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RESEARCH ARTICLE

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Engaging elementary mathematics specialists: Strengthening the connections between university coursework and practice

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Abstract

Elementary teachers are underprepared to teach mathematics, and there is a lack of field-based support for mathematics-specific pedagogies in the elementary grades. To address this theory to practice gap, we developed an innovative model of fieldwork that draws on the expertise of in-service teachers (elementary mathematics specialists [EMSs]) who had recently completed a K–5 mathematics endorsement to work in the role of university supervisors supporting beginning teachers (BTs) in initial fieldwork. We argue that this model has three key aspects that will support BTs bridging the theory to practice gap: (1) as in-service teachers the EMSs are keenly connected to the context of schools; (2) recent experience in university coursework in mathematics while serving as in-service teachers required the EMSs to navigate the theory to practice gap themselves; (3) one-on-one mentorship supports strong and trusting relationships. Drawing on data from a 3-year study we found that EMSs brought intimate knowledge of the school context and knowledge of the mathematics-specific pedagogies taught at the university. These connections to the field and the university allowed EMSs to support BTs in implementing research-based practices in their mathematics lessons that went against the norms of their school settings.

KEYWORDS

curriculum, professional development, reform, teacher education, teachers and teaching

While COVID-19 caused disruption to university and K–12 teaching practices (Panther et al., 2021; Prothero, 2022), it also provided opportunities for questioning taken-for-granted practices and the exploration of new models. In this article, we report on a 3-year study that investigated an innovative model of fieldwork for beginning[1] teachers (BTs). The model relied on the expertise of in-service mathematics teachers who had recently engaged in an advanced degree with an embedded certification for an elementary mathematics endorsement. We

[1]We use the term beginning teachers to refer to preservice teachers and teachers of record within their first year of teaching. We follow (Hobson et al., 2009) in defining "'beginning' (or 'beginner') teachers to be those who are undertaking programs of initial teacher preparation (ITP) or are in their first 3 years as qualified teachers." (p. 207).

conceptualize these in-service teachers as elementary mathematics specialists (EMSs). McGatha and Rigelman (2017) outlined a definition of mathematics specialists that includes holding an advanced certification as a mathematics instructional leader and working in a leadership role. They distinguished EMSs by the nature of their leadership; coaches work primarily with teachers, teachers work primarily with students. Given that the EMSs in this project were engaged full-time with students in their own classrooms *and* also supported a BT in developing their mathematics instruction, they served in EMS roles as both teachers and coaches. This is a key feature of the innovation in this model. Being in both roles simultaneously supported the effectiveness of the EMSs in both the coaching and teacher role.

To understand how the EMSs continued the research-based practices from the endorsement program as they supported BTs, we interviewed three EMSs from the project. We were also curious as to how their position as teacher and university supervisor (coach) might allow them to support BTs in bridging the research practice gap. Because the EMSs were in-service teachers, we had to rethink supervision. The disruptions, due to COVID-19, in the spring of 2020 and into the fall necessitated supporting BTs in fieldwork through virtual supervision. This change in practice opened a window into innovation. Since the EMSs had their own classrooms, they did not have the flexibility to visit BTs' schools. Virtual supervision, including the asynchronous review of recorded teaching episodes in place of in-person observations, allowed these in-service teachers to take on a role that had not traditionally been available to full-time teachers.

We posit that this model creates a hybrid space where knowledge from the university and from the field come into conversation to support BTs as they enter the field. This hybrid space (see Zeichner, 2010) where knowledge from EMSs' teaching experience supports BTs to reflect on and connect their university and field experience, in turn, helping EMSs to continue to reflect on their recent university learning. The model supports continued reflection and integration of recently learned pedagogies and practices into the EMSs' classrooms and supports the initial implementation of these research-based practices in the BTs' classrooms. The research question that guided this portion of the study was: What are the benefits and drawbacks of a model of fieldwork that pairs in-service teacher leaders who have research-based mathematics content expertise with BTs in fieldwork? We begin with a review of the literature that establishes the need for this innovation before presenting our findings over the 3 years.

1 | LITERATURE REVIEW

When the university- and school-based worlds collide, BTs often face discontinuities in beliefs, cultures, and practices that they must contend with to cultivate their own professional identities and approaches to teaching (Beltman et al., 2015). Research has shown that they feel pressure to conform to their school communities while negotiating desires to implement ideas from university (Correa et al., 2014). According to Feiman-Nemser (2001) the central tasks of preservice teacher education require (1) analyzing beliefs and forming new visions to "examine critically their taken-for-granted, often deeply entrenched beliefs" and "develop powerful images of good teaching" (p. 1017) with the support of teacher educators; (2) developing subject matter knowledge for teaching; (3) developing understandings of learners and learning; (4) developing a beginning repertoire including having the "judgment, skill, and understanding" (p. 1018) to decide among different approaches; and (5) developing the tools to study teaching "in the company of others" (p. 1019). However, there is not a strong connection between how these central tasks are integrated in university coursework and how they are applied to school practice. In the following sections, we focus on building strong connections for BTs to build understanding of school contexts, subject matter knowledge, and critical and collaborative reflection.

1.1 | The need for understanding the context of schools

The early-career stage (sometimes referred to as induction) is a critical time for BTs as they learn to navigate their new workplace and create their understanding of what their role is going to look like within that context (Dicke et al., 2015; Edwards & Nuttall, 2015; Guarino et al., 2006; Ingersoll, 2012). Kearney's (2015) theoretical model of how BTs progress through their careers represents three of the defining influences on professional development as situated learning, socialization, and induction practices. These impact BTs situated within a learning community aimed at the improvement of their teaching practices (Kearney, 2015). Participating in this development are key figures such as school administrators, mentor or CTs (CTs), and university supervisors (USs) who can serve as role models for BTs. To help them acclimate to their new working environment, BTs quickly construct a network of supporters during their early-career and appear to narrow that network as time passes (März & Kelchtermans, 2020).

While the input and role modeling BTs receive from more experienced personnel can be helpful, research has shown that exactly how BTs are enculturated and adopt the practices modeled for them can be complex and varied. For instance, Jones et al. (2016) found that BTs often take up the practices of the CTs in whose classrooms they intern without question. In addition, Ward et al. (2011) noted that "productive friction" often requires "diverse expertise from different social worlds [coming] together to support candidates' learning" (p. 14) and that BTs depend on critical feedback to address "unresolved conflicts between these worlds" (p. 15). BTs are simultaneously exposed to a host of new practices and approaches as they begin their careers; having space and support to reflect on these is key. To navigate this complex and novel context, Correa et al. (2014) found that BTs seek creative solutions through interactions with colleagues including their USs who "play a major role in mediating to solve or at least soothe the practical problems and emotional conflicts regarding student teachers' praxis" (p. 461). Providing BTs with the needed support of modeling from expert educators as well as reflective practices by which to understand what they are seeing is a promising direction of induction.

1.2 | The need for mathematics content area expertise

In addition to navigating the general context of schools, within the area of mathematics BTs are asked to "negotiate new discourses about the learning and teaching of mathematics and link those discourses to their existing vision of high-quality mathematics teaching" (Schwartz et al., 2018, p. 62). Without the support of school-based mentors, BTs often have few, if any, opportunities to try out or practice the skills and teaching moves learned through methods coursework during field experiences (Zeichner & Bier, 2012). In a study that explored the type of feedback USs provided on observations of elementary teacher candidates' mathematics lessons, Schwartz et al. (2018) found that many of the USs provided no feedback on mathematics content or practices, and of the 68% that did, much of the feedback countered the research-informed beliefs promoted within university-based coursework.

In a sample of 625 elementary teachers, Hill (2010) asserted that there is more specialized mathematics content knowledge that needs to be learned by BTs than time in methods courses allows and that current mentoring and coaching activities tend to lack a focus on mathematics content knowledge. They concluded that "mathematics educators will have to implement strategies that enable teachers to learn this content in their workplace from more experienced colleagues and/or curriculum material" (Hill, 2010, p. 537). It is crucial that they do learn the mathematics content as mathematical knowledge for teaching, positively affects the quality of mathematics instruction (Santagata & Lee, 2021). In the current model, many USs do not have the mathematics content area knowledge to support student teachers in embedding rich mathematics into their praxis (Barahona, 2019; Burns et al., 2016).

1.3 | The need for interpersonal support

Prior scholarship and our experiences across three universities have shown USs to be undervalued (Burns & Badiali, 2015), underpaid, and under-supported. The high number of assignments and requirements in fieldwork, in tandem with the large numbers of students per supervisor, has inevitably led to a "supervisor as inspector" (Burns & Badiali, 2015, p. 431) relationship, with the supervisor ultimately checking off assignments and points. Given these pressures on time, emotional and interpersonal support are added onto USs workload as service. Capello (2022), in a study of what USs do across their job, dubbed this "emotional service" (p. 12) and found that this was a service administrators expected in addition to the other more formalized tasks related to supervision. Burns et al. (2016) outlined five core supervisory tasks, one of which they called "individual support," which included emotional and socioemotional support such as helping BTs cope with anxiety and stress and providing appropriate challenge and support. While not formalized in most field programs, this support is essential to supporting BTs, helping them to face challenges positively and reduce the stress of learning to teach (Barnes-Johnson et al., 2019). Possibly due to USs' general willingness to provide these services, teacher candidates "consistently rank that [their field experience] portion of their education as the single most influential factor in their teacher education programs" (Steadman & Brown, 2011, p. 52). Given the need for understanding school contexts, specialized mathematics content knowledge, and interpersonal support, we posit that in-service EMSs are uniquely situated to support elementary BTs learning to teach mathematics.

1.4 | The potential of EMSs

The Association of Mathematics Teacher Educators (2013) recommends that all elementary schools have an EMS. Over 15 years ago, the NCTM president Fennell

called for more EMSs in schools (Fennell, 2006), but there remains a lack of EMSs and insufficient programs to develop them. EMSs must "possess expert knowledge of elementary schools and students" (Bolyard & Baker, 2023, p. 568) and understand the importance of building relationships with teachers, administrators, and the community (Fennell et al., 2013). Just as Ragland (2017) found success in bridging the theory-to-practice gap through the recruitment of program alumni as CTs (see also Albert, 2019), in this project, we recruited in-service EMSs to serve as USs, providing a bridge between the university and schools.

This model presents an opportunity for universities to train in-service teachers to develop into EMSs and USs. This would benefit the university by having USs who are able to support BTs in embedding mathematics-specific teaching practices into their praxis (Barahona, 2019; Burns et al., 2016). It would also benefit schools as the EMSs work with BTs and develop coaching skills that they can take back to their schools. In their dual roles, EMSs can bridge the theory-to-practice gap and foster change across the school and school districts (Donaldson & Karp, 2023).

Using two complementary definitions of teacher leadership, this study conceptualizes EMSs as teacher leaders who maintain their own classroom teaching responsibilities but also, through additional roles and responsibilities, influence their colleagues toward improved instructional practices to better student outcomes (Wenner & Campbell, 2017) and who "rightly and importantly hold a central position in the ways schools operate and in the core functions of teaching and learning" (York-Barr & Duke, 2004, p. 255). These definitions of teacher leadership align with McGatha and Rigelman's (2017) definition that was outlined above whereby the mathematics specialists in this study maintained their classroom responsibilities while working with BTs to support their practice—serving as both a mathematics teacher and a mathematics coach.

The importance of effective leadership cannot be overstated when it comes to initiating and sustaining change within educational environments (Fennell et al., 2013). However, EMSs also face challenges as they assume leadership roles: they must balance leadership with the need to focus on teaching and learning (Bolyard & Baker, 2023) and learning how best to work with adult learners (Baker et al., 2022). Drawing on the expertise present in veteran teaching faculty to provide support to their more novice colleagues (BTs) is not a novel concept (Leithwood, 2003), but it has garnered increased attention as schools face staffing shortages and limited resources (Nguyen et al., 2019). In addition, several states (including Georgia, where this study was conducted) have recently formalized standards of teacher leadership and instructional coaching along with professional credentialing (Diffey & Aragon, 2018; Georgia Professional Standards Commission, 2023). The formalization of these roles at the license-level coupled with institutional pressures at the school district level has created an increased need to support teacher leaders.

As teacher leaders are increasingly asked to support BTs in the field in various ways, the body of research into their impact on teaching practices and student outcomes should continue to grow. Currently, there exist a relatively small number of inferential studies examining the impact of teacher leadership practices on teacher and student outcomes (Supovitz & Comstock, 2023), many of which solely focus on instructional coaching. Barnes-Johnson et al. (2019) studied the experiences of elementary BTs with STEM coaching and found that their experiences with their coach also helped to improve their feelings of self-efficacy. In addition to the benefits to BTs and their students, as described above, there are important positive effects on the teacher leaders. Research has shown that supporting BTs can also positively impact the instructional practices of the teacher leaders themselves (Yager et al., 2013; York-Barr & Duke, 2004), increase their feelings of job satisfaction (Nguyen et al., 2019; Wenner & Campbell, 2017), as well as boost their own professional learning (Bektaş et al., 2022). This growing body of research draws attention to the benefits of positioning teacher leaders to support BTs through instructional coaching; therefore, schools and other educational institutions should invest in creating opportunities for these partnerships to form (Ingersoll et al., 2018; Katzenmeyer & Moller, 2009; Yow et al., 2021). This model of fieldwork has two potential benefits: BTs are supported in integrating mathematics-specific research-based practices into their practice. Second, in-service teachers with content knowledge expertise are supported in their development as teacher leaders.

2 | THEORETICAL MODEL

The conventional model of fieldwork creates barriers for BTs to take up and put into practice research-based pedagogies learned at the university. BTs participate in fieldwork within a mentor teacher's classroom and are thus embedded within their school's discourses relating to mathematics education, which may not be aligned with the research-based practices promoted in the university. To learn to incorporate these mathematics practices, BTs can benefit from ongoing practical advice and support from outside their particular school setting. In addition,

in-service teachers with advanced degrees may have little opportunity to develop their skills as teacher leaders prior to moving into more formalized leadership roles. This model supports both BTs and EMSs.

2.1 | Conventional fieldwork model and local context

The traditional model of university supervision includes the BTs, a school-based cooperating (mentor) teacher, and the US. Within this model, the CT provides a strong connection to the school and provides day-to-day guidance and mentorship. In a survey of USs at the study site, a small private university in the Southeastern United States, in the Spring of 2020, 38 of 43 USs had taught K–12 for over 10 years, 40% had been an administrator at some point in their careers, none had an elementary mathematics endorsement and none had a degree related to mathematics or mathematics education. At least for this sample of USs, the connections to K–12 schools were strong (they had many years of experience in schools), yet outdated (the majority had been out of the classroom for more than 5 years). This may cause BTs, as well as CTs, to view them as out of touch with the current context of schools. Within our conventional US population, the connections to the University were also weak, only five had been engaged in higher education within the past decade. The USs reported that they spent the majority of their time assessing assignments in the learning management system. These factors make it difficult for the conventional US to support BTs in connecting the theory they are learning in their university courses to classroom practice. Rather, in the conventional model, the US is viewed as an authority figure who decides to pass or fail the BTs, upholding the "supervisor as inspector" (Burns & Badiali, 2015, p. 431) role.

2.2 | Project fieldwork model and rationale

In developing a new model to support BTs, we focused on three areas within the conventional model (see Figure 1) related to the US that could support a more intimate connection between theory and practice. First, we sought to strengthen the connection between USs and the context of schools and communities. To accomplish this, our model connected BTs with a US who was a current practicing teacher with in-depth and practice-based knowledge of the current realities of schools. Second, we wanted to improve the connections between the USs and the research-informed mathematics content and pedagogy taught in university-based coursework. BTs in this model were supported by a US that had recent experiences in higher education and understood the current research-based pedagogies in elementary mathematics. Finally, we wanted to center the connections between educators and nurture the relationships between the USs and the BTs. To engage with these opportunities, we recruited graduates of the same university's elementary mathematics endorsement program to serve as USs. In this new model (see Figure 2), the EMS has a stronger connection to both the school and the university than in the conventional model. Because the EMSs were recent graduates, they had spent a year navigating and incorporating research-based practices into their own classrooms, helping them to experience productive friction

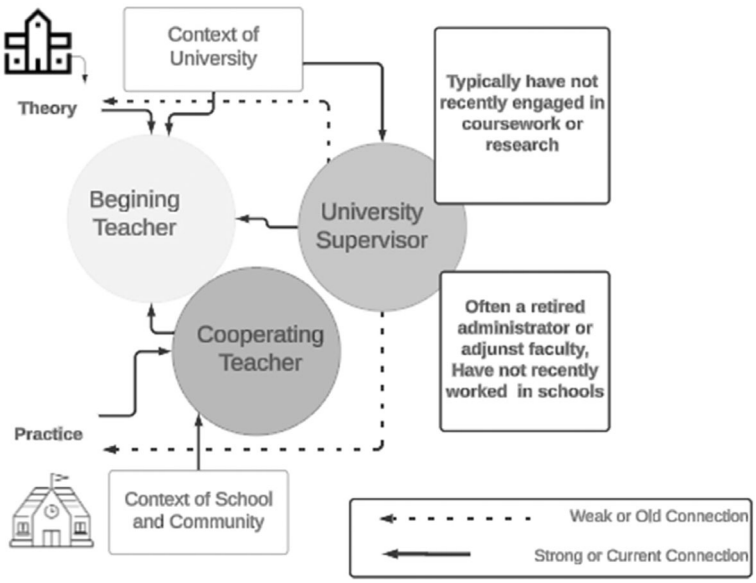

FIGURE 1 Conventional fieldwork model.

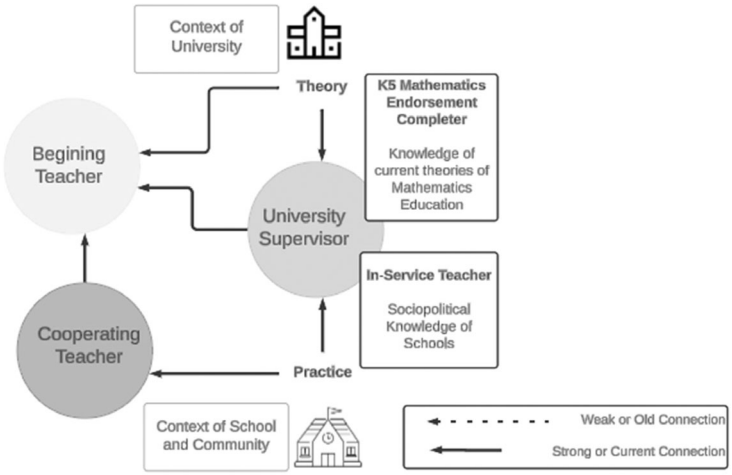

FIGURE 2 Project fieldwork model.

and understand the tensions that can arise in this integration. Having EMSs currently working in elementary schools presented a logistical challenge because they could not leave their classrooms to observe BTs, necessitating virtual supervision. While virtual supervision became commonplace during the response to COVID, supervising using recorded teaching episodes is not new, especially when large distances and many supervisees are involved (Currin et al., 2019).

Schwartz-Bechet (2014) conducted a case study comparison of traditional and distant supervision models and found that supervisor buy-in to the use of technology was a key factor determining the success of the experience for the BT. There have been challenges in implementing virtual supervision. These challenges include: inconsistent communication, limited perspective due to audio–video recordings, parental permission for recordings, and training and support for the use of the technology (Currin et al., 2019; Endacott, 2016; Wash et al., 2014). Despite challenges, Watson (2006) found that asynchronous field supervision provides "a rich 'field experience' without the usual barriers of transportation, illness, and schedule complications" (p. 175). Further Van Boxtel (2017) noted that video-recorded observations allow mentors to rewind and review the video to provide specific meaningful feedback. However, in spite of these difficulties, we felt that the practice-based experience EMSs had provided benefits that outweighed the challenges.

To center the relationship between the BTs and the EMSs and to honor the limitations of the EMSs time, the research team carefully considered the EMSs capacity to mentor BTs while working full-time. Each EMS was paired with only one BT, in 1 year, an EMS requested mentoring two BTs, but the outcomes from that semester encouraged the research team to continue with the one-to-one ratio. The pairs met every other week over Zoom (vs. less frequent in-person meetings typical of the traditional model). The online format facilitated the more frequent meetings and was designed to help counter the difficulty of forming relationships across distance.

The EMSs received coaching and supervision support directly from the first author. Support was centered around dilemmas of practice that the EMSs brought to the working sessions (Barahona, 2019). We held professional learning community meetings for the EMSs and the BTs every other week to reflect on and discuss tensions in bringing theories learned at the university into practice (Smith et al., 2021).

3 | MODES OF INQUIRY

We employed exploratory case study methodology. Given the use of in-service teachers with content expertise as field supervisors through virtual tools, the study constituted an unusual case and provided "a distinct opportunity" that "may reveal insights about normal processes" (Yin, 2009, p. 52). Each case was defined as an EMS/US and BT pair. The EMS participants had all completed their MEd and the K–5 mathematics endorsement and were recruited based on their success in the endorsement program and their ability to reflect on their own practice. In addition, while it is not a focus of this paper, one goal of this project was to build equitable mathematics discourse communities. In the first 2 years of the study, we found that the BTs, who were all undergraduate preservice teachers, struggled to incorporate the discourse practices because they were not yet adept at task design or leading discourse. Therefore, in Year 3, we changed the BT population to teachers in the final year of their Elementary Masters of Arts in Teaching program who were already teachers of record on provisional certificates. We hypothesized that they might be able to incorporate the higher-level practices more effectively.

TABLE 1 Summary of the cases included in this paper.

EMS	Year 1 (2020–2021)	Year 2 (2021–2022)	Year 3 (2022–2023)
Sierra Fifth grade in Years 1–2 Induction specialist Year 3	Ayanna Kindergarten	Elana Third grade Hope Kindergarten	Denise Fifth grade
Emily Third grade	Ellie Third grade	Brooke Kindergarten	Amanda Third grade

The data that informed this paper was drawn from 3 years of implementation, beginning in the spring of 2020 and ending in the spring of 2023. We conducted semi-structured interviews with EMSs and BTs at the beginning and end of each semester-long field experience. The research team analyzed interview data using concept coding and thematic analysis (Saldaña, 2016) and considered both individual cases and patterns across the three cases. Within and across the cases we coded broadly for drawbacks and benefits of the supervision model. We also established sub-codes in each area. For this paper, we draw data from the cases of two EMSs, Emily and Sierra (all names are pseudonyms) who participated in all 3 years of the implementation. See Table 1 for participant pairings.

4 | FINDINGS

Given that all EMSs interviewed for this study were practicing educators, they approached their supervising duties with a deep understanding of the complex world in which the BTs were immersed, acting as an instructional coach. In terms of our research question, the fortified connections to schools and communities were overwhelmingly positive, and participants frequently discussed them as a substantial benefit of the supervision model. BTs and EMSs also often noted and appreciated the parallels between their circumstances.

In Year 1, the EMSs were able to support their BTs in navigating the ongoing tensions and adaptations due to the COVID-19 pandemic, which were changing frequently and unpredictably. A clear benefit for Ayanna, a BT placed in a Kindergarten classroom, was that her US understood intimately the current context of schools and was "doing it, too." Ayanna also expressed her appreciation that Sierra, her US, was also teaching through the pandemic, and she stated that Sierra was "attached" to the school environment, drawing a contrast with her previous US who she described as "detached." Ayanna described Sierra's perspective: "I [Sierra] get where you [Ayanna] are because I'm doing it, too. And there's more of a connection, more so than when it was with my previous [US]. It was different... you can tell when someone's attached to an experience and detached..."

Ellie described sharing a grade with her US as "helpful." Ellie, a BT, explained how her US Emily would reassure her that she could always talk to her about issues she was experiencing. Ellie also described Emily as "realistic" and stated: "she's younger so she's you know kind of in that beginning stage as well, which is helpful because I know that the first 5 years of teaching can be crazy.... In the past when I've had a supervisor who is not currently teaching, I feel like there's almost like a disconnect when it comes to those practical situations."

During the study, Sierra's role as a classroom teacher transitioned to an induction specialist. Although she feared that this might impact her credibility as a mentor, in other interviews, she discussed how this deepened the experience she could share and potentially improved her ability to mentor. In one interview she explained:

> I think whenever you step out of the classroom, I think you lose credibility... with teachers. ... You don't understand. You don't do lesson plans when you get home. You don't grade. We're not up on the weekends trying to plan for the next week. You don't understand these kids, after the pandemic. And so, it's hard for them to relate to you.

While Sierra expressed concern, her BT Denise expressed confidence describing Sierra's knowledge and experience as "fresher than... like previous professors who weren't in the classroom or weren't doing things hands-on." Reiterating Denise's thought, in another interview, Sierra said, "I feel like I could help with multiple grade levels, you know, because I'm in every grade level K–12, you know, and so I feel like I have more experience." She also made it clear that even though she did not have her own classroom any more, her experience was quite recent: "I'm not that far removed that I can't remember."

Throughout this transition, Sierra's BTs felt like she was able to support and meet their needs. Elana stated that Sierra helped her to feel connected to the school system, something that was important because she did not grow up attending U.S. schools. Her US also supported her in implementing differentiation with her students. She stated, "For instance, I focused a lot on differentiating the process, and she's like, remember back that there are sort of three parts of differentiation... the product, the process, and the content!" Sierra also was excited that

Denise was teaching fifth grade, "I knew exactly what standard she was on and I could share with her resources that I used in my classroom."

Emily and Amanda were also paired because they were in the same school district. Emily stated, "I think it was just nice to be in that same grade band, like, I teach third grade. She teaches fifth. I've had experience in fifth, so that was really nice." Emily felt that the model was "way more effective... because education is changing on a yearly basis." Amanda noted how Emily understood the constraints of being in a testing grade, mentioning:

> there's a lot of pressure with testing and so having Emily, being someone who knows what that pressure feels like and experience with it, she was able to kind of walk me through that stress of like, oh, we're being told, testing, testing. Whereas a professor who's a supervisor who may not have been in the classroom in the past 5 to 10 years, they're not going to know that same pressure.

Amanda explained that she was able to try out new, research-informed practices with Emily's support that she might not have otherwise.

4.1 | Connections to mathematics content and pedagogy

Another benefit regularly discussed among participants across Years 2 and 3 of this project was the added support of having a US who had advanced knowledge and experience with mathematics content and research-informed pedagogical practices. The EMSs not only had experience working as an elementary mathematics educator, but they also had recently completed a mathematics endorsement at the same university the BTs were enrolled in for initial teacher preparation.

In Year 1, conversations about mathematics were often overshadowed by discussions focused more on general pedagogical support and completing the numerous assignments required by the college for the final field experience. The EMSs shared that even though there was little time to target mathematics in their discussions with BTs, they were eager to engage in this support. Sierra shared one area of growth she encouraged with Ayana, related to productive struggle in the mathematics classroom. She stated, "we had a lot of those great discussions about just really elevating conversations in the math classroom and just letting students learn from their own strategies and mistakes." While most traditional USs strictly observe the lessons of their assigned teacher candidates, Emily took a different approach with Ellie. She shared, "She observed me teaching a math lesson one day, and we talked a lot about, you know, what types of questions to ask your students, especially those high achieving students..." Given that Emily was a current, practicing mathematics teacher, observations and learning of mathematical practices were not strictly focused on the BT.

In Years 2 and 3, several of the BTs entered the program because they wanted support with mathematics specifically. Hope expressed that she wanted to get support in mathematics from Sierra because "I've never been really strong in that area." Elana also expressed that she valued Sierra's mathematics endorsement, stating, "that's very important, that's key" because "math has always been one of my weaknesses personally." Elana shared a specific instance when her CT did not want her to try a potentially more challenging "start unknown" or "change unknown" story problem with her kindergarten students (see Carpenter et al., 2015). Elana described her response, saying "that's what this program actually wants me to do, is to go outside the box and extend their thinking a little bit on mathematical practices." Sierra supported Elana in maintaining a belief in the mathematical ability of her students.

Brooke shared that having a US that was also a mathematics specialist was helpful in making her more comfortable collaborating on mathematics lessons. She stated, "I can ask about anything, and she can give me good advice." In Year 3, Sierra supported Denise in her incorporation of research-based practices and with mathematics content. Sierra said, "every conversation was a math conversation." This emphasis on mathematics led Denise to explain:

> So, math ended up being like the favorite subject by the end of May... because she [Sierra] was able to help me engage them more and get them, take them to the higher level, or even the students that were still on the beginning levels challenge them to where they're like, oh, this stuff is easy. Now I'm on *developing* [on the rubric] because I understand them more. I can do this, and just putting them in the seats of their own learning.

Denise's CT was also a mathematics specialist, so she felt that she got a "double dose" of mathematics and both her CT and Sierra were "on the same page with things." Emily and Amanda also shared their experience of working together to strengthen mathematical practices. Amanda discussed the tensions she felt applying practices

learned in her mathematics methods coursework to her classroom and stated that Emily "really helped me tailor it to the time I actually had." In addition, Emily was able to provide a "wealth of knowledge and resources" related to teaching mathematics and compared Emily's ability to support mathematical practice to that of a "veteran mathematics specialist" at her school.

4.2 | Connections between educators

The third benefit of the model was the connections that participants felt in the mentor and mentee relationship and between mentors. EMSs indicated that their interactions with BTs expanded their thinking about mathematics teaching and learning. Aside from one participant, the BTs uniformly expressed that they felt a strong connection to their EMSs. Denise felt that the level of support was "as if I did meet with her in person, like very supportive. She helped me every step of the way, no matter what it was, even like things on a personal level like she was just there for me." When a BT, Brooke, needed additional support and guidance in meeting the goals of the internship, her EMS Emily commented that the relationship building from the beginning of the semester provided a foundation for when challenges arose. After watching the first teaching episode, Emily described her response, "'okay pump the brakes, we got to back it up a bit' and so I would say it got easier to have the hard conversations."

The Year 3 pairings yielded the most compelling evidence related to this benefit. Sierra and Denise both expressed how quickly they were able to bond and form a positive relationship given that they both identified as African American women and were both mothers. Sierra stated, "It was probably the best [semester]. I really, really connected with my student teacher." Denise echoed this stating, "it was really neat to have someone who could relate as much as she was able to relate to me." Sierra explained that this gave their relationship a solid foundation so that they were able to talk freely. Coincidentally, after pairing Emily and Amanda, we discovered that they attended the same high school and already knew one another. They were also teaching in the same school district which yielded an additional layer of connection. Amanda shared that Emily was:

> available for me to like.... there are some days you're like, come on, cry right now, and I feel like I haven't done anything right today, and you like working through that because that's part of the process... I was able to talk with her, talk about students and see what they needed, and like pivot.

Emily and Amanda both shared that they looked forward to continuing to collaborate and learn from one another after the semester ended.

The support between EMSs also emerged as an important aspect of the project. While Emily recognized that the frequent supervisor-facilitated meetings had created a strong foundation with Brooke, Emily also discussed how important the biweekly supervisor support meetings were in this particular semester. She described how the meetings supported her work with Brooke:

> You know, it's a collaborative effort and like, even though we each are assigned to somebody like we all know about each other's [teacher] candidate, so we all know, like 'okay we'll try this' or 'I tried this with my students or my teacher candidate, maybe try this'

In addition to the learning that happened from EMS to BT, and between EMSs, two of the EMSs spoke directly about how coaching expanded their understanding of teaching and learning mathematics at the elementary level. At the close of the semester, Sierra stated that through her discussions with Ayanna, she ended up seeing connections between the upper-grade curriculum and primary-level mathematics. She specifically noted that she saw how important counting was in practice and how it was foundational to concepts taught in the upper grades.

4.3 | Drawbacks and modifications

After three semesters as a US within this model, Emily remained positive and excited about her work with BTs, but she was also transparent about the difficulties. She stated, "It can be challenging to balance both because you want to be, you know, there for your student teacher, but also you have your own classroom that you're managing, and parents and expectations and things like that." In addition, BTs found the virtual context to be a challenge at times. Ayanna stated that she felt Sierra was, "seeing the back end, like the paper of it, not necessarily me in action." Sierra echoed this sentiment; she felt that there were too many assignments in the field experience that distanced her from relating to Ayanna around her teaching.

Finally, while we intended for mathematics to be a focus of the support EMSs provided, in the year end interviews the participants reported that their conversations focused more on the general pedagogical support, relationships, and emotional support. Therefore, in Years

2 and 3, we asked EMSs to make mathematics support a more explicit part of their coaching conversations. After this structural change in programming and protocols, the participants reported that they felt supported in mathematics content.

5 | DISCUSSION

The teaching profession "is in a state of distress" (Jacobs & Burns, 2021, p. 295) with 44% of teachers in Georgia leaving the profession within 5 years and only 66% of Georgia teachers responding that they would encourage a high school graduate to go into teaching (Owens, 2015). In a report on teacher burnout (Taskforce for Teacher Burnout, 2022), the task force suggested that schools, districts, and stakeholders "provide support for teachers throughout their professional careers—from first-year teacher to teacher leader and beyond" (p. 19). This project's innovative model of fieldwork offers a response to this call by providing ongoing and relational support to new teachers and professional development for EMSs as they learn to coach BTs.

We have argued that this model strengthens the connections between research and practice and between schools and universities in three important ways. First the data demonstrated that the EMSs position as in-service teachers was important to BTS, Ayanna described how Sierra was "attached" to the context of schools while her previous US had been "detached." Ellie described Emily as "realistic" and her previous US as "disconnected." Given that research has shown that this disconnect between universities and schools is pervasive and problematic (Zeichner, 2010), in this model we attempt to disrupt conventional assumptions of whose knowledge should count (Zeichner & Payne, 2013) in teacher education spaces. By inviting in-service teachers to serve as USs, we created an improvisational "third space" which privileged in-service teacher knowledge (Beck, 2020). Third spaces have been shown to open up a possibility for less hierarchical models of teaching learning and to support disruption of the theory/practice binary (Daza et al., 2021). However, as Beck (2020) has pointed out, there can be "undertones of colonization" (p. 388) in policies and practices that affect the implementation of projects that include third spaces. For example in our implementation, we faced significant pushback from the fieldwork director to enact any change in coursework or supervision models. In addition, when one of the BTs demonstrated a clear lack of progress and the EMS recommended that she not pass fieldwork, the field director ignored the EMSs input, despite the fact that it aligned with the school principal's recommendation. While we expressed our confidence in the EMSs ability to mentor and her ongoing support of the BT, the field office declined the EMSs recommendations. We wonder if her third space positioning, as an active in-service teacher, in this instance detracted from her authority in the eyes of the university.

In addition to strengthening the connection to schools and practice, we asserted that the model strengthens the connection between the BT and the university and research. The data showed that the EMSs recent completion of a mathematics endorsement allowed them to support BTs in upholding research-based practices in schools. Sierra's support of Elena in maintaining high expectations of her students' mathematical abilities in spite of the mentor teacher's pushback is an example of the importance of the mathematics specific research knowledge that Sierra brought to her role as a US. This interaction showcased an important example of how research-based practices that are taught and encouraged in methods courses can be stamped out in classrooms if school leaders do not understand content specific, research-based practices. Without Sierra's encouragement, Elana might have aligned her mathematics teaching to conform to the school's gradual release approach. Sierra supported Elana in maintaining the research-based practices she learned in her methods courses. The BTs appreciated their US's ability to help them connect theories and ideas learned within university coursework to their classroom practice. Sierra was able to explicitly support Elana in maintaining practices that she learned in her mathematics methods classes when faced with criticism from school personnel. Similarly, Emily was able to reassure Elana that diverging from the curricular mandates to do "what's best for your kids" was sometimes necessary and helped to build her confidence in "meeting the students where they are" rather than strictly adhering to the mathematics pacing guides. BTs felt supported in the implementation of research-based practices they had been hesitant to try on their own.

One additional benefit, that aligned with our rationale for beginning this project, was that the EMSs developed their own understanding of the mathematics that they were teaching and their leadership abilities through their interaction with BTs. They developed their own practice through their use of the tools and engagement with research and considered relationships among mathematical topics taught across the elementary curriculum. Emily shared that she "learned a lot as a coach," and Sierra discussed that she was able to make connections between her coursework as a Mathematics Endorsement student and the field by watching one of her BTs teach a primary grade level, which was very different than her experience teaching fifth grade mathematics.

In terms of drawbacks, all USs and several BTs mentioned a desire for at least one face-to-face classroom visit since all observation lessons were video recorded due to the US's responsibilities as in-service teachers. Two of the USs expressed difficulty in balancing time and tasks for their own classroom with supporting their BT. To mitigate the strain on EMSs serving as USs, we would recommend minimizing written assignments and responsibilities in a learning management system. While we think reflection is crucial to developing as a teacher, written reflection in our opinion has been overused in teacher education (Myers et al., 2017).

6 | IMPLICATIONS FOR FUTURE RESEARCH

While the initial findings are positive, the support provided to the EMSs should not be underestimated. The EMSs had biweekly virtual meetings with the university-based research team and the other EMSs. The EMSs brought problems of practice and received both practical advice and emotional support. While the EMSs had knowledge of classroom practice and current research, many of them had never coached a new teacher. In order for this model to be sustainable, we imagine recruiting graduates of the mathematics endorsement program to serve as US with faculty and peer support for 1–3 years post-graduation. After this period, the EMSs would be well equipped to continue to support new teachers in their schools as mentor teachers or to transition into EMS roles focused on coaching teachers full-time within their school buildings or districts.

Given that the EMSs developed abilities not only in coaching, but in coaching at a distance, these experienced EMSs hold potential to serve as supports for teachers across the state, especially since many districts and schools do not have dedicated math coaches. This model provides BTs with support from USs with advanced knowledge of mathematics education and an intimate connection to the field. BTs were supported in implementing research-based practices in their classrooms. In addition, engaging teacher leaders in tasks that allow them to exercise their expertise has been shown to positively impact their job satisfaction, professional learning, and longevity (Bektaş et al., 2022; Nguyen et al., 2019; Wenner & Campbell, 2017) while benefiting their schools, colleagues, and students (Nguyen et al., 2019; Supovitz & Comstock, 2023). This was evident in Emily's reflection on her experience:

> If you're gonna get out of teaching, it's probably gonna be in those years [the first 5 years]. And I definitely get why they say that ...So I think it's really encouraging to be able to... motivate and support new educators. And, it kind of like makes me think more positive about the education field and why I chose that as a profession to begin with because it's really easy to lose sight of that. But, I kinda feel like as you mentor someone you can kind of like go back to your roots of why you actually chose to do this and so it kind of helps you. It's kind of giving yourself a pep talk, while also encouraging a new teacher.

Teacher preparation programs that engage in-service teacher leaders as USs within field-based experiences could be a promising approach to dismantling hierarchical relationships associated with teacher development and evaluation, and to developing teacher leaders in schools.

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