadership Practice in an Online Environment

Our graduate program's online platform allowed us to seamlessly connect, create, and collaborate, which was pivotal to our mathematics leadership journey. Instead of basing our lesson study self-reflections on memory, we reviewed the lessons in their entirety using video recordings. We benefited from the diverse perspectives of our group members, unbounded by geography. The online platform of our graduate program provided consistent access to multiple educators from various grade levels and differing roles throughout the East Coast and international settings.

Because we were never in the same room together, collaborating online required professionalism and collegiality when providing honest and constructive criticism. We achieved these goals in three ways. First, the online format allowed us to develop better time management due to candidate locations across multiple time zones. Second, we learned to communicate more succinctly because online communication prevented us from relying on facial expressions or body language. Having candid conversations enhanced and invigorated our leadership skills because we learned to courteously, yet frankly, critique our peers, which in turn provided invaluable practice for us aspiring mathematics teacher-leaders. Lastly, the online lesson study format was executed without the need for substitute coverage. During live lesson study experiences, teachers often have to get substitute coverage in order to be able to view and debrief

the lesson. Using the online format, we were able to meet and discuss our lesson outside of the time constraints of a school day. This format's flexibility makes it an interesting option for schools and districts looking to normalize in-house professional development.

Our K–8 Students' Experiences with Equitable Mathematics Instruction

Students possessing mathematical agency participate in meaningful mathematics that connects to their background knowledge and experiences as well as those of their peers (NCTM, 2020). The K–8 students who participated in each of our lesson studies engaged in rich mathematical tasks which were intentionally designed with multiple entry points so all students could access the problems. Holding true to our lessons' student-centered design, our learning goals were driven by students learning from one another as they listened, questioned, and explored each other's ideas and made mathematical connections independent of teacher input. In this way we embraced *Catalyzing Change's* (NCTM, 2020) intent to ensure all students' voices and ideas were welcomed into our classrooms and fostered others' learning. Below are the stories from each of our lesson study implementations and how we cultivated an equitable mathematics practice that emphasized students' mathematical agency.

Adrienne's Implementation: Equity in Exploration and Discovery

At the core of Three-Act Tasks is student-driven engagement and participation. The tasks cannot be solved without student input. Student input is rarely categorized as “correct” or “incorrect”; rather, it is considered integral to progressing along a solution path. Because the teacher serves as a facilitator, student input leads to understanding with pivotal observations, questions, exploration, risk-taking and decision-making. My (Adrienne's) lesson study team's plan was structured to maintain these critical aspects of the Three-Act Task. During the process, we designed my instructional role to shift from teacher to facilitator by explicitly contemplating how we could launch the task.

In the first act of the task, I asked students to brainstorm the focus question that would guide their inquiry. Each student voiced an opinion that I recorded on our chart paper, which was posted for all to view. As each student actively contributed and listened to their classmates, they individually and collectively determined whether an idea could be further considered, developed, or eliminated. Every student played a leadership and collaborative role by sharing ideas, attempting to justify their thoughts, and critiquing others' suggestions. During a 40-second turn-and-talk, students shared their thinking and considered the ideas of one or more classmates. The students spent almost eight minutes discussing the possibilities of the main question, during which time they combined questions, eliminated unnecessary ones, and eventually realized that they would answer subsequent questions with an exploration of their selected focus question.

This dynamic aspect of the task on which we focused in our lesson study helped students take ownership of their learning. They could not progress to the next act without making decisions collaboratively around the first act. At some point in the discussion, each student played both a follower and a leader, further developing a sense of mathematical confidence and agency.

Alyson's Implementation: Equity in Access

A productive belief about children's mathematical ability in *Catalyzing Change* (NCTM, 2020) is that access to high-quality mathematics instruction is impacted by the labels we place on

children. Similarly, teachers must leverage student differences by considering how we can invite all students to participate by encouraging representations that support sense-making at all levels (NCTM, 2020). In my (Alyson's) lesson study project, my group strove to create an accessible mathematical opportunity through which all students could engage in the same rich task. We did this by selecting a problem with multiple entry points, providing students with a variety of manipulatives, and encouraging student groups to investigate a solution strategy that made sense to them.

The task we selected was centered on a real-word activity with which most students in the classroom had personal experience: raking leaves. While launching the task, students were shown different manipulatives that they could use to help them explore and solve the problem, including play money, snap cubes, pattern blocks, counters, and color tiles. The variety of materials sent a clear message to students that varied representations and creative strategies were welcomed and invited students to construct their own meaning. Student groups were also given chart paper and markers to record their thinking as they collaborated to make sense of the task. While groups collaborated, I circulated from group to group, checking in on student thinking. I supported sense-making by asking purposeful questions that probed their mathematical understandings and encouraged divergent solution strategies. The freedom to develop their own strategies, along with verbal encouragement to represent strategies with manipulatives, pictures, words, and numbers encouraged all students in the class to be *doers* of mathematics. This belief that all students are capable of doing mathematics and the practice of giving them the means to access the problem and materials are huge steps towards creating equitable mathematics instruction.

During the post-lesson reflection, our group realized that our purposefully planned lesson had positively impacted student learning. By creating the conditions whereby students had both access to the problem and the materials that enabled them to collectively reach a solution, students demonstrated a deeper understanding of the content and feelings of being valued as mathematical thinkers.

Scarlett's Implementation: Equity in Opportunity

Equity does not mean that everyone gets the same instruction; it means that every student receives quality instruction and the opportunities that they individually need to find success in mathematics. One of the benefits of a lesson study is that it allows educators to plan and consider how to provide quality instruction for all learners. Lesson study becomes extremely important when planning effective and meaningful mathematics instruction, especially because students bring with them varied experiences and readiness for learning.

In my (Scarlett's) lesson study experience, students were given opportunities to discuss and evaluate strategies and consider strengths and weaknesses of their computation. Students were given time to analyze strategies based on their experiences with numbers and to decide why and how their strategies worked. Students identified and made connections between new strategies and ones they had used previously. Through this practice, students developed deeper conceptual understandings for how to decompose numbers into friendlier numbers to use when calculating. Through this lesson, students were able to build on the idea that there are multiple pathways to solving a problem in mathematics. Once students made a meaningful connection to a concept they understood, they experienced a "lightbulb" moment. As students analyzed the strategies more closely, their conceptual understanding and confidence increased, enabling them to move forward with problem-solving because they were able to find a point of familiarity.

The mathematical insights students gained through making a mathematical connection during this lesson will support them as they continue to deepen their mathematical thinking. The lesson created in our Online Lesson Study Assignment offered a lens into how developing leadership skills fosters instructional practices which lead to equitable learning experiences for students.

Final Thoughts

Whether in a formal or informal leadership position (McGatha & Rigelman, 2017), mathematics specialists can be positioned as powerful change agents who support the transformation of mathematics instruction into collaborative spaces: spaces in which students are encouraged to take new approaches, advance their learning, and foster mathematical agency (NCTM, 2014). To accomplish these goals, mathematics specialists require targeted leadership knowledge and skills so that they can help transform mathematics instruction in their schools (AMTE, 2013; NCTM, 2012; Sutton et al., 2011). The Online Lesson Study Assignment in George Mason University's Mathematics Specialist Program provided candidates with opportunities to intentionally design and facilitate lessons that provided multiple access points to ensure all students meaningful engagement with rich mathematical learning experiences. Ultimately, engaging in this experience allowed candidates the opportunity to transform their classrooms into mathematically powerful spaces in which teachers facilitated equitable learning opportunities and students increased their mathematical agency.

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