

# Virtual Summer Institutes as a Method of Rural Science Teacher Development

Stephen L Thompson, Rachele Curcio, Amber Adgerson, Kristin E. Harbour, Leigh Kale D'Amico, Hall S. West, George J. Roy, Melissa A. Baker, Jessie Guest, and Catherine Compton-Lilly, *University of South Carolina*

Key policy documents call for science teacher preparation programs to provide teacher candidates with approximations to authentic teaching experiences that occur in realistic contexts. Providing such opportunities for teacher candidates located in communities that are rural as well as geographically far from university settings is especially difficult. Stakeholders also point to the importance of positive coaching and mentoring relationships as key factors impacting the growth of teacher candidates. In this paper we discuss the positive potential of virtual science-related summer institutes as a vehicle to (a) provide authentic science teaching experiences for teacher candidates and (b) promote the development of positive coaching and mentoring relationships. We also share features of a summer science institute developed as a launch to our teacher residency preparation program that incorporated teacher candidates, school-based teacher educators, and university-based supervisors to maximize the potential positive impacts. Data included quantitative and qualitative post-institute survey data from teacher candidates, school-based teacher educators, and university-based supervisors. Findings revealed that residents' perception of their content knowledge development, pedagogical knowledge development, and overall effectiveness of the summer institute were high; additionally, school-based teacher educators and university-based supervisors indicated positive perceptions of the institute, noting their knowledge of coaching increased, helpful resources were provided, and institute structures promoted the development of positive coaching relationships. These results provide tentative evidence to support the continued use of virtual science summer institutes as a viable option for supporting both preservice and in-service teacher development.

**Keywords:** rural science teacher preparation, science camp, coaching

A recent report from the American Association of Colleges for Teacher Preparation Clinical Practice Commission (American Association of Colleges for Teacher Education [AACTE], 2018) argued that the process of learning to teach requires sustained opportunities for teacher candidates to engage in authentic teaching experiences and contexts. Additionally, the report emphasized that clinical practice should be the framework through which all teacher preparation is designed and that teacher preparation systems be designed to allow teacher candidates to develop over time in collaboration with accomplished practitioners (AACTE, 2018). Similar recommendations are emerging from the science teacher preparation community. For example, key recommendations from a synthesis of research studies focused on new teachers of science emphasized that initial teacher preparation programs (a) need to be organized in a manner that encourages the cultivation of teaching practices over time and (b) be grounded in contexts that approximate future teaching environments (Luft et al., 2015).

While responding to these recommendations is difficult for science teacher preparation in general, creating such systems for rural science teacher preparation is especially challenging given rural teacher preparation's unique contextual factors (Huffling et al., 2017); additionally, much of the current research focuses on practicing or veteran rural teacher professional development rather than the preparation of new teachers (Annetta & Shymansky, 2006, 2008; Cicchinelli & Beesley, 2017). The distance associated with rural settings further exacerbate pressing issues associated with preservice science teacher development. Namely, that science methods instructors have few opportunities to observe teacher candidates' initial enactments of targeted instructional approaches or provide them feedback on actual lesson enactments (Lampert et al., 2013; Menon, 2020). Related research also emphasizes that teacher candidates who work in rural communities should learn teaching strategies appropriate for rural contexts (Burton et al., 2010; Institute of Education Sciences, 2013; Reagan et al., 2019) and that rural teacher preparation must be place-based and place-conscious (Greenwood, 2013).

To respond to these key recommendations from guiding teacher preparation policy documents (e.g., AACTE, 2018) and to mitigate many of the rural science teacher preparation obstacles highlighted in related research (e.g., Annetta & Shymansky, 2006, 2008; Cicchinelli & Beesley, 2017; Huffling et al., 2017), we created a Virtual Science Summer Institute (institute) as an initial component of an 18-month rural teacher residency program. The institute brought teacher candidates together with school-based teacher educators, university-based teacher educators, program faculty, and elementary students from the local community to take part in shared virtual teaching and learning experiences. The shared experiences occurred within authentic rural schooling contexts, provided teacher candidates with initial practice teaching opportunities, promoted the development of coaching and mentoring relationships, and allowed all stakeholders to develop a common lexicon and ways of thinking about teaching.

### **Literature Review: Rural Teacher Preparation**

More than half of the school districts in the United States are classified as rural. However, the definition of rural varies widely in the literature, and there are many definitions for what constitutes a rural school district (Dunstan et al., 2021; National Center for Education Statistics [NCES], 2021; Reagan et al., 2019; Thier et al., 2021). NCES designates three types of rural communities: fringe, distant, and remote. Additionally, NCES defines fringe rural as "territory that is less than or equal to 5 miles from an urbanized area, as well as rural territory that is less than or equal to 2.5 miles from an urban cluster" (NCES, 2021, p.1). The Census Bureau delineates rural as "any population, housing, or territory NOT in an urban area" with urban areas being defined as an area with a population of more than 50,000 (United States Census Bureau, 2021, p. 1).

The wide variation in classifying rural schools and locales has affected the research on rural teacher preparation. Many scholars argue successful teacher preparation programs in rural areas must attend to the uniqueness of every rural locale (Greenwood, 2013; Huffling et al., 2017; Reagan et al., 2019). As a result, much of the literature focuses on the juxtaposition of the fixed and static locations of rural school communities and the ever-evolving cultural constructs that affect "the ways [they] talk about and enact 'rural'" (Reagan et al., 2019, p. 84). In other words, teacher education programs must emphasize the nuances of rural contexts while simultaneously

focusing on the recruitment, preparation, support, and retention of teacher candidates (Huffling et al., 2017, Regan et al., 2019).

As a result of this ongoing dialogue, key recommendations for rural teacher preparation are advocated by multiple stakeholder groups. One key recommendation is that teacher candidates who will serve rural areas must be given opportunities in teacher education programs to learn explicit strategies for teaching in rural contexts (Burton & Johnson, 2010; Institute of Education Sciences, 2013; Reagan et al., 2019). For example, rural teacher candidates should be exposed to place-based theories that promote their learning about local communities and how to access local knowledge and expertise to support instruction (Eppley, 2011). Another key recommendation is that teacher candidates have field experiences and practicums in their preparation programs that lend themselves to the application of general education initiatives. More specifically, rural teacher education must be place-based and place-conscious (Greenwood, 2013). Even so, some teacher education programs that serve future teachers of rural communities focus more on rural teacher education than others. As an example, of nine teacher education programs serving teacher candidates in rural contexts, Barley (2009) found only four programs sought teacher candidates from actual rural communities. Additionally, two programs placed teacher candidates in rural communities, and only one program had coursework experiences in rural educational contexts. This lack of targeted programming and recruitment is relevant as programs with a focus on rural contexts are essential to the adequate preparation of teachers for rural communities. These omissions also highlight the importance of contextually based programs that take into consideration the geography, demographics, economies of each rural area and the implications on teacher candidates' social capital, identity, and culture (Huffling et al., 2017; Reagan et al., 2019).

Further, we argue that rural schools and the teacher education programs that serve rural communities, must be nuanced, and reflect the working theories of place and the cultural constraints within each rural community. While the research on rural teacher education in the United States has increased in the last decade and a half, there continues to be a need for more research on rural teacher education preparation in the midst of the technological shifts of the 21st century (Azano & Stewart, 2016; Cicchinelli & Beesley, 2017; Helge, 1985; Thier et al., 2021). As Azano and Stewart stated, "there is relatively little known about intentional efforts to prepare teachers specifically for rural classrooms" (2016, p. 108). The extant knowledge around rural teacher preparation is further exacerbated when considering the overlap of rural teacher education within the field of science. For instance, much of the current literature focuses on practicing or veteran rural teachers and their professional development within science teaching as opposed to teacher candidates (Annetta & Shymansky 2006; 2008; Cicchinelli & Beesley, 2017). To gain deeper insight, additional research in the areas of rural science teacher preparation is needed, especially in the areas of recruitment, retention, preparation, and ongoing support of teacher candidates (Burton & Johnson, 2010; Institute of Education Science, 2013).

### **Summer Camp Experiences for Rural Science Teacher Candidates**

Several longitudinal studies highlight that teacher candidates have lower teaching self-efficacy in science and mathematics when compared to other content areas (Buss, 2010; Franks et al., 2016; Swars & Dooley, 2010). One possible intervention, summer camp experiences with a science focus, has been found to be useful in nurturing the science teaching self-efficacy of

teacher candidates from various contexts (Franks et al., 2016). Franks et al. (2016) found that the self-efficacy of teacher candidates' science was enhanced through science summer camp experiences with primarily African American female students. A key outcome from the study was that 98.2% of the surveyed teacher candidates indicated the experiences were "the most useful aspect of the course in influencing their self-efficacy" in science (p. 70). Other study outcomes highlight that the opportunity to practice science within authentic contexts, like summer camps, can help teacher candidates confront their fears and misconceptions about science teaching methods and teaching students from diverse backgrounds (Franks et al., 2016; Swars & Dooley, 2010). Furthermore, experiences like these can also help teacher candidates understand the necessity of prior knowledge and its impact on students' conceptual change in science (Wallace et al., 2013).

Other studies support the notion that science related summer camp experiences can improve the academic outcomes and perceptions of participating youth (Edwards et al., 2001; Fields, 2009; Tichenor & Playchan, 2010). The positive influence of science-related summer camps is especially evident for students who reside in rural contexts. For example, research that examined the positive impacts of a virtual Science Technology Engineering and Mathematics (STEM) camp experience on the mathematics self-efficacy of rural middle-schoolers revealed that STEM camp experiences increased students' positive interactions with adults and peers, their math identity development, and their math self-efficacy (Lindt & Gupta, 2020). Despite their potential, much of the science summer camp literature focuses on contexts that are face-to-face and occur on university campuses or in K-12 schools. The contexts of these studies reveal the importance of school and university partnerships in the cultivation of summer science camp experiences in order to strengthen teacher candidates' science teaching self-efficacy while simultaneously providing programming and positive impacts for K-12 students (Petersen & Treagust, 2014).

This backdrop, and the changes to schooling contexts that occurred as a result of the COVID-19 pandemic, have coincided with an increase in virtual science-related camps (Louis & King, 2022; Scheina & CCDC C5ISR Center Public Affairs, 2020). Related research highlights that virtual STEM camps allow participants to engage in learning from multiple contexts such as their "bedrooms, kitchens, and cars" (Smith-Mutegi & Morton, 2021, p. 12). In addition to expanding our notions of classroom spaces, the shift to more virtual experiences also increased opportunities to participate in such experiences and created a wider audience of students who may be able to attend such camps (Mellieon-Williams et al., 2021). The shift to more virtual science camp experiences also highlighted important limitations of the approaches. For example, virtual experiences create the need for more physical support from adults who can assist participating students, which was seen as a drawback of the virtual science camp context (Fayed et al., 2021; Milbrath, 2021). The lack of broadband internet access in rural communities and technology gaps were also important limitations on the reach and impact of virtual science camps (Clemson Engineers for Developing Communities, 2020; Prensky, 2020).

### **The Virtual Science Summer Institute**

With the literature in mind, our team sought to develop a Virtual Science Summer Institute that embodied tenets of clinically centered teacher preparation and science teacher preparation in rural communities. The institute, situated in an 18-month grant funded teacher residency model,

served as a key programmatic component and was an initial program experience. The Carolina Transition to Teaching program supports the preparation of individuals who are transitioning into teaching from other careers. It is a masters level program in partnership with two local rural school districts, and all teacher residents reside within these districts. The institute sets the stage for the varied coursework and corresponding clinical practice experiences occurring throughout the entirety of the residency.

Specifically, our research team designed and facilitated a two-week institute as the launch to our teacher residency program. To support collaboration and learning among all stakeholders during the institute, a wide variety of participants were involved throughout the two-week experience. These participants included the following: teacher candidates (teacher residents), school-based teacher educators (coaching teachers), university-based teacher educators (supervisors), and program staff (i.e., university faculty, graduate assistants, and professional development providers). The institute immersed all participants in equity-centered, reform-based elementary science and mathematics teaching practices (e.g., National Council of Teachers of Mathematics [NCTM], 2014; Next Generation Science Standards Lead States, 2013). These immersive experiences were designed to establish a common base of knowledge about equity-centered science teaching and cultivate a collegial community of co-learners. Further, the institute focused on the following goals: (a) deepening residents' content and pedagogical content knowledge, (b) providing authentic opportunities for enacting content and pedagogy, (c) creating spaces for cultivating a reflective stance, and (d) developing coaching skills and dispositions.

### **The Virtual Science Summer Institute Overview**

The institute occurred over the course of ten days in July from 8:30–3:30 daily and was held virtually using video conferencing software (i.e., Zoom). The daily agenda (see Table 1 for an example agenda) engaged participants in authentic experiences through the modeling and enactment of varied pedagogical strategies.

The institute was designed to support residents' growth in science, mathematics, and computer science content knowledge and pedagogy, with science content highlighted as the primary emphasis for daily instructional enactments. An overarching goal was to provide a space for teaching residents to learn common approaches to equitable science teaching and engage in supported initial science teaching experiences in a low-risk setting.

Table 1

*Summer Institute Daily Schedule Samples*

Week 1, Day Two		Week 2, Day Two	
Week One Sample Schedule		Week Two Sample Schedule	
8:30-9:00	Agenda and Opening Moves	8:30-8:45	Agenda and Opening Moves
9:00-10:00	Science Pedagogy	8:45-9:15	Rehearsals for Work with Students
10:00-10:20	Reflective Break	9:15-10:00	Teaching STEM
10:20-11:00	Unpack and Debrief Teaching and Pedagogy	10:00-10:30	Individual Reflection on Reaching and Break
11:00-12:00	Lunch	10:30-11:00	Whole Group Debrief and Reflection
12:00-1:00	Literacy	11:00-12:00	Lunch
1:00-1:15	Read Aloud	12:00-12:15	Read Aloud
1:15-2:00	Science Pedagogy	12:15-1:45	Culturally Sustaining STEM Pedagogy
2:00-2:15	Reflection Break	1:45-2:00	Reflection Break
2:15-3:15	Mathematics Pedagogy	2:00-3:15	Planning for Tomorrow's Teaching
3:15-3:30	Wrap Up and What's Next	3:15-3:30	Wrap Up and What's Next

Prior to the institute, all participants received a science kit, a box of common materials, that would be used during learning activities and lesson enactments. During week one, participants engaged as learners in model 5E Lessons (Bybee, 2014) focused on energy content aligned with state elementary science standards. During week two, students in grades 4-6 who were recruited from local partner schools joined the institute, and teacher residents engaged them in virtual science teaching experiences while coaching teams composed of coaching teachers, supervisors, and program staff observed and supported the teacher residents' initial science teaching enactments. Following each lesson enactment, teacher residents and coaching team members individually and collectively participated in reflective discussions focused on the teacher residents' science lesson enactments and goal setting for the next day's teaching enactments.

In the following narrative, we describe the critical design structures of our institute model. The first sections focus on structures designed to deepen participants' science and content knowledge and establish a coaching community. The next sections focus on structures designed to provide teacher residents with opportunities to apply and practice recently learned science pedagogy and for coaching teachers and supervisors to apply and practice recently learned coaching pedagogy.

### **Key Design Structures of Virtual STEM Summer Institute**

Institute structures were designed to cultivate a collegial community of co-learners focused on an equity orientation to science teaching. At the onset of the institute, emphasis was placed

on developing relationships across all stakeholders and establishing common norms and technological protocols. On day one, institute objectives were introduced to set the stage for a collegial experience situated in authentic practice. These objectives consisted of items such as: (a) observing, reflecting upon, and enacting science practices; (b) exploring strategies for establishing and maintaining culturally sustaining classroom environments; (c) creating collaborative opportunities to discuss institute-to-classroom connections; and (d) cultivating participants' inquiry and equity stance. These objectives were supported through varied institute structures and protocols that guided our day-to-day learning.

Of particular emphasis were the institute's shared science learning experiences that modeled targeted science pedagogical approaches while also promoting the development of a shared teaching lexicon and orientation. Additionally, throughout the institute participants engaged in activities designed to cultivate teacher residents' attitudes, skills, and dispositions for coaching while growing the coaching practices of both the coaching teachers and supervisors. The collective experiences provided the context for participant groups to focus on teacher residents learning how to teach science. The context also promoted the development of coaching practices and the establishment of a positive coaching community to effectively support the growth of teacher residents' teaching abilities. By establishing relationships and beginning this work in a safe, non-evaluative setting, the power structure inequities inherent in mentor/mentee relationships were reduced, a community of co-learners was formed, and a collective focus on effective science teaching was established.

### **Design Structure 1: Deepen Content and Pedagogical Content Knowledge**

The first essential institute design structure was the intentional inclusion of experiences aimed at deepening content and pedagogical content knowledge for all participants. In addition to the focus on science content and pedagogy, the institute design strategically planned to strengthen coaching teachers' and supervisors' knowledge on the practice of coaching while also developing teacher residents' habits for being coached. The information below elaborates on these areas of this design structure.

#### ***Science Content and Pedagogy***

At the beginning of the institute, all participants learned about 5E Learning Cycle approaches to science teaching (Bybee, 2014). Initially, as part of the coursework, teacher residents read an article that provided an overview of 5E Learning Cycle approaches. This article was also shared with coaching teachers, supervisors, and program staff. Then, participants took part in a model instructional sequence as learners that was led by a science methods instructor who was a member of the program staff. The initial lesson sequence focused on how to light a bulb using just a battery and wire. The modeled light bulb lesson was also the first science lesson the teacher residents would later enact with elementary students during week two of the institute. Following engagement in the model 5E lesson sequence, the collective group made explicit connections between the modeled instructional sequence and approaches they experienced and the targeted instructional approaches they read about. The modeled lessons were also designed to portray a coherent content storyline across the week one activities.

This technique, immersion in model 5E lessons followed by activities designed to make explicit connections to the instructional approaches, was repeated each day of the first week of

the summer institute. This structure was supported by prior research, which highlighted that exposing elementary teacher candidates to the use of hands-on activities during science lessons (Watters & Ginn, 2000) and instruction about pedagogical techniques like the learning cycle (Settlage, 2000) has been shown to positively impact teacher candidates' science teaching self-efficacy.

### ***Coaching Content and Pedagogy***

A key component of the institute was the development of coaching teachers' and supervisors' coaching skills and the cultivation of teacher residents' dispositions for coaching. Through systematic professional learning and intentional coaching conversations, we sought to support the maturation of mentoring interactions and coaching team relationships – knowing that these items are interdependent of each other (Ambrosetti et al., 2014). During week one, these conversations were nurtured through dialogic conversations connected to reflecting on the modeled science methods instructional approaches. To facilitate these conversations, participants engaged in individual and group reflections using a program-developed observation protocol to guide discussions. Recognizing the importance of situating all participants as learners (Canipe & Gunckel, 2019; Turner & Blackburn, 2016), we intentionally created a Noticings and Wonderings observation protocol that allowed for all participants to actively contribute to reflective conversations. The goals for these conversations were twofold: (a) creating an authentic space for educative conversations focused on teaching and learning, and (b) providing opportunities for all participants to develop a common language and structure for reflection that could continue into the residency.

Another facet of establishing a coaching community was the inclusion of dedicated time to develop coaching teachers' and supervisors' coaching capacity. Additional professional learning occurred outside the institute agenda for coaching team members. These five one-hour sessions engaged coaching teachers and supervisors in content specifically focused on the role of a coach, co-teaching as a catalyst for mentoring interactions, and the strategic use of our Noticing and Wondering coaching observation protocol. Objectives for these sessions centered on (a) establishing a cadre of coaches – a community of school-based and university-based teacher educators working together to enhance teaching and learning in rural school settings, and (b) developing a repertoire of technical and interpersonal coaching skills that would, in turn, inform resident learning. To support the facilitation of our coaching community, sessions were structured to encourage dialogue on the coaching process, with the final session occurring during week two; thus, allowing coaches to reflect on the application of their skills. By focusing on developing an educative community that authentically situated all participants as learners, the institute promoted the forming of mentoring and coaching partnerships and supported the establishment of teacher observation and related conferencing routines, norms, and practices.

### **Design Structure 2: Authentic Application of Content and Pedagogy**

The next institute design structure focuses on the authentic application of learned content and pedagogy. Responding to AACTE's Clinical Practice Commission Report (2018), this design structure provided intentional pedagogical experiences grounded in contexts that approximated future science teaching environments (Luft et al., 2015). Moreover, these experiences guided teacher residents through intentional reflection on their teaching and on student learning. In



addition to the authentic application of science content and pedagogy, various opportunities were provided to engage in authentic coaching. Coaching teachers and supervisors were provided space to practice coaching, and teacher residents were immersed in coaching conversations – setting the stage for a culture of coaching. The information below elaborates on the authentic application design structure across science and coaching pedagogy.

### ***Application of Science Pedagogy***

At the end of week one, teaching teams (2-3 teacher residents) were formed and paired with a coaching team (composed of coaching teachers, supervisors, and program staff). Then each teaching team, with support from their coaching team, planned and rehearsed the first virtual 5E lesson sequence they would enact with small groups of elementary students ( $n = 4-5$ ) the following Monday. The first lesson focused on how to light a bulb with just a wire and battery. Teaching teams were given instructional materials (presentation slides) that outlined the lesson and teacher residents were encouraged to follow the same initial sequence they experienced as learners. Following the enactment of the lesson, the teaching and coaching teams individually, and then collectively, reflected on the enacted lesson using the same process and protocol from week one. These conversations enabled participants to debrief about the enacted lesson, engage in coaching conversations, and establish individual goals for each teacher resident to focus on during the next lesson enactment that would occur the following day.

Each day during week two continued this pattern. Teaching and coaching teams engaged in afternoon planning and rehearsing of science lessons that would be enacted by teaching teams the following morning with elementary students. Teaching teams were provided with daily instructional materials (presentation slides) that outlined the lesson for the following day. However, fewer details were provided each subsequent day so that coaching teams could promote teacher residents' gradual assumption of responsibility for lesson planning, with support.

The scaffolded and supportive approach focused on a pressing need for the teaching residents, learning how to teach science (Luft, et al., 2015). It was also supported by related research findings that highlight that teaching science to elementary students can positively impact elementary teacher candidates' science teachers' self-efficacy (Cantrell et al., 2003) and that science teaching experiences and opportunities to practice reform-based science teaching approaches were the primary factors to positively impact teacher candidates' science teaching self-efficacy (Swars & Dooley, 2010). These approaches also provided opportunities for teacher candidates to collaboratively plan, rehearse, and enact lessons that are informed by the methods course instructor, coaching teacher, and supervisor feedback. In this way our approaches mitigated key weaknesses identified in science teacher preparation, that science methods instructors rarely observe teacher candidates' initial enactments of targeted instructional approaches or provide them with feedback on actual lesson enactments (Lampert et al., 2013). Further, practice teaching science lessons accompanied by post-lesson reflective sessions with goal setting and monitoring for future science lessons have been shown to be instrumental in changing teachers' understanding of inquiry teaching and their beliefs about how students learn science best (Lotter et al., 2017).

### ***Application of Coaching Pedagogy***

Throughout the entirety of the institute, participants were engaged in authentic experiences that supported their enactment of coaching skills and cultivation of dispositions for coaching. As noted previously, week one of the institute was a space to deepen participants' knowledge of coaching, develop common capacity, and nurture coherent coaching language, thus, setting the stage for the application of this knowledge during week two. The structure of week two provided varied opportunities for coaching teachers and supervisors to apply and practice coaching skills, and this structure gave teacher residents opportunities to be coached.

The institute's week two design created repeated opportunities for daily coaching: a 20-minute pre-teaching rehearsal, in-action coaching during science instruction, post-teaching reflective coaching conversations, and a 45-minute planning session to close the day. These processes were used repeatedly as instructional strategies to nurture teacher residents' reflective stance and develop habits of mind to guide their future teaching. Additionally, during week two teaching enactments, coaching team members used the Noticings and Wonderings protocol during lesson observation to gather data, inform coaching conversations, set teacher resident goals, and plan for the next day's teaching. This structure, and consistent use of the observation protocol, provided coaching teachers and supervisors opportunities to practice coaching in a parallel manner to the residents' practice teaching. The intentional inclusion of authentic opportunities to enact coaching knowledge and pedagogy aligns with the assertions that mentoring and coaching in teacher preparation should be viewed as a professional practice (He, 2010; Schulle, 2008), a practice that is strategically developed and supported over time.

### **Findings**

To explore teacher residents' and coaches' (i.e., coaching teachers and supervisors) perceptions on the design and implementation of our institute, we collected post-institute survey data. Survey questions were both quantitative (Likert-scaled) and qualitative (open-response) in nature and were given to all teacher residents, coaching teachers, and supervisors approximately one week after the completion of the two-week institute. As our overarching goals were to create a collegial community of co-learners and develop science and coaching knowledge, two surveys were created to collect data from our two distinct participant groups (i.e., teacher residents and school- and university-based coaches). The teacher resident and coaching teacher and supervisor surveys are provided in Appendix A and B, respectively. Below we highlight initial findings across these groups as well as offer recommendations from lessons learned.

#### **Teacher Resident Data Overview**

Nine teacher residents participated in the post-institute survey, including 5-point Likert-scaled items and open response items. In the following section, we provide evidence around teacher residents' perceptions of content knowledge development, pedagogical knowledge development, and overall effectiveness of the summer institute.

Teacher residents reported the summer institute increased their knowledge of targeted STEM, Computer Science, and Literacy content, with particularly high outcomes noted in the teacher residents' perceptions of their gains in STEM and Computer Science content knowledge, with means of 5.0 and 4.78 respectively (scale ranged from strongly disagree response as a 1 to

strongly agree response as a 5;  $n = 9$ ). Additionally, teacher residents' responses to open-ended writing prompts also supported the notion that the Summer Institute resulted in content knowledge gains. For example, when asked, "*What did you gain from your experience at the Institute?*", the majority of the Teacher Residents ( $n=7$ ) referenced content knowledge gains.

Survey results also revealed that participation in the summer institute increased the residents' perceptions of their pedagogical knowledge across targeted content areas, with especially high mean scores noted in STEM and equity-centered pedagogical approaches ( $n = 9$ , with means of 4.71 and 4.92, respectively). Additionally, regarding general pedagogy, residents indicated a 4.57 ( $n = 9$ ) response, meaning agree to strongly agree around the question of "*Please rate how prepared you feel to implement the strategies learned at the Institute in the classroom.*" Open-ended response also highlighted that teacher residents found the virtual teaching experiences with elementary-aged students helped them feel more comfortable interacting with and teaching elementary-aged students. For instance, one resident wrote, "*I really loved the hands-on feel of being able to interact with the students.*"

The increased teaching preparedness reported in survey responses was supported by open responses as well. A key program component referenced by many teacher residents were the practice teaching experiences. Here a resident wrote about the authenticity of work with students at the onset of the program: "*It was a great introduction of what is to come along. . . . We also got to practice what we learned.*" Teacher residents further shared that the virtual practice teaching experiences gave them confidence in the effectiveness of the targeted instructional approaches and confidence in their own abilities to enact them. For example, when responding to the prompt "*What did you gain from your experience at the Institute?*", responses such as "*I gained confidence in myself. As to how I plan to carry out my tasks as an instructor*" and "*Confidence in my ability to teach*" were typical.

Finally, when asked to rate the effectiveness of the institute and the related virtual learning format, teacher residents assessed both highly. Residents were asked to rate the overall effectiveness of the institute on a scale of 1-5, with 1 being not effective and 5 being very effective. The resultant mean was 5.0, indicating very effective across all residents ( $n = 9$ ). Additionally, residents indicated a 4.85 rating ( $n = 9$ ) for the effectiveness of the virtual format of the institute.

### **Coaching Teacher and Supervisor Data Overview**

Nine coaching teachers ( $n = 7$ ) and supervisors ( $n = 2$ ) participated in the post-institute survey, including 4-point Likert-scaled items and open-response items. When asked to identify the usefulness of the professional learning sessions explicitly connected to coaching, the majority ( $n = 8$ ) indicated the sessions were *very useful* (score of 4) and one individual noted the sessions were *somewhat useful* (score of 3), resulting in a mean score of 3.89. All coaching teachers and supervisors reported *somewhat increased* or *substantially increased* awareness of resources and supports related to their roles ( $n = 9$ ;  $M = 3.56$ ). Additionally, two coaching teachers reported being *not at all prepared* to serve in their role prior to the coaching sessions; however, following our coaching sessions, all coaching teachers reported being *somewhat prepared* (score of 3) or *very prepared* (score of 4) to serve in their role ( $n = 7$ ,  $M = 3.71$ ).

When asked how participating in the summer institute prepared them for their role as coaching teachers and supervisors, multiple coaching teachers and supervisors mentioned that

the institute assisted them in getting to know the residents, and one reported a greater understanding of the residents' roles and how to help them succeed in the classroom. Specifically, one coaching teacher noted that the institute “*gave me insights into [the residents'] personality and working closely with a new teacher*” and it enabled them to develop relationships to “*correct misconceptions while guiding and mentoring lessons.*” Similarly, another coaching teacher appreciated the ability to “*practice over the summer and receive tips before beginning my role.*”

Coaching teachers also shared they liked receiving helpful resources, and they appreciated the opportunity to interact with and get to know residents and supervisors when asked “*What did you like most about the coaching sessions?*” Additionally, the supervisors appreciated the collaborative nature of the sessions and found the ability to interact and work with the coaching teachers prior to the school year as beneficial. All coaching teachers and supervisors indicated appreciation of “*being involved in the development process*” for the Noticing and Wondering observation protocol with one coaching teacher stating they felt “*heard*” and another feeling like “*a valuable part of the team.*”

### **Discussion and Recommendations**

Outcomes from the institute revealed that teacher residents, coaching teachers, and supervisors placed high value on the opportunities to practice their newly learned respective strategies and approaches. Both participant groups indicated the opportunities to enact learned content and pedagogy resulted in enhanced confidence and feelings of preparedness. The collective findings give us assurance that similar experiences may assist in mitigating some of the most pressing science teacher preparation issues while also benefiting the collective efficacy of teacher candidates, coaching teachers, and supervisors in other teacher education contexts.

Within our institute, each teacher resident engaged in approximations of reform-based science teaching and collaborated in real time with experienced science educators (Luft et al., 2015). The teaching feedback residents received was immediate and grounded in a shared authentic context and set of experiences. Our teacher residents indicated the structure provided a safe environment where they could practice teaching and gain science teaching confidence. These features highlight how the approaches diminish constraints associated with other more independent practice-based science teacher preparation approaches such as creating opportunities for each teacher candidate to practice instructional strategies with students and ensuring teacher educators can observe and provide feedback on teaching enactments that occur in authentic settings.

Recognizing that embedded experiences similar to the institute create educative environments that promote learning for all stakeholders, we recommend that when planning future experiences design teams focus on the cultivation of authentic settings for learning that situate all participants as learners engaged in shared sense-making (AACTE, 2018; Canipe & Gunckel, 2019). One key institute component that contributed to providing space for shared sense-making was the use of the *Noticing and Wondering* protocol. Similar to Wood and Turner's (2015) findings centered on the importance of professional learning tasks that encourage shared discussion, our work extends these findings through the incorporation of a shared protocol to guide conversations. The *Noticing and Wondering* protocol aligned with our context and programmatic objectives of

cultivating an inquiry stance (Cochran-Smith & Lytle, 2009); thus, we encourage others to design or identify discussion protocols coherent with their contexts.

In addition to developing participants' content and pedagogical content knowledge, the shared experiences at the institute promoted the development of a positive coaching community. Coaching teachers valued "in the moment" opportunities to practice coaching as well as the promotion of positive working relationships between teacher candidates, coaching teachers, university supervisors, and program staff. The ability to enact coaching practices laid the foundation for coaching throughout the residency, and the intentional cultivation of a cadre of coaches joined together by a common mission established a sense of collegiality among coaching team members. Similarly, teacher residents appreciated the coaching supports received during the institute as well as the collegial relationships they developed with coaching teachers, supervisors, and program staff. With this in mind, we recommend providing opportunities for partners in teacher education to strategically connect prior to the onset of the final clinical experience, and if possible, to incorporate authentic teaching enactments within these experiences. As Thompson and Emmer (2019) noted in their study centered on professional learning held prior to the final internship, intentionally designed shared learning experiences similar to our institute provide critical spaces for relationship development. Extending upon this research, we designed a clinically centered experience that provided all participants space for growth. The inclusion of this design feature fostered clinical partnerships that not only influenced our coaching community but also became the vehicle for future collaborative science clinical experiences to become operational (AACTE, 2018).

Connected to these findings, we wonder how professional learning of this nature might be used more widely to provide context-rich, clinically centered professional learning to science educators in rural contexts - not just teacher candidates. Currently, local and international literature note the use of virtual professional learning communities to connect rural teachers in learning networks (Rolandson & Ross-Hekkel, 2022) and discuss the availability of asynchronous virtual learning experiences to support rural teacher development (Herbert et al., 2016); however, connections to authentic application of content and pedagogy appear to be absent from these models. Thus, we posit that professional learning experiences similar to the institute may become viable spaces for providing access to high-quality, clinically centered professional learning coherent with the needs and structures found in rural contexts.

While the experiences from our virtual summer institute revealed potential for expanding the reach of clinically centered teacher preparation into rural communities, we recognize our model has some limitations and there are lessons to be learned. First, we note that our institute was supported through grant funding and that constrained resources may restrict the extent to which these collaborations can flourish in non-funded spaces. Additionally, since our institute was connected to a grant, structures were in place at the university to support the significant time commitment needed to implement the institute's design, planning, implementation, and evaluation. For preparation programs interested in designing similar institute experiences with current resources, we recommend considering existing structures that may lend themselves to creating clinically centered shared learning opportunities situated in authentic science teaching.

Other limitations of this work are also important to consider. While feedback from participants was favorable, we acknowledge that our approach has only been implemented by

one research team in one university setting. Therefore, we seek to engage in additional iterations of research within new rural partnership contexts centered on the institute's influence on teaching, coaching, and learning. Likewise, we encourage others who engage in institutes of this nature to conduct research. Our field would benefit from more robust research that explores varied institute design and implementation models and their impact on not only science instruction but more importantly science learning.

### Conclusion

Authentic teaching experiences in collaboration with accomplished practitioners is an essential part of teacher preparation programs (AACTE, 2018); moreover, teacher preparation programs must attend to the unique contexts in which they serve (AACTE, 2018), such as within rural communities (Huffling et al., 2017; Regan et al., 2019). However, continued research is needed within rural teacher preparation (Azano & Stewart, 2016; Cicchinelli & Beesley, 2017; Helge, 1985; Thier et al., 2021), and even more so in the area of rural science teacher preparation (Burton & Johnson, 2010; Institute of Education Science, 2013). To address the extant literature around science teacher preparation in rural communities and expand on the positive findings related to science camps and teacher candidates (Franks et al., 2016; Seung et al., 2019), we developed a two-week virtual summer institute as a launch to our residency-based preparation program. Within the institute, we sought to create a community of co-learners among teacher candidates, school- and university-based teacher educators, and program staff. Specifically, we engaged in immersive experiences designed to establish a common base of knowledge about equity-centered science teaching and effective coaching practices. Findings indicated that the residents' perception of their content knowledge development, pedagogical knowledge development, and overall effectiveness of the summer institute was high; additionally, coaching teachers and supervisors indicated positive perceptions of the institute, noting their knowledge of coaching increased, helpful resources were provided, and space for relationship building with the residents was established. Through these findings and lessons learned, all groups of participants placed a high value on the embedded and authentic opportunities to enact their newly learned strategies and expressed increased confidence and feelings of preparedness. By building our institute around tenets of effective teacher preparation in general, and within rural communities specifically, results provide promising, albeit tentative, evidence to support the continued use of virtual science summer camps as a viable option for supporting both preservice and in-service teacher development.

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### About the Authors

**Stephen Thompson, PhD**, is a professor of Elementary Science Education at the University of South Carolina. Dr. Thompson's primary research interests center on improving elementary and middle level science education, especially in high-need communities, through teacher development focused on the use of reform-based teaching strategies. He has been a leader in his local professional development school network and views such partnerships as instrumental in addressing some of the most pressing issues in K-12 science education.

**Rachelle Curcio, PhD**, is an assistant professor of Teacher Education at the University of North Florida. Her research and interests are grounded in an inquiry stance and focus on aspects of clinically-centered teacher preparation with an emphasis on preparing teachers for racially, ethnically, and linguistically diverse 21st-century classroom contexts. Specifically, Rachelle's research is centered on the supervision and coaching that occurs in clinical spaces as well as the cultivation of teachers' critical curriculum literacy skills connected to their role as curriculum makers.

**Amber Adgerson**, is a native South Carolinian, scholar, and educator activist who brings over a decade of practical, public-school experience to the field of academia. She is currently pursuing a PhD in Teaching and Learning at the University of South Carolina. Guided by her experiences as a former classroom teacher, her research focuses on STEM and teacher education.

**Kristin E. Harbour, PhD**, is an associate professor of Elementary Education in the Department of Instruction and Teacher Education, College of Education at the University of South Carolina. Her scholarship includes support systems for advancing teachers' ambitious and inclusive mathematics teaching practices and teacher preparation with a focus on authentic experiences to navigate the complexities of the teaching and learning of mathematics. She serves as the professional development

school liaison for a local elementary school and focuses on supports to recruit, prepare, and retain teachers through clinically centered partnerships.

**Leigh Kale D'Amico, EdD**, is a research associate professor in the Research, Evaluation, and Measurement Center in the College of Education at the University of South Carolina. Her research focuses on early childhood education, PK-12 curriculum and instruction, teacher preparation, professional development, and student success.

**Hall S. West, PhD**, is a research associate at the Research, Evaluation, and Measurement Center in the College of Education at the University of South Carolina where she serves as an evaluator for various educational programs and efforts across South Carolina.

**George J. Roy, PhD**, is a professor of Middle Level Education at the University of South Carolina. He was a public-school mathematics teacher where he earned a National Board of Professional Teaching Standards certification in Early Adolescence Mathematics. Currently, Dr. Roy teaches in the Department of Instruction and Teacher Education. His current research interests include examining uses of technology in mathematics classrooms, pre-service teachers' development of mathematical knowledge for teaching, and university-school district partnerships.

**Melissa A. Baker, PhD**, is a professional track assistant professor at the University of South Carolina. She is committed to school–university partnerships (SUP) and serves as chair of the American Education Research Association Profession Development Schools Research Special Interest Group (AERA PDSR SIG), secretary of the National Association of Professional Development Schools, past-president and board member of PDS SERVE, and co-creator of the Southeastern PDS Research Consortium. Dr. Baker's research centers on the intersections between clinically-centered teacher preparation, recruitment, induction, and retention within PDS and SUP partnerships, primarily in rural settings.

**Jessie Guest, PhD**, is a clinical assistant professor at the University of South Carolina where she received her PhD in Counselor Education and Supervision. Dr. Guest is the coordinator of the Graduate Certificate in Play Therapy and a Licensed Clinical Mental Health Counselor Supervisor and Registered Play Therapist Supervisor. Jessie's research interests and publications consist of social emotional learning, mindfulness, play therapy, countertransference, and trauma.

**Catherine Compton-Lilly, EdD**, is the John C. Hungerpiller Professor at the University of South Carolina. Dr. Compton-Lilly teaches courses in literacy studies and works with professional development schools in at the University of South Carolina. She has a passion for helping teachers to support children in learning to read and write. Her interests include examining how time operates as a contextual factor in children's lives as they progress through school and construct their identities as students and readers. She is the author and editor of several books and has published widely in educational journals.

**Appendix A**

**Please take a few minutes to complete this brief survey regarding your experience at the Transition to Teaching Summer Institute. Your responses will be anonymous and will be used to help improve future learning experiences for our residents.**

\* 1. Please rate the overall effectiveness of the Transition to Teaching Summer Institute on a scale of 1-5, with 1 being *not effective* and 5 being *very effective*.

1 (Not effective)	2	3	4	5 (Very effective)
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* 2. To what extent did your content knowledge increase in the following areas as a result of participation in the Institute?

	1 (No increase)	2	3	4	5 (Significant increase)
STEM	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Computer Science	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Literacy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* 3. To what extent did your pedagogical knowledge (teaching strategies and techniques) increase in the following areas as a result of participation in the Institute?

	1 (No increase)	2	3	4	5 (Significant increase)
Equity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inquiry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cultural sensitivity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Creation and maintenance of responsive classroom environments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
STEM	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Computer Science	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Literacy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* 4. Please rate how prepared you feel to implement the strategies learned at the Institute in the classroom.

1 (Not at all)	2	3	4	5 (Very prepared)
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

\* 5. To what extent do you agree or disagree with the following statements.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The virtual learning format was <u>effective</u> .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The virtual learning format was <u>engaging</u> .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The virtual learning format was <u>organized</u> .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The virtual learning format was <u>accessible</u> .	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The virtual learning format <u>supported a sense of community</u> among the residents, mentor teachers, and instructors.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. What did you like about the Summer Institute?

7. What did you gain from your experience at the Institute?

8. What do you wish would have been included in the Institute? What activities and supports do you think should be included?

9. What aspects would you improve about the Institute?

10. How might we improve the virtual learning aspect of coursework?

11. What else would you like to share with us about your experience at the Summer Institute?

\* 12. What age range do you fall into?

- Below 30
- 30-39
- 40-49
- 50-59
- 60 or above

\* 13. How much experience do you have working with students in a school setting including this past school year (2019-2020)?

- No experience
- Less than 1 year
- 1 to 2 years
- 3 to 4 years
- 5 to 6 years
- 7 to 8 years
- 9 to 10 years
- More than 10 years


**Appendix B**

**Thank you for serving as a coaching teacher in the Carolina Transition to Teaching Program. Your work is contributing to the preparation of future teachers in South Carolina.**


**Please take a few minutes to share your thoughts and feedback related to the Coaching Teacher Professional Development. Your name will not be requested on the survey, and your responses are anonymous.**

1. How would you describe the Coaching Teacher Professional Development?  0


- Very useful
- Somewhat useful
- Not very useful
- Not at all useful


2. How much did participating in the Coaching Teacher Professional Development increase your awareness of resources and supports related to your role as a coaching teacher?  0

- Substantially increased
- Somewhat increased
- Slightly increased
- Did not increase


3. Please indicate your level of preparedness to serve as a coaching teacher before the Coaching Teacher PD and after the Coaching Teacher PD.  0

	Very prepared	Somewhat prepared	Not so prepared	Not at all prepared
<b>Before Coaching Teacher PD</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>After Coaching Teacher PD</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. What did you like **most** about the Coaching Teacher PD?  0

5. What did you like **least** about the Coaching Teacher PD?  0




6. Would you recommend that coaching teachers attend training (like the Coaching Teacher PD) prior to mentoring student teachers or residents?  0


- Definitely
- Probably
- Probably Not
- Definitely Not

7. What could be improved about the Coaching Teacher PD for future coaching teachers?  0

8. How beneficial do you think the residency model will be in the following areas?

UofSC residency model includes coaching teacher and resident teacher working together during an entire school year while the resident is completing coursework toward a master's degree.  0

	Very beneficial	Somewhat beneficial	Not very beneficial	Not at all beneficial
Preparing Effective Teachers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increasing Retention of Teachers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Promoting Teacher Leadership	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increasing Student Achievement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. Did you attend the Summer Institute with the residents?  0

- Yes
- No

10. How beneficial was the Summer Institute in preparing the residents for the upcoming school year? 0

Very beneficial

Somewhat beneficial

Not very beneficial

Not at all beneficial

11. What suggestions do you have to improve the Summer Institute to prepare the residents for the upcoming school year? 0

12. How did participating in the Summer Institute prepare you for your role as a coaching teacher? 0

13. What are your current thoughts about serving as a coaching teacher during the 2020-2021 school year? 0