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EXPLORING THE USE OF MIXED-REALITY SIMULATIONS AS A TOOL IN TEACHER
TRAINING TO SUPPORT LANGUAGE FOR ACADEMIC PURPOSES

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EXPLORING THE USE OF MIXED-REALITY SIMULATIONS AS A TOOL IN TEACHER
TRAINING TO SUPPORT LANGUAGE FOR ACADEMIC PURPOSES

A Dissertation Presented to the Graduate Faculty of the

Simmons School of Education

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in

Partial Fulfillment of the Requirements

for the degree of

Doctor of Philosophy

with a

Major in Education

by

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May 13, 2023

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Exploring the Use of Mixed-Reality Simulations as a Tool in Teacher Training
to Support Language for Academic Purposes

Advisor: Dr. Annie Garrison Wilhelm
Doctor of Philosophy degree conferred May 13, 2023
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Applying a three-paper structure, this dissertation explores three ways in which mixed-reality simulations were used as a tool in teacher training to support the development of language for academic purposes. This dissertation explores how teachers reflect, reason, and notice their practice when integrating academic language with content using mixed-reality simulations. This is taken up through analyzing trends that emerge in debrief conversations after instructional activities are enacted in mixed-reality simulations (MRS). Learning through the activity of teaching has potential to help teachers integrate their understandings of rigorous content instruction with equitable English Learner instruction (Von Esch & Kavanagh, 2018). Framed by practice based professional education (Ball & Forzani, 2009; Grossman et al., 2009; McDonald, Kazemi, & Kavanagh, 2013), this research is situated within professional learning contexts that focus on developing teachers who can integrate English Learner instructional practices into content area teaching (Kahmi-Stein et al., 2020; Von Esch & Kavanagh, 2018). This work examines teachers debrief conversations after mixed-reality simulations to gain insights into the knowledge and perspectives they gained from the experience, and how it shapes their pedagogical practices. Paper one examines teacher and coach topical episode functions to learn how reflection is activated in a virtual coaching context. Paper two examines problems of

practice through episodes of pedagogical reasoning focused on English Learner instruction from a disciplinary literacy perspective, and paper three explores what teachers' notice about English Learner instruction across connected simulations, and how their noticings shift over time.

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Chapter 1: Introduction

This three-paper dissertation examines how teachers learn to support English Learners within content instruction. This is taken up through analyzing trends that emerge in debrief conversations after instructional activities, planned or structured learning experiences (cite), are enacted in mixed-reality simulations. Learning through the activity of teaching has potential to help teachers integrate their understandings of rigorous content instruction with equitable English Learner instruction (Von Esch & Kavanagh, 2018). Framed by practice based professional education (Ball & Forzani, 2009; Grossman et al., 2009; McDonald, Kazemi, & Kavanagh, 2013), this research is situated within professional learning contexts that focus on developing teachers who can integrate English Learner instructional practices into content area teaching (Kahmi-Stein et al., 2020; Von Esch & Kavanagh, 2018). This work examines teachers debrief conversations after mixed-reality simulations to gain insights into the knowledge and perspectives they gained from the experience, and how it influences and shifts their instructional practices. In paper one, teacher and coach topical episode functions are examined to learn how reflection is activated in a virtual coaching context. Topical episode functions are a concept within discourse analysis that refer to the different roles or purposes that topical episodes, or units of conversation that are organized around a particular topic, can serve in communication (Schegloff, 1987). Paper two examines problems of practice that arise during debrief conversations after mixed-reality simulations focused on English Learner instruction, and paper three explores what teachers' notice about instruction (cite) across connected simulations, and how their noticings shift over time.

Positionality

I view teacher learning through a sociocultural lens, where I believe teachers learn best from one another in a collaborative environment that considers the social and cultural contexts in which they work (Darling Hammond & Bransford, 2007; Horn & Garner, 2022). Therefore, I believe teachers learn most effectively when they engage in joint activities that are culturally and socially relevant, and when they have support from their peers and teachers (Grossman et al., 1999; Scribner & Cole, 1996). This view builds on the work of Vygotsky (1978) who emphasized the importance of social interaction and cultural context in shaping learning experiences. Additionally, I draw on Dewey's (1933) theory of experiential learning, and believe learning is most effective when it is grounded in students' lived experiences and when teachers create learning opportunities that engage students' interests and allow them to actively participate in their own learning. Within the realm of teacher training, this perspective has been thoughtfully implemented, allowing for deep exploration into the multifaceted ways in which teachers learn from one another in collaborative environments (Darling Hammond et al, 2005; Grossman et al., 2009). Moreover, I hold the belief that collaborative learning is a key ingredient in the recipe for effective teacher training. Its benefits are abundant and far-reaching: it can lead to improvement in teaching practices, an increase in teacher knowledge and understanding, improved student outcomes, and enhanced teacher collaboration, teamwork, and professional identity (Desimone, 2011; Lee & Yang, 2023; Sancar et al., 2021). To expand on this further, I believe that recognizing and respecting the diverse cultural and social backgrounds of students is important for teachers to meaningfully engage with them. In fact, this perspective has been utilized as a catalyst for promoting culturally responsive teaching practices that not only acknowledge but celebrate the diversity of student backgrounds (Ladson-Billings, 1995; Villegas & Lucas, 2002).

Finally, I believe that activities play a pivotal role in facilitating effective teacher learning. Teachers acquire knowledge and skills more effectively when they are involved in authentic, relevant activities that allow them to apply their knowledge and skills in meaningful ways (Darling-Hammond, 1995; Lampert & Graziano, 2009; Lampert et al., 2010). In conclusion, my theoretical framework for understanding teacher learning underscores the significance of collaborative learning, sociocultural context, and active learning approaches.

Practice Based Teacher Education

Practice based teacher education (PBTE) has gained momentum within educator preparation programs over the last decade with a focus on integrating key problems of practice and critical tasks of teaching into teacher education courses (Ball & Forzani, 2009; Grossman, Hammerness, et al., 2009). At the onset, Cohen and Ball (1999) defined PBTE as learning focused on professional performance, centered around key activities of the profession. This movement in teacher education to focus teacher learning more directly on the work of teaching was in response to the education communities' critique that teachers are not being prepared for the complex work of teaching (Berry, 2007; Lampert et al., 2013; McDonald, Kazemi, & Kavanagh, 2013). Consequently, educator preparation programs began revamping their course sequencing and rethinking the "batches of front-loaded coursework in isolation" (Darling Hammond, 2006, p.307). Consequently, this put a greater emphasis on identifying and embedding the central activities of teaching practice into courses and curriculum (Cohen and Ball, 1999). Specifically, the PBTE movement foregrounded socially and intellectually ambitious pedagogies that teachers could examine and enact throughout their preparation (Grossman & McDonald, 2008; Kazemi et al., 2016; Lampert et al., 2013). Two frameworks that have taken hold and become common for situating this shift are

Lampert et al. (2013) work around rehearsals and Grossman et al. (2009) work around pedagogies of practice: approximations, decompositions, and representations of practice.

Rehearsals and Cycles of Enactment and Investigation

One way that PBTE has been implemented is through the use of rehearsals and cycles of enactment and investigation. Lampert and colleagues (2013) define rehearsal as a social setting for building novices' commitment to teach ambitiously, where rigorous content is taught to students using instructional activities. Rehearsals are a vital component of the cycle of enactment and investigation, and the cycle is designed to bridge the gap between theory and practice for teachers by connecting coursework and fieldwork. It focuses on a set of principles about the nature of teaching and learning that are organized around carefully designed instructional activities, which are intended to guide novice teachers in their use of practices (Kazemi et al., 2016; Lampert & Graziani, 2009). Rehearsals enable teacher educators to offer teachers a variety of instructional challenges while also creating a community of practice for discussing a shared vision of what ambitious teaching looks like in action.

In summary, rehearsals are viewed as pedagogies of enactment, providing a social setting for building novices' commitment to teach ambitiously (Lampert et al., 2013, p. 227). They are an essential component of the cycle of enactment and investigation, providing teachers with a safe space to practice instruction and receive feedback before attempting the same lesson in the classroom environment.

Pedagogies of Practice: Approximations, Decompositions and Representations

Another common framework frequently cited within PBTE literature, is Grossman and colleagues (2009) foundational work around the pedagogies of practice. As Grossman (2009)

explains, teaching is a complex practice, learned over time, through rigorous and deliberate study combined with thoughtfully orchestrated opportunities to practice. In an attempt to coalesce the education community around a shared language of practice, the pedagogies of practice are defined as having three core elements: (1) representations of practice illustrate one or more facets of teaching in particular ways; (2) decompositions of practice parse the work of teaching into components that get named and explicated; and (3) approximations of practice engage teachers in doing tasks of teaching that are proximal to actual practice (Grossman, Compton, et al., 2009). These three pedagogies, situated within a pedagogy of practice, are developed through social interaction, and are frequently incorporated into teachers' preparation through fieldwork.

Further, the representations, decompositions and approximations of practice purposefully overlap and underscore each other (Grossman, Compton, et al., 2009), as they are meant to be employed in conjunction with one another. It is important to note, that this framework is purposively blurry. As Howell and Mikeska (2021) explain, a teacher educator might use a vignette to represent challenges teachers encounter in classrooms, use the same vignette as an approximation with the teacher picturing themselves in the teacher's shoes, or they might have the teacher focus on teacher decision making through decomposing the vignette. Hence, the framework affords teacher educators flexibility and ingenuity in how they apply the pedagogies of practice (representations, decompositions, and approximations) within their courses, and serves as a guidepost for teacher educators to situate their core practices and instructional activities in hopes of creating a common language to move the field forward. Overall, the intended effort of this framework is to create a common language that would continue to guide discussion and analysis of the pedagogy of professional

education (Grossman, Compton, et al., 2009, p. 2093).

Mixed-Reality Simulations as a Rehearsal Platform in Teacher Training

In addition to traditional rehearsals, some teacher education programs have begun to incorporate mixed-reality simulations as a rehearsal platform. By using mixed-reality simulations, teachers can practice teaching strategies and techniques for supporting learners in an interactive environment that closely mimics the challenges of the classroom (Dalinger et al., 2020; Lew et al., 2021). Simulations also enable teachers to practice communication with a group of students, improving their ability to engage and connect with all learners (Lew et al., 2021) and can help teachers develop their cultural competence and language awareness (Kamhi-Stein, 2020). In addition, mixed-reality simulations have been found to be effective in promoting self-reflection and critical thinking, which are essential for teacher development and growth (Bondie & Dede, 2020; Walker & Dotger., 2012). Through simulations, teachers can experiment with different instructional approaches and receive immediate feedback on their performance, allowing them to reflect on and improve their teaching practices. Overall, mixed-reality simulations offer a valuable tool for supporting the training of new teachers who work with language learners, helping to improve the quality of their instruction (Dalinger et al., 2020). While research on mixed-reality simulations is still in its infancy, Dieker et al., (2013) asserted the potential for teachers to reflect on and in action through simulations. Moreover, Cohen et al., (2020) found that methods courses that incorporate mixed-reality simulations can provide an additional context for coaching and skill development during preparation coursework. Integration of simulation experiences with coursework can foster teacher growth both in person and virtually, providing a flexible learning tool that could be leveraged throughout a teacher's learning continuum. To provide teachers with opportunities

to develop their instructional skills, mixed-reality simulations offer a safe and immersive environment that can complement traditional classroom settings. The shared context and learning environment that mixed-reality simulations afford, allow discovery, and joint construction to occur; and when one learner discovers something new, the partner will experience this discovery too (Bondie & Dede, 2020). Further, simulations provide teachers the opportunity to develop more granular, specified aspects of teaching practice in a scaffolded environment (Cohen et al., 2020, p. 209). Practice-based theories of teacher learning suggest that teachers would benefit from opportunities to practice in a simulated environment where various aspects of the classroom can be deliberately tailored to support specific learning opportunities and there would be no risk of harm to students (Dieker et al., 2013; Girod & Girod, 2008; Mikeska & Howell, 2020). Increasingly, educator preparation programs are using mixed-reality simulations to support and train teachers in learning how to enact ambitious instructional activities (Dalinger et al., 2020; Gundel et al., 2019; Piro & O’Callaghan, 2019).

Academic Language Use for English Learners

Recently, mixed-reality simulations have been implemented within teacher training programs to support teachers who work with English Learners, a population that faces unique challenges in developing academic language proficiency (Kamhi-Stein, 2020; Lew et al., 2021). Academic language refers to the specialized language used in academic contexts, such as textbooks, lectures, and assessments. English Learners may struggle to understand and use academic language, as it often differs from the everyday language they use outside of school. In addition, academic language often includes complex grammatical structures, abstract vocabulary, and discipline-specific terminology (Galguera, 2011; O’Hara et al., 2014).

Galguera (2011) argues that a focus on language use in the classroom can help English Learners understand the purpose and function of academic language, which can in turn improve their ability to use it appropriately. One effective approach to supporting English Learners' academic language development is through content-based language instruction. Content-based language instruction involves teaching academic content while also explicitly teaching academic language use. This approach has been shown to be effective in improving English Learners' content knowledge and academic language proficiency simultaneously (Tedick & Lyster, 2019). For example, teachers can provide sentence stems or graphic organizers to support English Learners' written and oral expression of academic concepts (O'Hara et al., 2014). By explicitly teaching academic language use, teachers can support English Learners' access to academic content and success in school.

Dissertation Purpose

My research aims to explore the potential of technology, particularly mixed-reality simulations, in supporting teacher training for English Learner instructional practices in practice-based teacher education settings. Chapter II examines how coaching, in conjunction with mixed-reality simulations, encourages teachers to reflect on their teaching practices. In Chapter III, teacher learning trends are analyzed through three simulated text-based discussions, highlighting instances of pedagogical reasoning that arise as teachers navigate how to facilitate discussions that support English Learners. Finally, Chapter IV discusses teachers' noticings of instruction for academic language use across interconnected simulations and how their noticings shift over time.

Chapter II: Coaching in the time of coronavirus 2019: how simulations spark reflection (Wernick, Conry & Ware, 2021)

Purpose – This study investigates how debrief conversations unfold during virtual coaching sessions that provide embedded opportunities to practice teaching within a mixed reality simulation (MRS). We examine how teacher and coach topical episodes function (agreeing, explaining, clarifying, probing, recapping, reflecting, and suggesting) to activate reflection as part of virtual coaching.

Design/methodology/approach – Grounded in Vygotsky’s sociocultural theory and the belief that learning is collaborative and impacts how pre- and in-service teachers construct knowledge, this exploratory case study draws on insights from 15 graduate students (5 pre-service teachers (PSTs) and 10 in-service teachers (ISTs)) who participated in virtual coaching with embedded practice opportunities. Data sources were video recordings and transcripts of 15 virtual coaching sessions, and one-on-one postcoaching interviews. Coding categories were determined through the constant comparative analysis method.

Findings – Findings indicate that an MRS provides an immediate context for reflection, which guided the debrief conversations. Additionally, functions occurred with varying frequency among PSTs and ISTs, and across both groups, probing questions often led directly to reflecting and recapping the shared simulation context.

Research limitations/implications – This study had a small sample ($n = 15$) and the use of an MRS, while widely used, is not necessarily a scalable practice.

Originality/value – In times of remote teaching, like during corona virus 2019 (COVID-19), opportunities to simulate clinical experiences become vital. With a limited research base, learning how teachers engage with and learn from simulated experiences is key to creating rich learning opportunities for teachers.

Keywords – Virtual coaching, pre-and in-service teacher professional learning, Mixed-reality simulation, COVID-19

Introduction

With the advent of COVID-19 during the spring 2020 semester and a sudden shift to emergency remote teaching (ERT), teacher education faced disruptions to common practices such as seminars, clinical experiences, and in-person, supervised student teaching. In response to this and anticipated future disruptions, teacher educators began to re-envision how to coach and support teachers remotely. The pandemic also exacerbated well-documented, inequitable learning experiences for culturally and linguistically diverse students (CLDS) (Fry, 2008; Walqui, 2006). To address this inequity, high-quality instruction with linguistic accommodations must be prioritized so students can access the core curriculum and learn academic language necessary to succeed in school (Kareva and Echevarria, 2013). However, few teachers receive pre-service preparation to teach CLDS, resulting in their learning these essential skills on the job (Batt, 2008). Providing high-quality instruction for CLDS *remotely* is an even rarer skill. The Migration Policy Institute (2020) advocated: Ongoing decision-making around digital learning should prioritize . . . ensuring all teachers participate in professional development that includes a focus on English Learner instruction. Both language instruction teachers and general, core content teachers, can benefit from increased professional development that focuses on supporting English Learner instruction in the digital sphere as well as low-tech strategies that support home Learning (Sugarman and Lazarin, 2020, p. 13). The pandemic has provided an unprecedented opportunity to coach teachers remotely in an effort to empower them to support their students during times of ERT. As Hodges *et al.* (2020) acknowledged, in times of crisis, educational planning requires creative problem solving to meet the needs of learners. With creative problem solving in mind, this exploratory study employs mixed-reality simulation (MRS) with CLDS avatars to investigate how pre-service teachers (PSTs) and in-service teachers

(ISTs) navigate a simulated teaching environment with embedded coaching and debrief cycles.

Research Context

This study took place at a private university in a large metropolitan area in the southern United States. It is part of a larger, 5-year research project focused on strengthening PSTs' and ISTs' knowledge and skills regarding working with CLDS. As part of the research team (first author as tutoring facilitator; second and third authors as course instructors), we provided cohorts of 50 teachers with weekly three-hour classes and after-school tutoring practice with real-time coaching for a full academic year. Teacher participants taught in a mixed-reality simulator at the beginning and end of the year-long program, serving as pre- and posttest measures for the grant. By necessity of the research design, these virtual teaching snapshots had limited feedback opportunities, but teachers appreciated the opportunity to practice implementing teaching strategies and expressed interest in personalized feedback. Their requests for additional opportunities to practice enacting questioning strategies and extending student responses sparked our interest in exploring simulations as a context for virtual coaching with real-time feedback for teachers. The pandemic further solidified this demand for teachers to enact teaching in formats that complement their coursework and teaching. They were practicing strategies in real time in an after-school setting and receiving feedback, but such opportunities were lost with the crisis. Hence, virtual coaching began as a support to fill the void of in-person teaching, leading to the realization that teachers really valued this type of coaching and support.

Literature Review

Educator preparation programs (EPPs) that interweave extended clinical preparation with coursework on teaching and learning produce effective teachers who are more likely to stay in teaching (Darling-Hammond, 2000). While we know clinical preparation is important, teachers

have varied opportunities to enact skills learned during coursework throughout their programs. One problem-solving approach embraced by many EPPs is the implementation of practice-based teaching opportunities. Specifically, *pedagogies of enactment*, termed by Grossman and McDonald (2008), is a pedagogical approach oriented toward novice teachers' development of clinical skill and craft, involving engagement in deliberate practice. Although the foregrounding of deliberate practice, like approximations of practice, has become popular, executing this work has challenges. For instance, providing rich, authentic opportunities for novices to approximate practice is challenging and was only exacerbated by COVID-19 and the cessation of field experiences. Simulations are one technological tool that can help supplement learning by providing a space for deliberate practice.

Teacher Reflection

Teacher reflection during preparation coursework and professional development occur in myriad ways. Examples of how reflection manifests include the process for making decisions (Korthagen, 2001), a critique of lesson development and delivery, and topical discussions during seminars (Etscheidt *et al.*, 2012). Although not exhaustive, these illustrate manifold ways in which teachers and teacher educators both conceptualize and implement reflection within EPPs. Therefore, in pursuit of clarity, Clarà (2015) focused on Dewey and Schön's belief that *reflection is spontaneous, common, real thinking* and, therefore, defines reflection as *a thinking process which gives coherence to a situation which is initially incoherent and unclear*. In keeping with this description, this study defines teacher reflection as episodes where a teacher gives coherence to a situation that is initially unclear. The goal of teacher reflection is to help teachers see chances for change and improvement in their teaching and to make meaning from the situation, so they come to see and understand their craft from different perspectives (Loughran, 2002;

Schön, 1987).

Talk Moves

Debrief conversations are a common tool used to support teachers in developing their reflective practice (Gabriel, 2017; Lefstein *et al.*, 2017), and talk move analysis is often applied to make meaning from discourse (Vetter *et al.*, 2020). Michaels and O'Connor (2015) defined *talk moves* as “simple families of conversational moves intended to accomplish local goals” (p. 334). They (O'Connor and Michaels, 2019) further underscored that talk moves intend to get the other player(s) to respond in some way, to bring something particular to the conversation. To explore patterns of teacher reflection, the present study analyzes debrief conversations between a teacher and coach using Michaels and O'Connor's conceptualization of talk moves.

Clinical Practice

Authentic opportunities to enact teaching, often referred to as “clinical experiences,” are a central part of EPPs (American Association of Colleges for Teacher Education [AACTE, 2010]; Darling-Hammond, 2014). Teaching is recognized as a complex practice that requires considerable knowledge, skill, and judgement (AACTE, 2010; Lampert *et al.*, 2013). For teachers to engage in this complex work, they must understand and be able to employ a variety of skills (Kennedy, 1999). Clinical experiences provide extended opportunities to observe and practice strategies for engaging students with subject matter in ways that are intellectually sound and developmentally appropriate (AACTE, 2010; Darling-Hammond, 2006). Further, the National Council for Accreditation of Teacher Education (2008) recommended that teachers should exhibit consistent success through clinical experience that involves a variety of situations. In light of the pandemic and ERT mandates, state education agencies have begun to revise clinical experience guidelines and expectations. For example, in Texas, the requirement for in-

person, field-based experiences have been waived, and clinical hours can now be completed virtually (Texas Education Agency, 2020). While virtual opportunities are abundant, their forms and functions serve divergent purposes, so there is a need for research that explores how remote teaching practice might inform the design of future virtual clinical experiences.

Cognitive Coaching

While mentoring and coaching often occur concurrently, our study employs the cognitive coaching model in which the coach strives to use trust, learning, and autonomy in order to support teacher learning (Costa and Garmston, 1992). We view coaching as a means to support teachers in becoming critically reflective and skilled practitioners and strive to respond to the needs of PSTs and ISTs in our program. Our conceptualization aligns with Salter (2015) who posited that coaching is not focused on role modelling but rather supporting coachees to develop critical reflective skills. Further, Schon (1987) recommended incorporating a reflective practicum, where people learn by doing, through interacting with someone who assumes the role of a coach. Accordingly, we designed this extension study to foster coach and teacher discussion in a shared simulation context. This design follows the notion that learning is not an isolated discreet cognitive activity; rather, learning cannot be separated from its social context (Heineke, 2013). Within the sociocultural paradigm, cognitive coaching complements Vygotsky's (1978) sociocultural theory as coaching is embedded within and emerges from social activity.

Pedagogies of Enactment with Coaching

As the field has shifted toward practice-based teacher education, pedagogies of enactment coupled with skilled coaching from teacher educators (Grossman, *et al.*, 2009) were foregrounded in designing this study with a focus on exploring how teacher and teacher educators' conversations unfold. As Grossman and colleagues (2009) highlighted, feedback

provided during coaching helps teachers develop ways of seeing and understanding complex practices. Furthermore, Cohen *et al.* (2020) suggested that coaching coupled with practice opportunities can help teachers improve more efficiently and effectively than practice with only self-reflection.

Mixed-reality Simulations

While research on MRS is still in its infancy, Dieker *et al.* (2013) asserted the potential for teachers to reflect *on* and *in* action through MRS. An initial pilot from Smith and Garrett's (2020) Simulated Instruction in Mathematics Professional Development Study found that there were large, positive improvements in instruction among teachers participating in the professional development, the program was feasible to implement, and the teachers had a positive experience. Moreover, Cohen *et al.* (2020) found that methods courses that incorporate MRS can provide an additional context for coaching and skill development during preparation coursework. Integration of simulation experiences with coursework can foster teacher growth both in person and during ERT, providing a flexible learning tool that could be leveraged throughout a teacher's learning continuum. In response to COVID-19 and the disruption of traditional enactment opportunities, EPPs realized the importance of designing learning scenarios that could be adapted and implemented both in person and virtually. We, the teacher educators, value the perspectives teachers bring from their experiences, so we decided to partner with our teachers as trusted informants who could provide insight into their experience with virtual enactments. In this study, we collaborated with 15 graduate students in education (comprised of both PSTs and ISTs) to learn how to utilize MRS most effectively to coach teachers remotely during shelter-in-place orders. While most extant research focuses solely on PSTs or ISTs, we were interested in how teacher reflection and talk move patterns might differ or align across teacher groups.

Research Design

These research questions guided our inquiry:

1. How do debrief conversations with pre- and in-service teachers evolve during a virtual coaching session with embedded MRS practice opportunities?
2. What patterns emerge to prompt pre- and in-service teachers' reflection on practice?

Grounded in socio-cultural theory and the belief that learning is collaborative and impacts how we construct knowledge (Vygotsky, 1978), this exploratory case study (Yin, 2014) aims to understand how teachers engage in virtual coaching with embedded simulation practice opportunities.

Data Sources and Analysis

Data—video recordings and transcripts of 15 virtual coaching sessions, and one-on-one post-coaching interviews—were analyzed using content analysis methods. Coding categories were determined by using the constant comparative analysis method (Corbin and Strauss, 2015) with specifics detailed in the *Analytic Strategy* section.

Teacher Participants

At the end of the 2020 school year during the pandemic, all 54 teachers from the most recent cohort of the larger study were invited to participate in this research extension, a 30- minute MRS session with a coach. Fifteen teachers (5 PSTs and 10 ISTs) volunteered. Overall, as reflected in Table 1, most participants were female (93%) and White (53%) with years of teaching experience ranging from none to more than 20.

Table I: Participant descriptions

Pseudonym	Teaching category	Grade level	Sex	Focus of skill	Coaching session	# of simulations	# of debriefs	Ethnicity	Years of teaching experience
Bridget	P	E	F	Questioning	1	2	2	White	0
Rosa	P	E	F	Questioning	1	3	3	Hispanic/Latino	0
Kayla	P	E	F	Questioning	1	2	2	White	0
Casey	P	M	F	Questioning	1	2	2	White	0
Ashley	P	M	F	Extending Responses	2	3	3	White	0
Emily	I	E	F	Questioning	3	3	3	White	6-10
Raul	I	E	M	Questioning	2	4	4	Hispanic/Latino	11-15
Brea	I	E	F	Questioning	1	2	2	White	6-10
Rene	I	E	F	Extending Responses	2	4	4	African American	1-5
Jackie	I	E	F	Extending Responses	3	4	4	White	11-15
Ana	I	E	F	Extending Responses	3	4	4	Hispanic/Latino	11-15
Pranali	I	S	F	Extending Responses	4	4	4	Foreign Nation	11-15
Dana	I	E	F	Extending Responses	4	4	4	African American	11-15
Mia	I	E	F	Extending Responses	4	4	4	Hispanic/Latino	21-25
Corey	I	E	F	Questioning	3	4	4	White	6-10

Note. Teaching category is denoted by “P” for pre-service and “I” for in-service teachers; Grade level is denoted by “E” for elementary school, “M” for middle school, and “S” for secondary school.

All three authors participated in the design and implementation of the study. As a former instructional coach and classroom English language arts and history teacher who worked with CLDS for more than 10 years, the first author served as coach, and the second and third authors supported the design and implementation of the coaching and simulation protocols. Further, we met daily for up to 2 hours of peer debriefing sessions each day of the 2-week data collection period to review the videos and document analytic memos on emerging themes.

Coaching Focus

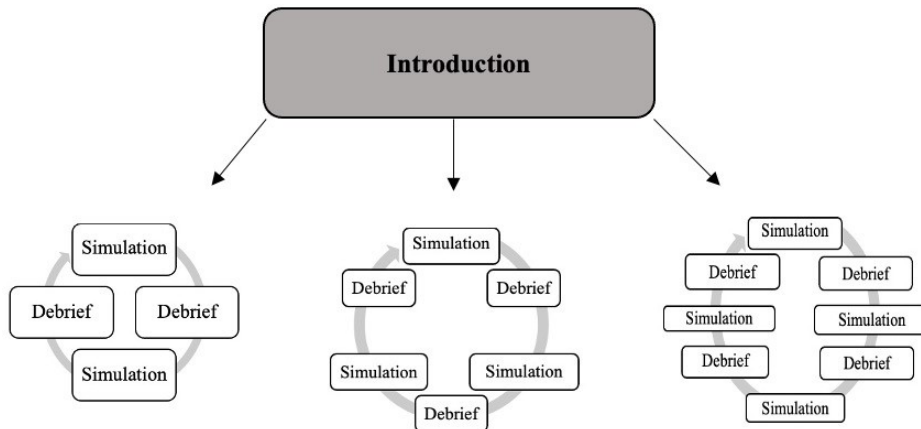
As noted, we used cognitive coaching to support teacher learning. Teachers were given an option of two focal skills for coaching: questioning strategies or strategies to extend student responses. Both skills were identified as high-leverage teaching practices that support CLDS (Echevarria *et al.*, 2012) while also being observable and appropriate for a simulated context. Identification of a single skill provided both coach and teacher a narrowed focus for discussion

during the debrief.

Simulation Design

We offered coaching sessions over four days with three to five sessions each day. The teacher and coach joined the session from their homes via Zoom. For the simulation platform, we used Mursion, a MRS program that uses artificial intelligence and a human simulation specialist. Each session lasted 30 minutes, with two to four simulation rehearsals and debriefs. After the first round of sessions, we realized the utility of having an immediate shared context and decided to leverage the MRS tool sooner in the coaching conversation to maximize simulation and debrief opportunities. Due to the exploratory nature of this study, and because the project deliberately aimed to develop an approach that served teachers well, iterative modifications were made and documented as the study progressed. As a result, the teachers experienced a varying number of simulation rehearsals depending on which coaching session they attended. The coaching sessions followed one of three paths as portrayed in Figure 1, so some teachers engaged in only two simulations and debriefs while others engaged in up to four simulations and debriefs. Additionally, teachers were interviewed using a semi-structured protocol immediately following the coaching session to share constructive criticism and their perspective on the affordances and utility of this kind of virtual coaching.

Figure 1: Overview of simulation cycles



Further information is provided in Table 1 with teacher descriptions. Most participants (67%) used the second simulation path. Figure 2 illustrates the student avatars with whom the teachers engaged during their small-group instruction enactment.

Figure 2: Mursion Avatars



Analytic Strategy and Coding Processes of Data Corpus

First, we uploaded all 15 video transcripts to Dedoose Version 8.3.35, a qualitative data analysis software program, and employed a detailed line-by-line coding strategy (Charmaz, 2008) of the debrief conversations between coach and teacher, which enabled a nuanced analysis of the coaching transcripts. To maximize the variation in concepts, we analyzed several transcripts that would contrast (one PST and two ISTs), as recommended by Bazelay and Jackson (2013). Then,

due to the nature of the debrief conversations, we utilized process coding to connote action in the data (Charmaz, 2002) and identify topical episodes and codes.

Identifying Talk Moves and Coding Topical Episodes

Our unit of analysis started at the turn-of-talk level. We consider talk moves useful tools that help teacher educators understand how teachers learn within a simulated space. When we began to read and memo turns of talk, we realized some were prolonged and encompassed multiple topics. Because topics were introduced sequentially by the speaker and rarely overlapped, we proceeded to disaggregate such turns into topical units. Therefore, our unit of analysis became topical episodes within turns of talk. Each turn of talk by a given speaker comprised one to three topical episodes. Open coding was used to note the purpose of these topical episodes which we call “functions.” We catalogued and analyzed these episodes for their linguistic and interactional value (Michaels and O’Connor, 2015). Across the 15 simulations, a set of nine recurrent functions were identified, which became codes. Topical episodes with more than one function were assigned all relevant codes, and the number of simultaneous functions per topical episode ranged from one to four. After double coding 20% of the transcripts, we compared codes and reached 81% inter-rater reliability on the final parent codes: agreeing, explaining, questioning, recapping, reflecting, and suggesting. Relationship building and collaboration were excluded during this stage because they were fluid across multiple topical episodes, more subjective, and not the study’s focus.

Findings

In this section, we first describe the topical episode functions and the frequency with which they were used by teacher category (PSTs and ISTs). Then, we discuss the patterns of teacher reflection and the topical episode functions that catalyzed reflection. Last, we expound

on the unique affordances and utility of MRS as a means to create an immediate, immersive, and shared coaching context.

Topical Episode Functions

Seven overarching topical episode functions emerged during the coding process: agreeing, explaining, questioning to clarify, questioning to probe, recapping, reflecting, and suggesting. Table 2 reflects the occurrence of topical episode functions per debrief. All were used by both coach and teacher, regardless of teaching experience, during debriefs with varying frequencies, except for probing which was not used by PSTs. *Agreement* occurred most frequently after a suggestion was made by either a teacher or coach and occasionally after reflection or explanation.

Explanations were most frequently provided by the coach, particularly with PSTs. For instance, on average, the coach explained three times more than a PST (1.55 and .45 times per debrief, respectively), indicating an uneven distribution of responsibility. For ISTs, on the other hand, the coach explained 1.3 times per debrief, on average, compared to 1.08 times by ISTs.

Clarifying questions occurred less often than probing questions and intended to eliminate confusion or misunderstanding. *Probing questions*, the function most regularly used by the coach, prompted further discussion. *Recapping* was denoted as anytime the current simulation context was referenced during the debrief.

Reflecting, the most common function of teacher topical episodes, was defined by any instance of engaging with one's thoughts and actions to give coherence to a situation. This definition is inspired by Dewey (1933) who described *reflection* as "turning a subject over in the mind and giving it serious and consecutive consideration, which allows us to act in a deliberate and intentional fashion" (p. 3). PSTs employed this function, on average, 3.27 times per debrief,

signaling partiality for this response when prompted by the coach. Finally, *suggesting*, the second most common function used by the coach, was coded any time an idea was put forward for consideration.

Table 2. Occurrence of topical episode functions within each post-simulation debrief

	Agreeing		Explaining		Questioning				Recapping		Reflecting		Suggesting	
	Coach	Teacher	Coach	Teacher	Clarifying		Probing		Coach	Teacher	Coach	Teacher	Coach	Teacher
PST	1.36	1.09	1.55	.45	.36	1.09	3.73	0	1.45	.73	.64	3.27	2.45	1
IST	.64	1.36	1.3	1.08	.02	.36	3	.01	1.25	.69	.94	2.11	2.47	1.47

PST Versus IST Topical Episodes

Three functions emerged with differing prevalence between PST and IST topical episodes: explaining, clarifying questions, and reflecting. These differences suggest that PSTs have different schemata than ISTs to pull from when discussing a simulation and therefore rely more heavily on reflecting about their recent experience in the simulator than other contexts to discuss next steps. Vignettes from each group (PSTs and ISTs) with pseudonyms for participants are displayed below to illustrate these differences. For example, after the coach asked Bridget a probing question, she reflected and referenced the simulation simultaneously to build context, a pattern unpacked in the section *Recapping*.

Coach: Why do you think that was what they wanted to talk about? [*probing*]

Bridget (PST): A bunch of, you know, like the details of reusing it or different ways to reuse it is really only targeting “reuse” and isn’t really engaging like the higher order thinking as much. [*reflecting*]. . . So, I think that kind of got them to connect “reuse” and “recycle” and then also think about higher order thinking in a way like why it’s important to do that.

[*recapping & reflecting*]

Kayla, another PST, referenced the simulation to help build understanding.

Coach: How do you feel after that one? [*probing*]

Kayla (PST): Yeah, I think it's just probing questions afterwards, like after their [student avatars'] answers and because like I think I get into the habit of assuming what they probably meant by that, instead of thinking of questions to probe after their answers. [*recapping & reflecting*]

In contrast, ISTs frequently access their own classroom contexts to build understanding around what they experienced in the simulator. Corey and Mia, both referred to their classroom experience during debriefs.

Coach: Whenever we think about our questioning strategies, what's the takeaway after we're finished? What do we want them to leave with?

[*probing*] Corey (IST): So, because I teach 2nd grade, I want my kids to know what things we recycle. [*reflecting*]

Additionally, Mia provided contextualization during the debrief to connect the simulation to her own classroom.

Coach: Do you think that as far as extending their talk, that this question is natural to go ahead and help them share more of their ideas? [*probing*]

Mia (IST): Yeah, I think we could use some sentence stems so when they talk to each other they would use the long sentence when they share.

[*reflecting & suggesting*] Coach: Yeah, definitely and how do you feel about extending their talk? Do you feel like it's getting more natural?

[*agreeing & probing*]

Mia (IST): Um, I think I do, but I work with kindergarteners, so we just say things many times in order to get the information from the kids.

[*reflecting*]

Mia's excerpt exemplifies how ISTs employ multiple functions simultaneously. ISTs used two or more functions simultaneously, 1.2 times per debrief, which was twice as frequently as PSTs who used multiple topical episode functions simultaneously, .55 times per debrief. This finding indicates that ISTs have the tendency to multitask and employ multiple functions per turn of talk during debriefs, perhaps suggesting more complex reflection. In this same vein, the ISTs drew on their own practice and experience in considering how they would proceed, while the PSTs referenced the simulation to inform their next steps. This divergence between ISTs and PSTs in the contextualization of their experience with the simulation is something that should be further interrogated in order to provide additional insight into the key design features of simulations to best support ISTs and PSTs.

Patterns of Teacher Reflection

While reflection looks different across teachers and contexts, scholars generally agree on the importance of actively and carefully examining one's thoughts to improve one's teaching (Freese, 1999). Additionally, since reflection was the most common function per debrief for ISTs and PSTs, we wanted to understand the role reflection played during the discussion between coach and teacher. Therefore, we next describe reflection patterns that emerged from the analysis of both PST and IST topical episodes.

Catalyst for Reflection

Throughout the debrief conversations, probing emerged as the main catalyst for reflection by both ISTs and PSTs. While probing occurred throughout these conversations, there was one instance, directly after each simulation enactment, where all ISTs and PSTs reflected. This reflection occurred in response to an initial probing question by the coach, along the lines of

“How did that feel?” This question, in turn, prompted every IST and PST to immediately reflect. For example, the coach said, “How do you feel like your questions were strung together?” and the PST, Kayla, replied “I think it was, it felt natural, I think whenever they [avatars] have those funny answers like when Dev said ‘to stomp on it,’ not to say like, oh, you don’t want to say like that’s wrong, but that’s a creative way to reduce but let’s think more like...” This reflection supports Schon’s (1987) belief that professionals who receive real-time coaching and encouragement to think carefully (about what they do while they do it) learn in a more profound way. Kayla further substantiated this in her post-simulation interview when she talked about the coaching experience:

I think she [the coach] definitely noticed similar things as to like what I thought. But then also, she was able, it's like a second set of eyes. And I got her feedback right away, and sometimes on things that I didn't really notice, or if I had questions. I like that she was able to answer them right then and there. I like virtual and doing it over Zoom with the coaching aspect of it. It is really beneficial.

Although probing by the coach was the most common catalyst for reflection across all teachers, there were several instances of the coach suggesting or agreeing that encouraged teacher reflection as well.

PST Reflection Patterns

Reflection, the most common topical episode for PSTs, was implemented 3.27 times on average per debrief as shown in Table 2. This suggests that the instant opportunity to reflect on practice after a simulation enactment affords teachers and teacher educators an immediate context for reflection. As Loughran (2002) stated, it seems reasonable to assert that how PSTs

engage with their actions within the practice setting, through reflection on those actions, must shape the possibilities for seeing as a result of experience. Ashley reflected on her practice by saying, “I mean, I was trying to get them all to tell me more about it, but maybe I should keep trying to make it applicable by asking them when they did something that helps the environment”. This reflection indicates that the teacher is making meaning from the simulated enactment. Another example is when Casey said:

Once I had pointed at the image, I was thinking, well now, it did kind of seem awkward and unnecessary because that’s not what we are trying to talk about the plastic cup, and you know plastic recycling and what we can do to it, but that image didn’t actually really work. I think that starting without that was a jumping off point but not really necessary.

Once again, the PST is making meaning about her practice from her reflection on the shared simulation context. These vignettes support Loughran’s (2002) argument that reflection is effective when it leads teachers to make meaning from the situation in ways that enhance understanding so that the practice setting can be considered from a variety of viewpoints. For PSTs, most topical episodes that led to reflection were probing questions posed by the coach. However, there were two instances of the PST agreeing before reflecting and one instance of the PST explaining before reflection occurred. This suggests that reflection naturally occurs in response to probing, but it is also possible for reflection to follow probing less directly. *IST*

Reflection Patterns

Similarly, ISTs used reflection more than any other topical episode at a rate of 2.11 times per debrief. While reflection content varied, the central thread was the simulation itself. Teachers commonly referenced the simulation as they reflected aloud, as if the simulation grounded them

in a context that enabled them to think about their practice more broadly. One example is when the coach asked, “How did that feel with extending student talk?” and the IST, Jackie, replied:

Sometimes you don’t think about those things on the fly. If you kind of have those, we think about sentence stems, and we think about things like that, but to also get them to relate to each other, it’s harder for them to get to rephrase and say, okay, can you repeat what they said and add to it?

This example illustrates strategies suggested by the teacher to engage students and prompt them to make connections with other students. Another example of teachers connecting the current experience to their practice was when Raul reflected on his recent simulation to explain his thinking and decide next steps:

With this particular video with the avatars since we are working with the ELLs is making sure there is content but there are also ways of expressing [themselves and] they have the language to express their ideas. One of the things I try to do is reword what they say in order to build more words, syntax, and structure that they can hear and gain more confidence in the topic and the way they express those things.

This reflection then led to further probing by the coach who wanted to come to a mutual understanding and arrive at next steps for the following enactment. For instance, the coach said, “Let’s talk about some of the questions that we might want to try to scaffold in a way to build the students’ understanding of this concept,” and Raul replied,

Yeah, I probably will start with the same question about recycling, and then talk about the idea of stopping waste where we will classify the ways we could recycle and see if we can focus on paper and link it with reusing.

This back and forth between the teacher and coach elucidates how probing instigates reflection, supporting Smyth's (1992) belief that reflection guides learning through questioning and investigation to lead to a deeper understanding.

Topical Episode Functions in Parallel with Reflection

While most teacher reflections occurred as isolated topical episodes, some combined reflection with other functions. For PSTs, the only function that occurred in conjunction with reflection was recapping (3 times), accounting for 1% of all PST reflections. For ISTs, reflection occurred in conjunction with explaining (11 times), suggesting (6 times), recapping (5 times), and agreeing (1 time), accounting for 2% of all IST reflections. Although concurrent functions occurred seldomly with reflection, this data analysis indicated that when it does ensue, it helps teachers make sense of the complex work of teaching. An example of reflection being employed alongside suggesting is when Jackie said,

Well, since we tied them all together, maybe they could think about adding that garden, or maybe even doing a mini garden in the classroom. Because it doesn't necessarily have to be one for the whole school. I liked the way that Jasmine (avatar) brought in decorations. Not only could she use decorations within the garden, but to do in the classroom. Maybe that's something that they could do as a class to add some flair to their classroom or even around the school. Students are always wanting to help unify their school. That could be a good idea for them.

This anecdote suggests that an affordance of the simulation is that teachers, grounded in a constrained, shared context, can immediately explain their thinking after reflection and make suggestions before their forthcoming enactment. Further, it substantiates Dewey's (1933) belief

that reflection allows teachers to act deliberately as Jackie was intentional about wanting to incorporate Jasmine's (avatar) decoration idea into her lesson.

Recapping

As Table 3 illustrates, recapping happened in conjunction with reflecting more than any other function, including in isolation. Rene, an IST, recapped what she noticed in the simulation as she reflected, saying,

It was good. They [the avatars] have some good ideas. I think I could have expanded on the iPad part a little bit, like what other things that we could do on our iPad that we would otherwise do with paper? So, like a book or drawing, that sort of thing.

This anecdote supports the notion that a shared simulation provides a rich context for teachers to access reflection and growth. Moreover, the opportunity to reattempt simulation scenarios based on feedback and reflection enhances growth for the candidate (Dalinger *et al.*, 2020). Rene substantiated this claim of growth during her post-simulation interview, stating:

. . . the coach pointed out where my thinking was, and kind of helped me tunnel through to . . . focus on like completing the circle that I was trying to get the students to think through. So that was really good, because sometimes you don't really know. Like you know where you're trying to go, but you're not really sure how to get there. So that was really helpful.

Further, the simulation affords teachers a practice setting with the ability to try and enact a variety of teaching practices, making visible a problem of practice. The ability to frame and reframe a teaching practice (Schön, 1987), an affordance of the simulator, helps teachers develop reflective practice as it influences their subsequent actions in practice (Loughlan, 1996). An

example of a teacher reframing their practice that influenced subsequent action was when Ana stated, “I’m thinking about extending the concept of recycling,” and the coach replied, “Okay, what do you mean by that?” to which Ana replied, “[The avatars] didn’t really specify anything like they kept saying it’s something that helps everyone, but who else is that everyone. . . like how it affects people maybe?” She was able to reframe how she was thinking about extending the concept of recycling, which spurred her to suggest subsequent action for her next simulation. As the earlier examples show, recapping manifested within debrief conversations as a way for teachers to contextualize their thinking and specify next steps.

Table 3. Average occurrence of recapping within each post-simulation debrief

	Recapping		Recapping & Explaining		Recapping & Probing		Recapping & Reflecting		Recapping & Suggesting	
	Coach	Teacher	Coach	Teacher	Coach	Teacher	Coach	Teacher	Coach	Teacher
PST	1.1	.27	0	.09	.27	0	0	.36	.09	0
IST	.42	.19	.14	.08	.31	0	.19	.33	.19	.08

Discussion

Answering our first research question: How do debrief conversations with PSTs and ISTs evolve during a virtual coaching session with embedded MRS practice opportunities? — we identified two key takeaways. First, the evolution of debrief conversations is directly connected to the simulation enactment. Having an immediate shared context provides teachers a proximate reference for reflection on incoherent parts of their practice (Clarà, 2015). For instance, one teacher recapped and reflected on assumptions made about the avatars during their debrief, which led the teacher to realize that probing student thinking would be more productive than making assumptions. This reflection allowed the teacher to see possibilities for change, supporting Loughran’s (2002) idea that reflection helps teachers see possibilities for change and improvement in their teaching, and the technology afforded the teacher the opportunity to immediately implement this change in the next simulation.

Second, the variation between ISTs and PSTs frequency of using specific talk moves suggests their teaching experience or lack thereof influences their underlying schema they tap into when reflecting on their simulation experience. For example, PSTs referenced the simulation to make sense of their recent enactment and rarely connected the simulation to their own teaching experience. This supports Berliner's (2001) finding that novices lack the cognitive resources to understand all that is happening in a classroom because they are cognitively overloaded. Further, it suggests that the simulation might be one of the few opportunities a PST has had to practice teaching, and therefore, their reflections during debriefs focus on the simulation context because of limited exposure to other teaching opportunities at this point in their EPP. On the other hand, ISTs frequently reference the simulation and immediately connect it to their own classrooms to decide next steps, suggesting they have more teaching contexts to reference, providing ISTs with an abstract schema. As Meschede *et al.* (2017) discussed, with practical experience, schemata become more abstract, and those more efficient schemata allow experienced teachers a holistic, integrated view of a situation, allowing them to quickly process information and connect it to their own contexts. These data underline the importance of MRS in grounding the debrief conversations while also highlighting that ISTs and PSTs have varying schemata to pull from when reflecting on their experience.

Our second research question—what patterns emerge to prompt PST and IST reflection on practice? — yielded several key patterns of note. First, probing and reflecting go hand in hand. Probing questions, predominately asked by the coach, furthered discussion, and teacher reflection. This aligns with scholarship on coaching (Salter, 2015), where coach probing helped teachers critically reflect on their practice. Second, ISTs provided more explanations and suggestions during debriefs, and the frequency of these functions were similar between coach

and teacher—providing a more balanced discussion. Conversely, the coach explained three times more frequently than the PSTs and made suggestions twice as frequently. This further reinforces that PSTs and ISTs have varying experience and schema to pull on when reflecting and deciding next steps.

In sum, to provide teachers with opportunities to enact practices and to reflect upon those practice-based experiences in supportive environments, this study uniquely provides insight into how reflection evolves within a virtual coaching session with embedded opportunities to enact teaching.

Limitations and Implications for Future Research

The sample size was small ($n=15$) and the use of MRS, while widely used, is not universally accessible. Although MRS can be a limitation, video-based coaching could be employed to evaluate the underlying constructs of this study. Additionally, given that participants had already developed a relationship with the coach across the year in this study, it is important to note that future iterations of one-session remote coaching opportunities would not likely result in similarly rich experiences. In their post-coaching interviews, all participants asserted the importance of trusting and respecting the coach in order to feel comfortable in coaching sessions. Finally, this coaching experience occurred unilaterally. Professional learning is most effective when it is ongoing and continuous (Garet *et al.*, 2001), so future studies could have multiple touchpoints that follow teachers more longitudinally.

To support the professional learning experiences of teachers, coaching must be strategic and intense, supportive, and collaborative, and be ongoing (Guskey, 2002). Hence, future research can explore what topical episodes best support teacher learning at different points along their learning continuum. Additionally, while COVID-19 was the impetus for transitioning

coaching to a remote simulated environment and proved to be a powerful tool for ERT, we believe that it could also be leveraged to help envision coaching opportunities for teachers throughout their preparation and professional development. The simulation technology affords teacher educators a controlled context, flexible scheduling, ability to pause, opportunities for immediate “do overs”, coaching, and reflection. These affordances posit simulations have a place in teacher education in the future whether students are remote or in person. To that end, another affordance of the technology is the ability to design learning experiences to support different student groups, age levels, and content areas. Disparities faced by CLDS could be assuaged by EPP through enhancing teacher readiness to advocate for and meet the needs of diverse student populations. Being culturally sensitive and learning how to leverage CLDS strengths would empower teachers to provide a more just and equitable education.

Conclusion

Although COVID-19 disrupted teaching and learning in myriad ways and the full impact of the pandemic remains unknown, one encouraging outcome is the discovery of new ways to support teachers and students in times of crisis and ERT. Should a sudden transition to ERT become necessary again in the future, education stakeholders will be able to navigate the context with the knowledge gleaned during the crisis. This study contributes to that growing body of knowledge by exemplifying the utility of simulations and remote coaching for providing safe and relevant opportunities for practicing teaching. It also suggests that virtual teaching and real-time discussion with a coach can be an enriching way to offer professional learning opportunities for teachers aiming to provide equitable instruction for CLDS. Given that CLDS have historically (and recently, according to emergent research) been underserved in education, the prospect for teachers to practice and iteratively reflect on how to scaffold instruction while maintaining high

expectations for CLDS is heartening. Moreover, the findings from the methodical analysis of post-simulation debrief discussions illuminate recurring functions of teacher and coach talk moves as well as patterns in how reflection unfolds.

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Chapter III: Integrating Language and Content with Mixed-Reality Simulations: Pre-Service Teachers' Pedagogical Reasoning

Abstract

This study examines episodes of pedagogical reasoning that surface during debrief conversations after pre-service teachers enact text-based disciplinary literacy lessons with a focus on integrating English Learner instructional strategies in the context of mixed-reality simulations. Framed by the pedagogies of practice framework (Cohen & Ball, 1999), this research seeks to understand problems of practice that emerge when pre-service teachers engage in pedagogical reasoning to improve their practice. Problems of practice refer to specific, real-world challenges that teachers face, requiring the application of professional knowledge, skills, and judgment to address effectively (Bullough, 2012, Shulman, 2005). With the goal of developing teachers who can flexibly and innovatively support English Learner student learning (Von Esch & Kavanagh, 2018), we designed a learning cycle with three embedded simulations for teachers to practice scaffolding language for academic purposes (Galguera, 2011). We applied a practice-based design to surface problems of practice and illuminate episodes of pedagogical reasoning that occur as teachers begin to negotiate how to lead a text-based discussion that support English Learners. The analysis of the debrief conversations revealed three central themes: effective discourse management, development of academic language skills, and commitment to promoting inclusive and engaging learning environments for all students. These themes revolved around the central component of integrating language with content through scaffolds. By identifying specific problems that teachers faced when integrating language and content instruction, targeted learning cycles can be developed to provide teachers with the necessary support to enhance their language integration skills. These findings can also be used by teacher educators to create and refine learning opportunities that help teachers improve their instructional practices to better

support English Learners.

Introduction

The diverse linguistic and educational backgrounds of English Learners pose a complex and persistent challenge in teacher education, particularly for mainstream classroom teachers who are expected to deliver rigorous content while accommodating the needs of linguistically diverse students (Bunch, 2014; de Jong & Harper, 2005; Menken, 2011). Despite these challenges, disciplinary literacy teaching has emerged as a valuable tool for English Learner instruction, as it emphasizes the social and problem-based use of texts to promote knowledge construction and sharing (Gee, 2015; Moje, 2008). As such, this study explores the use of text-based disciplinary literacy lessons that integrate English Learner instructional strategies within a mixed-reality simulation. Specifically, this research focuses on the pedagogical reasoning that emerges during debrief conversations after pre-service teachers enact these lessons, with the aim of enhancing teachers' language integration skills alongside literacy content instruction (Darling-Hammond & Bransford, 2007). To frame the study, we introduce the pedagogies of practice framework, which emphasizes the complex and dynamic nature of teaching and learning (Grossman et al., 2009). Through this framework, this study identifies the central themes that emerged from the analysis of the debrief conversations, which highlight teachers' focus on discourse management, the development of academic language skills, and their commitment to promoting inclusive and engaging learning environments for all students. Finally, the paper highlights how teachers developed pedagogical language knowledge, which refers to the knowledge and skills that teachers use to support English Learners to develop their language proficiency while teaching the core subject area (Bunch, 2013; Lucas & Villegas, 2013)

Literature Review

Pedagogies of Practice

Teaching is a complex practice that requires deliberate study and practice over time (Grossman, 2009). To provide a shared language of practice, Grossman, Compton, et al. (2009) define the pedagogies of practice as having three core elements: representations of practice, decompositions of practice, and approximations of practice. These pedagogies are developed through social interaction and are incorporated into teacher preparation coursework. The framework allows teacher educators flexibility in applying the pedagogies of practice in their courses and serves as a guidepost to create a common language for professional education. However, the framework is purposely blurry to afford teacher educators the ingenuity to apply the pedagogies of practice as they see fit (Howell and Mikeska, 2021). Overall, the intended effort of the framework is to create a common language that would guide discussion and analysis of the pedagogy of professional education.

English Learner Instruction

Nearly five million students in U.S. schools are classified as English Learners (Walqui & Bunch, 2019). These students come from different geographic, demographic, linguistic, educational, and socioeconomic backgrounds, and the range of their developmental stages of English is considerable (Walqui & Bunch, 2019). With the wide range of proficiency and diversity amongst English Learners, it is not surprising, the term English Learner is fraught with multiple meanings, underlying complexities, and dilemmas relevant to their education. The complex nature is also highlighted in the field of Second Language Acquisition and applied linguistics, where there is increasing agreement on the following points: Second Language Acquisition is a highly variable and individual process. It is not linear (Valdés et al., 2014). While an increasing number

of English Learners enter classrooms across the U.S., teachers remain overwhelmingly white and, presumably, monolingual speakers of English (Commission on Teacher Credentialing, 2008), and according to a report by the Migration Policy Institute (2015), about 60% of teachers in the United States reported feeling “not very” or “not at all” prepared to work with English Learners. Hence, preparing mainstream classroom teachers to meet the needs of linguistically diverse students while teaching rigorous content remains a persistent challenge in teacher education (Janzen, 2008; Von Esch & Kavanagh, 2018). Scholars have proposed addressing this challenge by integrating English Learner instruction across all content areas during teacher preparation, as emphasized by de Oliverira and Athanases (2017).

Disciplinary Literacy Teaching

In this section, we explore disciplinary literacy teaching and how it can be used to support English Learners. The social and problem-based work with texts that enables the critique and production of knowledge is known as disciplinary literacy (Rainey et al., 2020). Disciplinary literacy practices are tools participants use within discourse communities to construct and share knowledge (Kavanagh & Rainey, 2017), and deep learning in the subject areas requires complex literacy skills (Snow & Moje, 2010). According to Moje (2008; 2015), the heuristic for approaching disciplinary literacy includes four Es: engage, elicit/engineer, examine and evaluate. The engage portion views disciplinary literacy as an activity that engages students in disciplinary practices of a focal discourse community, particularly ways of using texts within cycles of inquiry (Rainey et al., 2020). As Kavanagh and Rainey (2017) highlight, all students deserve opportunities to be invited into text-based disciplinary practice insofar as the knowledge

and ways of constructing knowledge of the disciplines are valuable for understanding the world. Disciplinary practice is action oriented; it revolves around human beings trying to solve problems or address questions of curiosity, passion, or urgency (Moje, 2015). Hence, to teach disciplinary literacy, teachers need to involve learners in inquiry that allows the learner to gain insight into how questions are asked and examined and how conclusions are drawn, supported, communicated, contested, and defended and, therefore, need a strong knowledge and practice base for disciplinary teaching (Moje, 2015).

Pedagogical Language Knowledge

For mainstream teachers, this includes knowledge of language directly related to disciplinary teaching and learning. This is where the concept of pedagogical language knowledge comes in. Pedagogical language knowledge refers to the knowledge and skills, including pedagogical strategies, techniques, and tools, that teachers use to support English learners to develop their language proficiency while teaching the core subject area for which they are responsible (Bunch, 2013; Galguera, 2011). For mainstream teachers, pedagogical language knowledge can be construed as knowledge of language directly related to disciplinary teaching and learning and situated in the context in which teaching, and learning take place (Bunch, 2013 p. 307). When teachers are given the chance to explore functions of language within academic settings and observe how language is employed to convey knowledge within classrooms, they can develop a deeper understanding of language (Galguera, 2011). Additionally, by being exposed to the power dynamics and status differences that are inherent in language usage, teachers can begin to construct a more nuanced understanding of language and its

implications for learning (Walqui & Bunch, 2019). As Bunch (2013) argues, pedagogical language knowledge is essential for teachers because it helps them to understand the unique needs of English Learners and how to create learning environments that support their language development. Teachers who possess pedagogical language knowledge, can design instruction that is specifically tailored to meet the needs of students, using strategies such as visual aids, scaffolded instruction, and explicit language instruction that fosters critical language awareness.

Text-based Discussion

Text-based discussions, in which students evaluate evidence and formulate arguments, align with inquiry-oriented instruction (Reisman et al., 2018). When we refer to “discussion,” we are talking about a type of shared inquiry that involves listening and talking about a text - a group of inquirers is presented with a well-chosen text, a focusing question, and a purpose (Parker & Hess, 2001). This work requires that teachers have opportunities to talk with each other over time, to study their own teaching and the teaching of others, to read and question, and to be apprenticed into disciplinary literacy teaching practices (Greenleaf et al., 2001). Teachers need opportunities to learn about students’ experiences, backgrounds, and uses of texts, and they need practice in how to scaffold students’ navigation across every day and content area discourse and learning communities without appearing to suggest that the goal is to move from one discourse community to another (Moje, 2015). As Kavanagh and Rainey (2017) highlight, adolescent literacy instruction requires deliberate text selection, careful planning for specific literacy challenges, and explicit introduction to specialized ways of reading, writing, and reasoning of the academic disciplines.

Instructional Practice in Mixed-Reality Simulations

To provide teachers with opportunities to develop their skills in facilitating text-based discussions, mixed-reality simulations offer a safe and immersive environment that can complement traditional classroom settings. When mixed-reality simulations are conducted in pairs or groups, the shared context and learning environment that mixed-reality simulations afford, hereafter referred to as simulations, allow discovery, and joint construction to occur; and when one learner discovers something new, the partner, often a peer or colleague, will experience this discovery too (Bondie & Dede, 2020). Practice-based teacher education practices offer potentially productive ideas for how preservice teachers can integrate English Learner and content instruction into their practice (Lampert, 2010; Von Esch & Kavanagh, 2018). As the site where knowledge about language development, knowledge about content, and knowledge about instructional methods become inexorably intertwined, instructional practice can be a rich context for candidate learning (Von Esch & Kavanagh, 2018 p. 240). Further, simulations provide teachers the opportunity to develop more granular, specified aspects of teaching practice in a scaffolded environment (Cohen et al., 2020, p. 209). Practice-based theories of teacher learning suggest that teachers would benefit from opportunities to practice in a simulated environment where various aspects of the classroom can be deliberately tailored to support specific learning opportunities and there would be no risk of harm to students (Dieker et al., 2013; Girod & Girod, 2008; Mikeska & Howell, 2020).

Theoretical Framework

We draw on sociocultural theory (Vygotsky, 1978) to ground this work, wherein we view all literate practice as being nested within social and cultural contexts (Rainey et al., 2020; Street,

1984). Further, we use Grossman and colleagues' (2009) seminal work on pedagogies of practice to situate this work within practice-based teacher education and Shulman's (1987) work on pedagogical reasoning to inform how we view processes from content knowledge to teaching practices and strategies (Loughran, 2019; Mansfield, 2019). Our research focuses on the social practices of specific communities, with an emphasis on the development of teachers' pedagogical reasoning (Loughran, 2019; Shulman, 1987) about language for academic purposes (Galguera, 2011). As Grossman (2009) explains, teaching is a complex practice, learned over time, through rigorous and deliberate study combined with thoughtfully orchestrated opportunities to practice. Consistent with a sociocultural view of learning, teachers need assistance within their practice that is responsive to their "professional identities . . . and realized in their interactions with the multiple communities of practice in which they reside" (Russ et al., 2016, p. 403). Pedagogies of enactment are developed through social interaction and are frequently incorporated into novice's preparation through fieldwork and rehearsals (Grossman, 2009). Creating opportunities within teacher preparation that center student sensemaking will help teachers to focus on being responsive (Kavanagh, Metz, et al., 2020). In turn, the process of negotiation between teachers and students will evolve and strengthen as teachers and students' ideas develop and expand (Kavanagh & Rainey, 2017). This study utilizes the pedagogy of practice framework to design the learning cycle which views literacy as a social practice (Street, 1993) and takes up the text-based discussion through the lens that literacy is always practiced in social contexts (Moje, 2008). We posit that teacher education grounded in sociocultural theory and practice-based pedagogies can support preservice teachers as they (1) surface problems of practice within their instruction and (2) attend to language for academic purposes that support English Learners.

Methods

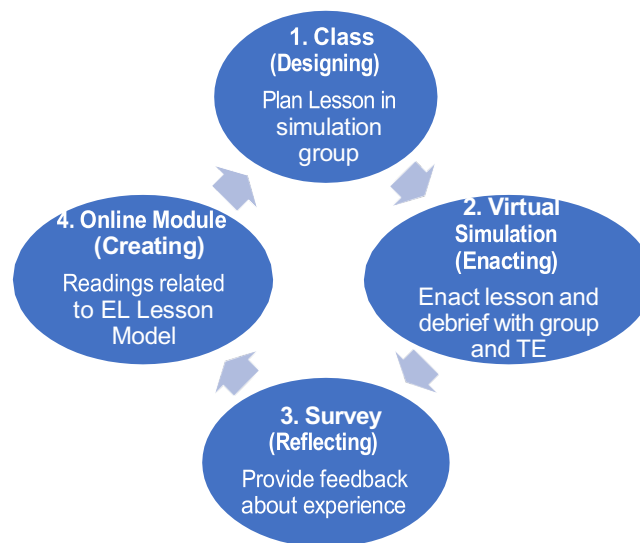
This study takes place during the fifth year of a larger, ongoing five-year professional development mixed-methods study funded by the Department of Education's Office of English Language Acquisition to prepare teachers to serve English Learners and earn an English as a Second Language supplemental certification. Situated within an Instruction and Assessment for Language Learners Course, there were 16 pre-service teachers who participated in the study. This course took place at the beginning of the Covid-19 pandemic, and students had the choice to take the class in-person or virtually over Zoom. Given the two formats for attending class, the course was designed to alternate between online modules every other week, during which students would participate in a series of simulations in small groups. For example, when the in-person class convened on campus, the virtual class completed modules online, and when the virtual class met synchronously on Zoom, the in-person class completed modules online (See Appendix A for course schedule, Appendix B for text, and Appendix C for simulation sequence).

Context

The three simulation scenarios embedded into the course were held virtually on Zoom every other week over the course of six weeks (See Appendix A). Each simulation focused on English Learner instructional practices within the context of literacy, and all the simulations were designed to present the student avatars as fifth graders. The teachers were divided into small groups of 3-4 teachers and a doctoral student, the first author, was the facilitator. The small group size maximized the time each teacher had to practice instructional activities within the simulator. The structure and design of the simulations were adapted from the Amplifying the Curriculum: Designing Quality Learning Opportunities for English Learners lesson model (Walqui & Bunch, 2019). Each of the three simulations utilized the same non-fiction text and aligned with

coursework focused on a different aspect of the learning model: preparing the learners, interacting with the text, and extending understanding (See Appendix B). The learning cycle design was influenced by Walqui and Bunch's (2019) ambitious pedagogy, where they identify four ways teachers can be pivotal in supporting English Learners: First, designing environments and opportunities for students to engage in activity that develops learners' autonomy, agency, and voice within democratic, participatory contexts; second, enacting these plans while at the same time observing how students take the invitations and interpreting evidence from their students as learning takes place; third, reflecting on what is working, what is no longer needed and what assistance must be provided next; and fourth, creating equitable environments in their classes and school with environments that support students' backgrounds, value their contributions, and build on them to advance their multilingualism, interculturalism, and participation in society (Walqui & Bunch, 2019 p. 36-37). Figure 1 depicts the sequence of events that teachers engaged in during the four- part learning cycle, which included classwork and lesson planning, simulation enactment, surveys, and online modules.

Figure 1
PST Learning Cycle



Participants

Participants were 16 graduate pre-service students in an urban university located in the southern United States, who were earning their master's degree in Education. As part of one of the 12 courses in the program sequence, they were enrolled in a course focused on developing strategies for teaching English Language Learner students. The teachers' grade levels and content areas spanned EC-12, ELAR, Math and generalist certification areas (See Table 1).

Table 1
Teacher Demographic Data

	(n = 16)	
	<i>n</i>	%
Gender		
Male	4	25
Female	12	75
Learning Environment		
Face to Face	9	56.25
Remote	7	43.75
Grade Level		
EC-6	7	43.75
4-8	5	31.25
7-12	3	18.75
Undecided	1	6.25
Content Areas		
Generalist	7	43.75
ELA	2	12.5
Math	2	12.5
Undecided	5	31.25

For the virtual simulation enactment portion of the learning cycle, teachers were split into smaller groups based on grade level within their course modality. Table 2 provides information on teacher grade levels, the number of simulations each teacher enacted and the number of debrief conversations in which they participated.

Table 2
Simulation Groups

Pseudonym	Grade level	Small Group	Course Modality	# of simulation enactments	# of debriefs
Lisa	Elementary	1	In-person	3	3
Breda	Elementary	1	In-person	3	3
Camden	Middle	2	In-person	3	3
Kyle	Middle	2	In-person	2	3
Ted	Middle	2	In-person	2	3
Mischa	Secondary	3	In-person	3	3
Erica	Secondary	3	In-person	2	3
Amaya	Secondary	3	In-person	3	3
Sasha	Undecided	3	In-person	3	3
Haylee	Elementary	4	Virtual	2	3
Philip	Elementary	4	Virtual	2	3
Bridget	Elementary	4	Virtual	3	3
Katia	Elementary	4	Virtual	3	3
Isla	Secondary	5	Virtual	2	3
Bria	Secondary	5	Virtual	3	3
Kate	Secondary	5	Virtual	2	3

Research Question

By examining the problems of practice, we sought to gain a deeper understanding of the complex interactions between language and content instruction, and to inform the development of future learning cycles with embedded simulations. Thus, our research was guided by the following question:

RQ1: What problems of practice arise within a text-based discussion focused on supporting English Learners, and how do teachers use pedagogical reasoning to respond to these problems?

Data sources

For this study, we collected and analyzed fifteen thirty-minute simulations of teachers enacting English Learner instructional strategies and the debrief conversations that followed. We draw on over three hours of debrief conversations (post-simulation enactment) between teachers and a doctoral research assistant (See Appendix D for simulation sequence). The recorded simulation enactments were determined in advance by the research team to capture conversations that focused on English Language instructional strategies. The research team identified three

focal instructional strategies from Walqui & Bunch's (2019) proposed lesson design with texts: preparing the learners (building the field), interacting with a text (examining individual components of a text), and extending understanding (connecting understanding to ideas beyond the lesson). The recorded videos captured the teachers approximating these three instructional practices. In addition to the simulations and debrief conversations, we also collected ancillary data, including post-simulation surveys, lesson plans, Zoom chats, class videos and analytic memos.

Data Analysis

Our analysis of the video recordings was guided by our research question, and our analysis emerged in four steps. First, we focused on the debrief conversation after a teacher had enacted the lesson since we were most interested in the problems of practice teachers surfaced in relation to integrating language for academic purposes; therefore, our coding only included the debrief portion of the simulation transcript. The fifteen debrief conversation transcripts were uploaded onto Dedoose Version 9.0.86, a software program used for qualitative data analysis. Second, we coded all episodes of pedagogical reasoning. We utilized Horn's (2007) definition of an episode of pedagogical reasoning (which we will hereafter refer to as "episodes") as units of teacher-to-teacher talk in which teachers identify an issue in their practice. Specifically, episodes, were defined as moments in teachers' interactions where they described issues in or raised questions about teaching practice that were accompanied by some elaboration of reasons, explanations, or justifications (Horn, 2010 p. 46). We pull on Horn's (2015) work to select the length of an episode. These episodes could be individual, single-turn utterances, or they could be multiparty co-constructions over many turns of talk. We decided topical shifts would be the appropriate grain size determined by the switching of conversational topics which would signal

the boundary of an episode (Horn, 2015). Next, we tallied the number of episodes that occurred within each group and across simulations and compared these counts to detect any patterns or differences, following the method described by Miles and Huberman (1994). We then used open coding to identify problems of practice that teachers surfaced (Charmaz, 2014), and problems of practice were coded as specific challenges or dilemmas that teachers faced in their practice (Lampert, 1985; Horn & Little., 2010). To establish that a conversation was conducive to professional learning, we sought evidence that the dialogue did more than simply report on or point to a problem of practice (Little, 2007). After initial coding of problems of practice, we used axial coding to refine our codes through an iterative process and cluster related problems of practice together to gain a nuanced understanding of the data (Boeije, 2010). This method aims to link categories with subcategories and ask how they are related (Charmaz, 2014). Finally, we employed pattern coding to detect similarities within the data and categorized them into thematic groups, following the approach outlined by Saldaña (2021). These thematic groups will be referred to as ‘themes’, and we adopted Creswell’s (2013) definition that they are broad units of information consisting of several codes aggregated to form a common idea.

Findings

First, we examined the frequency of episodes throughout the learning cycle to provide an overview of the distribution of data. The number of episodes that occurred during a simulation session ranged from five to ten depending on the session (see Table 3) and the number of turns of talk steadily increased per episode as the simulation cycle progressed (see Table 4).

Table 3
EPR occurrence

	Simulation 1	Simulation 2	Simulation 3
Group 1	7	5	5
Group 2	7	7	5
Group 3	10	6	5
Group 4	7	6	7
Group 5	6	7	5
Total	37	31	27

The data presented in Table 4 shows that as the simulation cycle progresses, the number of turns of talk per episode of pedagogical reasoning increases, leading to more multiparty conversations. This shift towards fewer episodes but increased dialogue is reflected in the data. For instance, simulation 1 had a total of 37 episodes across all groups, while simulation 3 had a total of 27 episodes across all groups, yet the number of turns of talk typically increased with each simulation. This suggests, as the simulation cycle progresses, the discussion among the group becomes more collaborative, leading to a more cohesive learning experience among the group.

Table 4
Number of Turn of Talk within EPRs

	Simulation 1 TT (Q)	Simulation 2 TT (Q)	Simulation 3 TT (Q)
Group 1	1 (2)	2 (1)	2 (1)
	2 (2)	3 (3)	4 (2)
	3 (2)	8 (1)	7 (1)
	5 (1)		10 (1)
Group 2	2 (2)	2 (2)	3 (2)
	3 (1)	3 (1)	5 (2)
	4 (2)	4 (1)	7 (1)
	5 (2)	5 (2)	
Group 3		6 (1)	
	1 (1)	3 (3)	3 (3)
	2 (6)	6 (2)	5 (1)
	3 (2)	8 (1)	6 (1)
Group 4	4 (1)		
	1 (1)	3 (4)	3 (5)
	2 (2)	4 (1)	4 (1)
	3 (3)	6 (1)	6 (1)
Group 5	4 (1)		
	1 (3)	2 (2)	3 (2)
	3 (2)	3 (3)	4 (2)
	5 (1)	4 (2)	6 (1)
Total			
	1 (7)	1 (0)	1 (0)
	2 (12)	2 (5)	2 (1)
	3 (10)	3 (13)	3 (12)

4 (4)	4 (3)	4 (5)
5 (4)	5 (2)	5 (3)
	6 (5)	6 (3)
	7 (0)	7 (2)
	8 (2)	8 (0)
	9 (1)	9 (0)
		10 (1)

TT = number of turns of talk, (Q) = quantity

Next, we present the themes and subthemes that emerged from our analysis of the data. Problems of practice were categorized into three overarching themes: discourse management, which focuses on managing classroom interactions to promote language learning; language for academic purposes, which emphasizes the development of academic language skills; and engagement and inclusion, which centers on creating an inclusive classroom environment that fosters engagement and participation of all students. These problems of practice are interrelated, and this section will provide an in-depth analysis of the problem of practice themes while discussing how teachers pedagogically reason to unpack them and develop their pedagogical language knowledge.

Facilitation

Facilitation encompasses the skills and strategies employed by teachers to facilitate student learning through language. This involves structuring conversations, asking questions, providing feedback, and managing group interactions. Within this context, three specific problems of practice emerged: balancing challenge and support, responding to student inquiries, and timing and sequencing (See Appendix D). Balancing challenge and support emerged as a skill that encourages students to engage in discussions while providing them with the necessary support to feel comfortable participating. For instance, during the third simulation, Camden, Kyle, and Ted are having a discussion focused on one of the avatar students, Jasmine, who provided brief answers during a discussion. Camden suggests that follow-up questions could be

used to support Jasmine without reducing the complexity of the discussion, while Kyle points out that Jasmine did understand the material, but just didn't use a lot of language. Ted suggests that follow-up questions could be used to support Jasmine without changing the content of the discussion, which highlights the importance of balancing challenge and support for students who may struggle with complex material.

Camden: my wonder and I had this issue last week is that... Two weeks ago, I guess was getting Jasmine to engage more with one- or two-word answers, So I noticed that when you asked her, "How did they get the disease from dogs or hyenas or whatever" she said, contact. So, I think a good follow-up question would've been, "How?" Or just, I think we need to provide more follow-up questions to support Jasmine to do that without reducing the complexity

Kyle: Ted, at the beginning she made a connection. I forget exactly what she said, but she understood the text. Her answer was correct. It's just, she didn't give us a lot of language.

Ted: So, I think Camden, you said follow-up questions? Maybe we could get her to say a little more through questioning to support her without changing the content?

Their reasoning underscores the complex work of providing appropriate support for students without sacrificing the complexity of the task, thereby facilitating their learning, and encouraging their engagement. It also highlights pedagogical language knowledge and how teachers' design instruction to meet the unique needs of their students. Additionally, teachers discussed how best to respond to students' inquiries. In this case, Mischa and Erica are discussing how best to respond to Ava's, an avatar student, question about the difference between wild and domestic dogs. Mischa initially didn't know how to answer the question but recognized that it was a good question that showed Ava was connecting the text with prior knowledge. Erica suggested that in the future, if a teacher doesn't know the answer to a question, they could ask the students to research it themselves and bring back their findings to the class.

Mischa: Oh, yeah. When Ava was curious about the difference between wild and domestic dogs, I thought, "Yeah. That was a good question." I didn't know how to answer it. I was like, "Oh, gosh," but yeah, that was definitely something you could tell that she was connecting the text with prior knowledge.

Erica: Okay. I was just going to add that in the future, even if you didn't know how to explain the difference between a dog and then a hyena, you could also ask the students to research it or look it up on their own time and then bring it back to the class later on, just because they do have iPads, at least in this scenario, and so they have access to the internet and looking stuff up.

Mischa: Oh, yeah, that would give me time to keep the lesson moving too and not getting derailed.

Anticipating student questions and learning to respond to unknown inquiries was a common problem of practice that continued to surface during the debrief conversations. The teachers were able to explain their pedagogical moves with Mischa acknowledging the importance of the student's question and Erica providing a practical solution of asking students to research the answer and share it later, which not only allows for students to take ownership of their learning but also keeps the lesson moving forward. The third problem of practice that surfaced within the discourse management theme was teachers timing and sequencing. The teachers in the conversation are discussing the challenges of transitioning between talking points during instruction. Bria notes that with some age groups, students may fire off multiple comments, making it difficult to transition smoothly between them. Isla also acknowledges that it can be challenging to purposefully transition from answer to answer without shutting students down. Kate agrees, and Bria suggests ways to manage the situation, such as tabling irrelevant questions and assigning them as homework or extra credit activities.

Bria: The only thing I wondered was transitioning between talking points. I noticed that with around this age group that sometimes they're just firing off all these different comments and it's hard to transition between all of it.

That's something that I always wonder, and that was a great example of when that can happen.

Isla: You never know what's going to come out of their mouth. I think that's something I think about is how to purposefully transition from answer to answer and when to redirect, but without shutting students down. I think it's a great thing to practice in this space.

Kate: I agree

Bria: I always struggle with if I answer all the questions then I won't get through the lesson, but I think some ideas that could work would be to table the questions that aren't relevant or say I will get to them later and make it into a homework assignment or extra credit activity.

This conversation highlights the importance of teachers being able to transition smoothly between talking points and manage student questions and comments without disrupting the flow of the lesson. Effective time management and pacing skills are crucial for achieving this, as well as the ability to redirect students without shutting them down. Teachers who are skilled in these areas are better equipped to engage their students, leading to more time for learning. Effective discussion management skills are a core element of teaching. While these skills are not limited to working with English Learners, teachers must manage discussions with an eye towards inclusiveness, which is key to making the discussions accessible. The findings highlight the complex work of providing appropriate support for students without sacrificing the complexity of the task, the importance of anticipating student questions and responding to unknown inquiries, and the need for effective time management and pacing skills.

Language for Academic Purposes

Our second theme coalesced around problems of practice to support language for academic purposes. Our data revealed that teachers focused on scaffolds and supplemental materials to support student language learning for academic purposes. For example, to address the language demands of content, teachers discuss the importance of explicitly teaching

vocabulary and incorporating opportunities for more language output. They also discussed strategies for breaking down complex texts through text deconstruction and providing multiple modes of representation to support English Learners. An example of “text deconstruction” occurred when Bridget wondered if Phillip could have had them go to a specific sentence or part of the chunk to help them answer their questions more effectively. Phillip felt that the text needed to be deconstructed and that there might be a need for more scaffolding.

Bridget: So, the first thing I noticed was the students were very curious and intrigued with all the information that Phillip was sharing. I think they really appreciated all the extra facts that he had related to the text, and it really drove their curiosity. And then I wondered if Phillip could've.....I wonder if Phillip would've had them go to a specific sentence or a part of the chunk that we were looking at, if maybe that would've helped them answer their questions more. Kind of like what Phillip you were talking about right before, when you're asking the question about having them review or whatever. I almost wonder if that would've ended up helping in this simulation or not. That was just, that was my wonder.

Phillip: It felt like they were having... It felt to me that the students were having trouble connecting to the text. Even as they have read it. So, I needed to dial it back to less specific, it felt like it needed to be deconstructed and made me think how much scaffolding is needed.

This excerpt illustrates that two teachers, Bridget, and Phillip, were both attending to the instructional practice of deconstructing a text to make it accessible to the avatar students, which was a key instructional activity emphasized during instructional practice is important for content literacy instruction but also attends to scaffolding that an English Learner might need to access the information. This excerpt further illustrates how the teachers were developing their pedagogical language knowledge through their identification of the function of language in the deconstruction of a text. In the next excerpt, another subtheme emerged around language focused on vocabulary instruction.

Amaya: I wondered about the vocab use with the culprit. You did a good job explaining it, and they got it. It's just... Wondering about being careful with our usage as we're going along the lesson.

Sasha: I think from our readings, the research would argue, you should use the word culprit, and then we should teach that in the context of the text and scaffold it. But I think it's an interesting point to think about when we are teaching, what language are we using and what assumptions are we making about that language?

Erica: Yes, because I think it was Ava that asked what it meant, right? But there might be students who just wouldn't ask that question. So, if we are going to use culprit, I think about what supports, whether it's a graphic organizer or explanation to give, because Ava asked about it, but in a lot of situations the students might not ask.

As illustrated above, the teachers are pedagogically reasoning by reflecting on the use of vocabulary in their lesson. Amaya expresses concern about the careful use of language in the lesson, while Sasha suggests the use of the word "culprit" in context and with scaffolding. Erica acknowledges the importance of providing support for students who may not understand the vocabulary used in the lesson, even if they don't ask questions. The teachers are considering how to effectively use language to support students' understanding of new vocabulary in their instruction, which points to their pedagogical language knowledge development of how to create learning environments that support English Learners. Another problem of practice teachers focused on throughout the simulations when attempting to integrate language for academic purposes was how to connect the students' personal experiences with the text.

The teachers highlighted the importance of providing textual evidence to support their answers and how to connect it back to their lives. Additionally, the teachers emphasized the need to guide students towards finding evidence in the text to support their responses and Katia acknowledges the importance of bridging connections between the text and students own lived experiences.

Katia: I did really like that Ava asked the question about the difference

between wild dogs and domestic dogs because like you said, Sarah, I feel like that was a good connection between the text and everyday life so that they could kind of imagine and connect it with their regular dogs kind of running around and how they might be able to get the virus and how it affects them.

Bridget: Yeah. And you had them identify the animals within the text with the highlighting. And I just wonder going forward when we think about interacting with the text, how we can further have them provide textual evidence with their responses to and get in the habit of going back to the text, finding the evidence to support their answers when they're explaining.

Haylee: I was going to ask Jasmine and then I guess the timing was almost over... I was almost done. Can you show me where you found the hyenas in the text, where the vet said that, but I think I got nervous and forgot.

Connecting students' prior knowledge to the text helps them develop a deeper understanding of the text and strengthens their ability to make connections between what they already know and the new information they are learning. Katia, Bridget, and Haylee engaging in conversation around how to connect students to the text, allowed them to evaluate their instructional decisions, consider a different approach and plan for future instruction. Teachers also reasoned about how to increase language output as evidenced by Isla, when she said, "I think all of the students maybe except for Ava, could have had a little bit more language output, so I wonder, how they can produce a little bit more language?" and Katia answered "I was wondering that too during this simulation and thought it would be a good idea to provide a graphic organizer or sentence starters to help increase comprehensible output." By reasoning about how to increase language output, teachers are addressing one of the key challenges of academic language instruction. Academic language is not only about comprehending complex texts, but also about producing and using language to communicate effectively. Providing students with tools such as graphic organizers and sentence starters can support them in expressing their ideas more clearly and confidently, which can ultimately lead to greater academic participation. The teachers' discussion

of this issue shows their commitment to meeting the diverse needs of their students and providing them with the best possible learning experience. The last subtheme that emerged during the debrief conversations was the teachers' concern about how to best strengthen students' speaking fluency. They recognized that some students needed more support in pronunciation, and they discussed various strategies, such as providing more opportunities for student talk, correcting incorrect grammar and pronunciation, and incorporating more collaborative activities. The teachers also recognized the importance of building students' confidence in speaking and providing a safe and supportive environment for students to practice their speaking skills. For example, Camden, Kyle, and Ted discuss when to correct students' mispronunciation.

Camden: Yeah. I also noticed Dev was struggling when he was reading and I also kind of think she was trying so hard to focus Ava, which is great, but I think it's also sometimes hard when you have other students that you have to also keep engaged. So, it's like a, definitely a balance. And I was wondering if a teacher should correct mispronunciations or miswords while it's happening or do you wait for the student to finish and then you kind of say oh, when you read 1994, I noticed that you said 19 nine four. I was just wondering when is the best time to do that?

Kyle: I think it depends on the student. Like some students, if you correct them in the moment, they'll totally shut down and other students would rather have you correct them in the moment. So, it's something that you do you need to know the students for.

Ted: Yeah, definitely. I think it's a balancing act, right? Depending on the purpose and how much you have to get through and other there's a lot of factors that go into it. So, I don't think it's a one size fits all and obviously we don't want to be shutting students down and having them get through it, but we also don't want them struggling and drowning.

The teachers reasoning centered around the challenge of balancing correcting student mispronunciations and keeping students engaged during reading activities. They agreed that the timing of correction depends on the individual student and the situation, and it is important to strike a balance between correcting errors and not discouraging students. Overall, teachers

focused on scaffolds and supplemental materials to support language learning for academic purposes. They reflected on the use of vocabulary and language in their lessons and considered how to effectively use language to support students' understanding of new vocabulary.

Additionally, they emphasized the need to guide students towards finding evidence in the text to support their responses and connect their prior knowledge to the text. Ultimately, they engaged in conversations around how to increase language output and plan for future instruction. They considered instructional practices such as deconstructing a text to make it accessible to English Learners and provided multiple modes of representation to support them. In sum, the teachers pedagogically reasoned about language for academic purposes to support their students' learning.

Engagement and Inclusion

The third dominant theme that arose from the data was focused on engagement and inclusion. Within this theme, three problems of practice prompted pedagogical reasoning: creating an inclusive environment, cultivating student interests, and encouraging student participation. For instance, during their second simulation, Lisa and Breda engaged in pedagogical reasoning by reflecting on their teaching practices within the simulation to create a more inclusive learning environment. They focused on addressing the needs of a student who was being unresponsive in class. First, Lisa notices Jasmine's lack of participation and begins to reflect on the possible reasons for her behavior. She considers that Jasmine may be uncomfortable with the new experience and wonders how they can engage her more and make her feel more welcome. Breda adds to the conversation by suggesting that they need to determine whether Jasmine's lack of participation is due to shyness or not understanding the material. She acknowledges the challenge of calling on shy students and expresses concern about making them feel uncomfortable. Lisa then highlights a positive teaching strategy that Breda used by giving an

opportunity for students to respond before calling on Jasmine.

Lisa: I also noticed in the last class, when we met the avatars for the first time, I'd observed that Jasmine wasn't participating. Yeah, my notice today was that she wasn't very talkative, and she required Breda to call on her. Then, I was wondering if she either just felt uncomfortable because it was a new teacher and it was a new experience and everything like that. Then, I also wondered how we could engage her more and try and make her feel more welcome and more willing to participate.

Breda: No, I think it's hard, too, because you don't know, with the shyer students, they probably don't like being called. I felt bad asking her to talk because I don't think she wanted to. So, knowing whether she's being shy or she's not understanding the material, I think we need to figure out as well.

Lisa: I did like how you gave an opportunity for them to respond before calling on her, though. That way, she was able to listen to Dev a little bit, because he seemed very enthusiastic and very willing to share. I wonder if maybe through our sessions, that'll increase her confidence a little bit.

This excerpt highlights how the teachers are reasoning about their teaching practices, considering the needs of the students, and exploring strategies for creating an inclusive learning environment. The teachers are specifically focused on finding ways to make the classroom environment welcoming and comfortable enough to encourage a hesitant student to participate. At the same time, they are aware of the challenge of identifying the underlying reasons for the student's limited participation. By discussing this problem of practice, it highlights their awareness of the importance of fostering a welcoming and comfortable learning environment that promotes student engagement and participation. Maintaining their focus on engagement and inclusion, the teachers came across a problem of practice concerning effective methods to encourage student participation. For instance, Amaya and Sasha reflected on different strategies to encourage student participation, including breaking down questions into smaller parts and finding a balance between asking specific students questions and engaging the whole class. They also discussed the idea of waiting longer to give students more time to participate and noticed Jasmine became

more engaged when the topic was more relevant to her life. Further, they noticed that providing relatable examples can encourage more comprehensible output from students.

Amaya: Yeah, I definitely think I noticed, right after I did this two-step questions, I was like, oh, that was probably too much. I should have broken it up into two separate parts. So, I definitely think that was probably overwhelming for them. Then, I agree, I think Jasmine obviously seemed more engaged when it was more relevant to her life and everything. But, with that being said, I felt like I wanted to try and balance it and not just only ask her questions, I didn't want to seem like I was singling her out and saying, oh, I know you like this, so let me keep hitting this point. I agree, I think there just needs to be a balance with that.

Sasha: Yeah, I noticed Jasmine's responses got longer as well, from just starting to say one word. When you related to her, Amaya, she started to give more back. Kind of How we all said. Then I said I wonder; Dev is always the first person to raise their hand. I wonder if we wait longer, I know in our classes they talk about wait time, if Ava and Jasmine will start raising their hand. I know it's hard though, because we only have four minutes, so we can't wait that long. But I was just wondering. That was my wonder.

Amaya: Oh, that's a good point.

During the simulation, Amaya and Sasha engaged in pedagogical reasoning to find ways to encourage student participation. They reflected on different strategies, including breaking down questions into smaller parts and balancing questions between different students. They also discussed the idea of wait time to give students more opportunity to participate. Notably, they found that providing relatable examples could increase student engagement and output, as demonstrated by Jasmine's longer responses when the topic was relevant to her life. Overall, the simulation prompted Amaya and Sasha to think critically about how to foster a more inclusive and engaging classroom environment.

Additionally, throughout the simulation enactments, teachers consistently brought up the problem of practice of cultivating student interests within a lesson. Tad

highlighted the importance of building on students' interests to keep them engaged, stating "Oh, yeah. When Ava was saying, 'Yeah, I love Africa. I'd like to be there,' I was wondering, I know we're limited with time for seven minutes, but if this was a normal hour lesson, I wonder if it'd be interesting to keep building on that a little. Maybe get the other students interested and be like, 'Oh, that would be really cool,' to keep that interest building up." Bria also observed that relating the lesson to students' individual experiences and interests can hook learners and encourage their contributions. She added that she wondered about the potential impact of providing students with more knowledge about the topic to further engage them. According to Bria,

"Phil did a great job of just involving each student and asking them individual questions as well as kind of peeking their interests. Ava really wanted to go on a safari, and she got excited when he had asked about that. And Jasmine and Dev both going to the zoo and relating to them about that experience. I think that's a great way to hook the learners, because they're able to really contribute with what they know. And then my wondering was just if they had more knowledge about Africa, which I know they do, and you didn't get very far and you're about to continue to ask those questions, but that was my wondering."

By incorporating students' interests and experiences into the curriculum, teachers can build connections between students and the content, thereby increasing student motivation and engagement. Through the simulation enactments, the teachers recognized the significance of students' interests and discussed strategies to incorporate them into their teaching practices. These discussions highlight how teachers prioritized creating an engaging and inclusive environment in their discussions to foster language for academic purposes. In addition to prioritizing an engaging and inclusive environment, the teachers also recognized the role of student voice and interest in fostering such an environment. They understood that incorporating student interests and experiences into the lesson can help to establish a sense of belonging and

motivation for English Learners while simultaneously contributing to building a positive classroom culture where students feel seen, heard, and valued.

Discussion

We began this research by studying teacher conversations within the context of a semester-long class for pre-service teachers focused on facilitating academic language use through text-based discussions in mixed-reality simulations. Our research was prompted by the difficulties associated with combining language and content instruction, which has been previously highlighted in the literature (Bunch., 2013; Von Esch & Kavanagh, 2018). To address this challenge, we focused on designing learning activities that aligned with the principles of collaborative learning environments, as articulated by Vygotsky's sociocultural theory. Providing spaces within teacher preparation that encourage teachers' opportunities to reason about their pedagogical choices can help teachers develop skills to support text-based discussions and pedagogical language knowledge. Our data analysis revealed that all five groups of teachers engaged in pedagogical reasoning around the integration of language for academic purposes with the text-based discussion: henceforth, demonstrating the utility of mixed-reality simulations as a tool for practicing language integration with content. The identified episodes of pedagogical reasoning highlighted critical language integration challenges, including vocabulary development, text analysis, text-to-self connections, increasing language output, and improving speaking fluency. These skills are often considered essential for active participation in academic discourse across content areas (Echevarria et al., 2008), and their recognition by teachers is encouraging for enhancing teacher awareness and developing pedagogical language knowledge for

teachers. Additionally, the data yielded three central themes: facilitation, academic language skills, and inclusive and engaging learning environments. These themes underscore the teachers' focus on designing instruction that meets the unique needs of their students (Bunch, 2013), which ultimately shows how their pedagogical language knowledge was changing. These findings are consistent with previous research by Galguera (2011) and Bunch (2013), which suggest that teachers can develop skills to support English Learners in developing their language proficiency through content. The study also demonstrates how debrief conversations after simulations can support teachers in identifying and addressing language integration challenges. Through discussing problems of practice that emerged during the simulations, the teachers began to develop a professional knowledge base that revealed the intricacy and complexity of teaching, ultimately, making visible the demanding work of teaching (Ball & Cohen, 1999).

In sum, the study demonstrates how teachers engaged in pedagogical reasoning as a group following simulations to support academic language use. They prioritized the creation of an engaging and inclusive learning environment, recognizing the importance of incorporating student voice and interest in fostering an inclusive environment while also attending to the role facilitation plays in developing academic language skills. Furthermore, this study illustrates that teachers were able to enhance their pedagogical language knowledge by placing an emphasis on creating an inclusive and captivating learning environment for their (avatar)

Future Directions

Mixed-reality simulations offer a promising approach to assist teachers in

acquiring the skills required to integrate academic language skills with content instruction for English learners. Simulations provide teachers with a safe and low-stakes environment to practice and refine their teaching strategies, enabling them to develop the awareness and skills necessary to support this population effectively. Research has consistently emphasized the importance of teacher awareness of their students' linguistic and academic needs when integrating language and content instruction for English Learners (Estapa, 2016). By integrating simulations into teacher preparation programs, teachers can gain valuable experience in designing and delivering instruction focused on academic language use for English Learners. . One of the advantages of using simulation-based training for teacher development is the ability to observe the development of teaching practices much more quickly than in traditional classroom settings. With traditional methods, collecting data on teachers. Another benefit of using simulation-based training for teachers is the ability to iterate on interventions and observe associated shifts in practice. Researchers can create multiple scenarios with different levels of complexity and provide feedback to teachers, allowing them to practice and refine their skills in a safe and controlled environment. This iterative approach helps teachers build confidence and competence in their instructional practices, which can lead to more robust instructional practices. To further enhance the effectiveness of simulation-based training, future research should focus on identifying the most effective instructional activities that are suited for a simulation context and determine the sequence in which to structure them. This will help ensure that teachers are exposed to a range of effective strategies and are able to practice and refine them in a logical sequence. In addition, determining the optimal frequency and length of time

for pre-service teachers to practice simulations would help ensure they gain the skills necessary to successfully implement these strategies while also avoiding unnecessary time and resource expenditures. Finding the right balance between frequency and length of practice is important to ensuring that pre-service teachers have the opportunity to practice and refine their skills without overburdening them with excessive training demands.

. By addressing these questions, future research can refine and improve the use of mixed-reality simulations in teacher preparation programs, better supporting teachers in effectively integrating academic language skills with content instruction for English Learners.

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Appendix A

Schedule

In-person learners meet on campus on these days. Virtual learners meet via Zoom on these days.

Date	Module Due	Group Discussion	Topic
August 25 th		A	Introduction to Teaching Language Learners
September 1 st	1		
September 8 th	2	B	History & Law of ESL Education
September 15 th	3		
September 22 nd	4	C	Reading & Writing
September 29 th	5		
October 6 th	6	D	Listening & Speaking (Simulation 1)
October 13 th	7		
October 20 th	8	E	Structure of English (Simulation 2)
October 27 th	9		
November 3 rd	10	F	EL Assessment & Achievement Across the Curriculum (Simulation 3)
November 10 th	11		
November 17 th	12	G	Student Diversity & Partnering with Families
November 24 th	13		
December 1 st			NO CLASS
December 8 th			NO CLASS—Reading Day
December 15 th			NO CLASS—Final Exam Reflection due by midnight.

Appendix B



Name: _____ Class: _____

A Lifeline for Lions

By Pamela S. Turner
2016

In 1994, a concerning number of lions began to die in a wildlife park in Africa, known as the Serengeti. In this informational text, Pamela S. Turner discusses the cause of the lions' deaths and how people responded to the situation. As you read, take notes on the actions that were taken to end the rise in lion deaths across the Serengeti.

- [1] All over the Serengeti, the lions were in trouble.

Tourists in a hot-air balloon were the first to notice. As the tourists were flying low over the savannah,¹ they spotted a big cat lying on the ground. This lion wasn't lazing around, as lions do when they are not hunting. It was shaking and shivering.

The tourists called the park veterinarian, Dr. Melody Roelke. She watched the lion, but didn't know what was wrong.

The Serengeti is a large wildlife park in Tanzania where no hunting is allowed. The Serengeti might seem like a safe place, but wild animals face dangers other than guns. In this case, the danger was disease.

- [5] Lions began to die all over the park. "After ten days, it was clear something extraordinary² was going on," says Dr. Craig Packer, a biologist at the University of Minnesota. He has studied lions for 25 years. "We had no idea what it was, and we were afraid we might never know."³



"Lions like this one were threatened by a disease called distemper," by Craig Packer is used with permission.

Usually, veterinary science focuses on the kinds of animals that are most important to people—pets and livestock.³ Wildlife diseases are not well understood. Dr. Packer and Dr. Roelke sent blood and tissue samples from dead lions to experts in different countries. One expert was able to solve the mystery. The lions were dying of distemper, a disease commonly found in pet dogs.

1. a grassy land, usually in Africa
2. **Extraordinary** (adjective): very unusual
3. farm animals



Small but Deadly

Distemper is caused by a virus. (Viruses cause many diseases, including measles, polio, and the common cold.) Sometimes an animal's body can fight off the distemper virus.

But if it can't, the virus invades the animal's nervous system.⁴ Distemper can cause fever, shaking, and finally death.

In 1994, just before the distemper outbreak, there were an estimated three thousand lions in the Serengeti. "Over ninety percent of the Serengeti's lions were infected," says Dr. Packer. "About one thousand lions died." Many other animals also died — leopards, hyenas, wild dogs, and bat-eared foxes.

- [10] How could a wild lion or leopard catch a disease from a pet? Serengeti National Park is huge — larger than the state of Connecticut — but there are farms and villages all around it. In those villages and on those farms are about thirty thousand dogs.

The disease is spread like a cold from dogs to wildlife. "We think hyenas are the key," says Dr. Packer. If a hyena looks for food in a village garbage dump, it may come into contact with an infected dog. Then the hyena may take distemper back into the park.

"Hyenas move over large distances and hang out around lions' kills," Dr. Packer says. From the hyenas, the distemper probably spread to lions and other animals.

Lion Lovers Respond

When people heard about the sick and dying lions, offers of help poured in from all over the world. Major funding came from the World Society for the Protection of Animals and several companies.

"We began vaccinating dogs around the Serengeti against distemper," says Dr. Packer. "That was the beginning of Project Lifelion." Why vaccinate dogs instead of the lions themselves? "It is a lot easier to catch and vaccinate thirty thousand dogs than three thousand lions," explains Dr. Packer. "Many lions are very shy, and live in remote⁵ areas. And vaccinating lions would do nothing for the other animals at risk — hyenas, leopards, wild dogs, and foxes."

Healthier Pets

- [15] Project Lifelion has been vaccinating dogs around the Serengeti since 1995. Before Project Lifelion, the Tanzanian Veterinary Service took care of cattle, goats, and sheep, but not pets. With funding from Project Lifelion, the veterinarians now offer free distemper shots for dogs. They also give rabies⁶ vaccinations. Although people can't catch distemper from dogs, they can get rabies.

4. the system of nerves in your body that sends messages for controlling movement and feeling between the brain and other parts of the body

5. **Remote (adjective):** far away from other people, houses, cities

6. a disease that causes abnormal behavior and death in humans when untreated



"Local people are happy with the program," says Dr. Packer. "We're saying, 'If you have a dog, let's make it a healthy dog.' We tell them it is for the lions, and that is OK, too. They know lions bring tourists, and tourism brings jobs."

A Circle of Protection

Project Lifelion aims to encircle the Serengeti with a ring of vaccinated dogs. This should prevent any future distemper outbreaks. New dogs are born or move into the area every year, so Project Lifelion will need to continue as long as lions roam the Serengeti.

The lions are now doing well — very well. Only three years after the terrible distemper outbreak of 1994, the lion population had rebounded⁷ to three thousand. Today, there are about four thousand lions. "There seem to be more lions than ever," says Dr. Packer. "The Serengeti is still a rich and robust⁸ place."

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7. **Rebound** (verb): to recover from a setback
8. **Robust** (adjective): strong and healthy

Appendix C

Simulation Sequence

Simulation 1 Preparing the Learner		Simulation 2 Interacting with the Text		Simulation 3 Extending Understanding	
5 min	PST 1 – Hook the learner	7 min	PST 1 – Deconstruct or focus on a chunk/part of text	7 min	PST 1 – apply newly gained knowledge to novel situations or use it to problem-solve
4 min	Debrief	7 min	Debrief	7 min	Debrief
5 min	PST 2 – Focus the learner	7 min	PST 2 – Reconnect chunk to whole text	7 min	PST 2 – connect ideas learned to ideas outside the text
4 min	Debrief	7 min	Debrief	7 min	Debrief
5 min	PST 3 – Activate Prior Knowledge				
4 min	Debrief				

Appendix D

Codebook of Emergent Themes Identified for Problems of Practice

Discourse Management		
Code	Definition	Example
Balancing challenge and support	Providing opportunities for students to learn and grow by challenging them to stretch their abilities while also providing support and feedback	“So I noticed that when you asked her, "How did they get the disease from dogs or hyenas or whatever" she said, contact. So I think a good follow-up question would've been, "How?" Or just, I think we need to provide more follow-up questions to support Jasmine to do that without reducing the complexity.”
Responding to Student Inquiries	Providing feedback to students' questions or comments during discussions.	“I kept forgetting what I wanted to say. I think I have a habit of planning it out and then not quite knowing what to do if something falls through in the plan or if I get a response that I wasn't expecting.”
Timing & Sequencing	Structuring and pacing instruction to promote learning and engagement among students.	“And then the only thing I wondered was transitioning between talking points. I noticed that with around this age group that sometimes they're just firing off all these different comments and it's hard to transition between all of it. That's something that I always wonder, and that was a great example of when that can happen.”
Language for Academic Purposes		
Building Vocabulary	Building vocabulary knowledge through explicit instruction on word meaning as well as strategies for learning and using new words in context.	“my wondering, which is for everyone going forward, is what if we already come up with a list of words that are already defined, so we don't have to stumble over the word 'prevent' and it's very common knowledge, but it would just be easy to glance over and know, prevent, yes, that's exactly what it is if we go over the word meaning prior to the activity, and then be able to say, "Prevent is to....”
Deconstructing Text	Breaking down a piece of writing into parts.	“I wonder if Phillip would've had them go to a specific sentence or a part of the chunk that we were looking at, if maybe that would've helped them answer their questions more.”
Connecting to Text	Making connections between prior knowledge and the text.	“I wonder what would've happened if Brianna would've tried to refocus Ava back to the text and be like these are good questions, but we're going to focus on reading this if she would've taken that feedback or if she would've shut down.”
Increasing Language Output	Practicing using language in meaningful ways.	“And then Jasmine was still just giving the one word answers. And I think all of the students maybe except for Ava, could have had a little bit more language output. So I wonder, I wonder how they can produce a little bit more language.”

Strengthening Speaking Fluency	Producing coherent and cohesive speech, using appropriate grammar, vocabulary, and pronunciation.	“And I was wondering if a teacher should correct mispronunciations or miswords while it's happening or do you wait for the student to finish and then you kind of say oh, when you read 1994, I noticed that you said 19 nine four. I was just wondering when is the best time to do that?”
Engagement and Inclusion		
Creating a welcoming environment	Creating an atmosphere where students feel comfortable, safe, and included.	“My notice today was that she wasn't very talkative, and she required the teacher to call on her. Then, I was wondering if she either just felt uncomfortable because it was a new teacher and it was a new experience and everything like that. Then, I also wondered how we could engage her more and try and make her feel more welcome and more willing to participate.”
Cultivating student interests	Encouraging students to pursue their interests and incorporating them into the lesson.	“When Ava was saying, "Yeah, I love Africa. I'd like to be there." I was wondering, I know we're limited with time for seven minutes, but if this was a normal hour lesson, I wonder if it'd be interesting to keep building on that a little. Maybe get the other students interested and be like, "Oh, that would be really cool," to keep that interest building up.”
Encouraging student participation	Encouraging students to engage in the lesson and be active learners.	“Maybe in those situations test out a think pair share activity or small group discussions that maybe make her feel more comfortable talking privately, and then inspire her to respond to the class afterwards.”

Chapter IV: Looking Back and Moving Forward: Pre-service Teacher Noticing Across Mixed-Reality Simulations

Supporting teachers to develop their noticing skills is seen as a promising approach to promoting effective classroom instruction while helping teachers to recognize and interpret critical classroom interactions (Jacobs et al., 2010; van Es & Sherin, 2008). Drawing on literature highlighting the importance of noticing in teacher practice (Amador et al., 2021; van Es et al., 2017) and the potential of simulations as a tool for teacher development (Dieker et al., 2015; Dotger, 2015; Peterson-Ahmad, 2018), this study aims to examine pre-service teacher noticing across connected mixed-reality simulations. The study centers on examining what teachers notice about instruction and how their observations shift across a series of simulations. Specifically, I focus on four pre-service teachers who are learning to facilitate text-based discussions aimed at promoting academic language use for English Learners. By analyzing the debrief conversations, I gain insights into what draws teachers' attention, how they interpret what they notice, and how they make decisions about how to respond. The analysis suggests that pre-service teachers can develop noticing skills through repeated exposure to simulations, as they provide a context for discussing past, present, and future instructional decision-making. The paper concludes by suggesting that a series of connected simulations can assist pre-service teachers in developing their capacity to identify and refine instructional practices and explores the implications of the connected mixed-reality learning cycle design and the potential of simulations as a tool for supporting teacher noticing. This study extends previous research on the use of mixed-reality simulations as a tool to support teacher learning and highlights the value of connected simulations for supporting the development of teacher's noticing.

Introduction

To engage students with ambitious learning goals, teachers must present them with challenging academic material, foster their capacity to construct their own knowledge, and facilitate opportunities for productive discourse (Darling-Hammond, 2020; Grossman et al., 2009). Responsive teaching is an instructional approach that prioritizes students' authentic contributions to the learning process and involves teachers making instructional decisions in response to students' ideas and ways of participating, while knowledge is negotiated collaboratively between teachers and students through dialogic interaction (Hammer, Goldberg, & Fargason, 2012; Kavanagh et al., 2020). Pre-service teachers who lack opportunities to practice responsive teaching may struggle to develop their instructional skills, leading to less effective teaching practices and less student learning (Grossman et al., 2009; Kavanagh et al., 2020; Lampert et al., 2013). Therefore, pre-service teachers need opportunities to practice responsive teaching in a safe, controlled environment with the opportunity for discussion and collaboration to identify and develop effective instructional practices (Lampert & Graziani, 2009). Mixed-reality simulations offer pre-service teachers a controlled environment to practice responsive teaching, which aligns with Lampert and Ball's (1998) concept of rehearsal — the process of practicing and refining instructional strategies and techniques in a safe environment. As noted by Dalinger et al., (2020) and Mikeska & Howell (2020), mixed-reality simulations have become a popular tool in teacher training. In the context of teacher education, simulation rehearsals provide pre-service teachers with a safe and supportive environment to practice their teaching skills without negatively impacting student learning (Gundel et al., 2019). During a simulation rehearsal, teachers can practice different teaching techniques, receive feedback, and refine instructional strategies in a low-stakes setting. Since professional learning is most effective

when it is ongoing and not isolated (Guskey & Yoon, 2009), this study situates noticing within the context of a course focused on supporting English Learners. The focus of this research is to investigate how connected simulations aid pre-service teachers in improving their noticing skills. This is accomplished through a qualitative case study design, which will involve analyzing the debriefing conversations of four pre-service teachers who participated in three simulations as part of a semester-long course. This paper is positioned within the frameworks of situated learning theory (Lave & Wenger, 1991) and sociocultural theory (Vygotsky, 1978), followed by a review of relevant literature on noticing (Amador et al., 2021; Sherin & van Es, 2005; van Es & Sherin, 2021) and the potential of simulations as a tool in teacher training (Cohen et al., 2020; Gundel et al., 2019; Mikeska & Howell, 2020). The paper then proceeds to describe the research design and methods, including data collection techniques and analysis procedures. Finally, the study's findings are presented, and their implications for teacher education programs and future research directions are discussed.

Theoretical Framework

Situated learning theory suggests that learning is most effective when it takes place in authentic contexts, where learners are actively engaged in meaningful activities (Lave & Wenger, 1991; Wenger, 1998). The concept of a situated view emphasizes that teachers' knowledge is shaped by social, cultural, and historical factors (Greeno, 1998; Resnick, 1987) To examine teacher knowledge, this study's design and analysis examine the ways in which knowledge and practice are influenced by the context in which they occur (Horn, 2010; Putnam & Borko, 2000), particularly through interactions with other teachers during debrief conversations (Daniel et al., 2013). Research on noticing suggests novice teachers experience a higher cognitive load compared to expert teachers, which can make it challenging for them to

prioritize critical details at specific moments in time (van Es & Sherin, 2002). For instance, novice teachers appear to attend, at least initially, to “low hanging fruit” in classroom interactions, such as student behavior and management, rather than focusing on what such behavior indicates about the internal processes of learning and cognition on the part of the student (Estapa, 2016). Therefore, simulation rehearsals that provide meaningful opportunities for pre-service teachers to practice noticing pedagogical practices, such as classroom discussions, can be particularly beneficial (Gul et al., 2020; Lampert et al., 2013; Lew et al., 2021). Further, research on noticing focuses on the differences between novice and expert teachers in learning to perceive, to conceptually organize, and to attend to classroom interactions in effective and efficient ways (Sherin & Star, 2011; van Es & Sherin, 2002). Emphasis is placed upon teacher situation awareness (Sherin & Star, 2011) and the ability to notice, to accurately interpret, and to effectively respond to relevant details amidst an array of possible choices. By participating in simulation rehearsals, teachers can gain experience implementing instructional strategies that support language use while noticing and interpreting ways in which language and culture shape student thinking and behavior (Lew et al., 2021). This aligns with sociocultural theory, which emphasizes the importance of social and cultural factors in the learning process. According to Vygotsky (1978), learning is a socially mediated process, and individuals construct knowledge and meaning through their interactions with others. In the context of a course preparing teachers to work with English Learners, this theory suggests that developing teachers’ noticing skills should involve opportunities for collaboration and social interaction (Butler & Schnellert, 2012; Dobber et al., 2014). Observing and analyzing teaching within a community of practice can foster a shared understanding among pre-service teachers of the complex ways in which language is used to support English Learners (Daniel et al., 2013; Hume, 2012; Sim,

2006)..

Literature Review

In this section, I provide a literature review on noticing in practice-based teacher preparation, including an overview of two common frameworks for defining noticing, an examination of conducive contexts for developing noticing, and a preview of research on mixed-reality simulations for cultivating noticing. The ability to attend to and reason about teaching and learning, as highlighted by Sherin and Jacobs (2011), is the foundation of noticing, and is essential for teachers to become critically reflective practitioners. By honing this skill, teachers can effectively observe and analyze their students' actions, reason about their ideas, and make informed decisions about how to proceed with a lesson (Cohen & Ball, 1999). Teaching is a complex profession, and opportunities for teachers to observe their practice and reflect on their decisions strengthen their ability to recognize and comprehend the learning opportunities in the classroom while developing the skills to respond effectively (Darling-Hammond, 2008; Dewey, 1933). Developing noticing skills allows educators to pause, discern the subtleties of teaching, and reflect on their observations, which informs their instructional decisions (van Es, 2011). Ultimately, refined noticing skills can support teachers to enhance and improve their instructional practice (Stanhke et al., 2016; van Es, 2011).

Teacher Noticing

Observing student thinking and classroom interactions is a common aspect of teaching, and noticing is a promising construct that contributes to efforts to make explicit the work of teaching and explore how teachers process complex instructional situations (Jacobs et al., 2010). Building on the concept of professional vision, which involves observing and interpreting classroom events (Goodwin, 1994), professional noticing focuses on how teachers make sense of

what occurs during instruction and how they plan to respond (Sherin, 2011). According to recent research, noticing - which involves attending to students' thinking - has been shown to be an effective approach for improving the pedagogical and content knowledge of both practicing and prospective teachers (Jacobs et al., 2010). Over the last decade, two noticing frameworks have been prominent in the literature: The Learning to Notice Framework and the Professional Noticing Framework (Amador et al., 2021). van Es and Sherin's (2008, 2021) Learning to Notice Framework defines professional noticing as a process that involves (a) identifying what is noteworthy in a teaching situation (attending), (b) using what is known about the context to reason about the situation (interpreting), and (c) making connections between specific events and broader principles of teaching and learning, which also includes the creation of interactions for the purpose of gaining access to additional information, in this case about student thinking (shaping). The Professional Noticing Framework by Jacobs et al. (2010) builds on van Es and Sherin's original framework by including the interpretation of students' thinking and decision-making about how to respond. To clarify, shaping and decision-making as a component of noticing are distinct in their form and purpose. While Jacobs et al., (2010) describe decision-making as a teacher's reasoning process to determine a suitable response based on their understanding of student thinking, shaping involves immediate interaction between teachers and students. Further, "deciding how to respond" is a component of noticing where teachers determine their subsequent instructional moves, with the aim of improving student's thinking (Jacobs et al., 2010; Smith and Sherin, 2019). For this article, I view teacher noticing as: 1) attending to instructional practices, 2) interpreting it, and 3) determining how to respond, based on analyzing the instructional practice or relating it to broader principles of teaching and learning. This study does not focus on shaping (van Es & Sherin, 2021), which refers to the

immediate interaction between teachers and students. Instead, it examines the conversations among teachers about their noticings of instruction.

What Contexts Support Noticing for Teachers?

Studies on noticing have examined the practice across various stages of teachers' professional development, from initial teacher preparation coursework to ongoing professional development opportunities for practicing teachers (Amador et al., 2021; Huang & Li, 2012). In their literature review on noticing, Amador et al., (2021) focused on prospective, pre-service teachers, as they typically have less knowledge and skill than experienced teachers and would benefit from opportunities to observe their own practice. Research has shown that noticing is a skill that can be cultivated through practice (Ivars et al., 2020; Jacobs & Spangler, 2017), as demonstrated by studies that have shown teachers' noticing ability can be enhanced in a short time frame, such as a single semester (Amador, 2021; Star & Strickland, 2008). While noticing has been utilized in various settings, including educator preparation programs, professional development workshops, and research studies, it has primarily been used in educator preparation programs to support novice teachers in developing their ability to observe and interpret classroom interactions, often through the use of videos (Estapa et al., 2016; Jacobs & Morita, 2002; van Es & Sherin, 2008). Video-based reflection has been the most common medium for noticing, enabling teachers to watch videos of their own or other teachers' teaching practice to reflect on their teaching and notice aspects of their practice that they may not have otherwise recognized (van Es et al., 2017). Two of the most common ways video has been utilized to help teachers notice are through video clubs (Luna & Sherin, 2017; Sherin & Han, 2004; van Es & Sherin, 2008; Walkoe, 2015) and lesson study (Amador & Carter, 2016; Lee & Choy, 2017). However, researchers have also utilized student work samples (Dick, 2017; Gupta et al., 2018)

and, more recently, simulations (Kamhi-Stein, 2020; Lew et al., 2021). In summary, noticing frameworks have been primarily utilized within teacher professional learning contexts to refine teaching practices through video-based reflection and analysis (Amador et al., 2021).

Mixed-Reality Simulations as a Context for Noticing in Teacher Education

Increasingly, educator preparation programs are using mixed-reality simulations, hereafter referred to as simulations, to support and train teachers in learning how to enact ambitious instructional activities (Dalinger et al., 2020; Gundel et al., 2019; Piro & O’Callaghan, 2019). Simulations provide opportunities for authentic practice in a controlled environment with reduced risk of harm (Dalinger et al., 2020; Driver et al., 2022). Current approaches to computer-based simulations, like the software Mursion® (2021), which is used in this study, allow teacher educators to design simulations where teachers can approximate teaching. Prior research on the use of simulations in teacher education has established simulations as a viable source of skills practice (Cohen et al., 2020; Dieker et al., 2015; Dalinger et al., 2020; Dotger, 2015; Shaughnessy & Boerst, 2018). In particular, the technology enables prospective teachers to enact lessons, manage the classroom, and practice the skills of teaching with avatars prior to entering the field and working with real children (Dalinger et al., 2020; Peterson-Ahmad, 2018). Recent research has found that the use of simulations provided an engaging and interactive learning experience for pre-service teachers with opportunities to practice teaching strategies and skills in a safe and controlled environment, which lead to deeper learning and improved retention of information when compared to traditional teaching methods (Dieker et al., 2007; Gallegos, 2016; Straub et al., 2014). In the context of simulations, noticing can be leveraged for teacher training in several ways. First, simulations provide a safe and controlled environment for teachers to practice noticing (Kamhi-Stein et al., 2020). Through repeated practice in a simulated

environment, teachers can develop their ability to observe and interpret classroom interactions, leading to improved teaching practices in real-world settings (Dalinger et al., 2020; Dieker et al., 2015). Second, simulations provide a platform for collaboration and professional development among teachers, facilitating the sharing of noticing strategies and techniques (Garland & Garland, 2020). In teacher education, the creation of communities of practice is a common way to encourage dialogue and support teachers in learning from one another (Daniel et al., 2013; Sim, 2006). Within these communities, teachers can work on representations, decompositions, and approximations of practice and receive feedback to enhance their teaching skills (Grossman et al., 2009). Moreover, simulations allow teachers to observe and learn from each other's teaching practices, leading to improved collaboration and knowledge-sharing (Zimmer et al., 2020). Additionally, simulations can provide immediate feedback to teachers on their teaching. For example, simulations can be integrated into coursework and structured to provide feedback to teachers on their interactions with virtual students. This feedback allows teachers to reflect on their teaching practices and make necessary adjustments (Aguilar, 2022). In summary, simulations can foster noticing development in teacher training by providing a safe and controlled environment for practice, promoting collaboration and knowledge-sharing among colleagues, and providing immediate feedback on teacher instruction.

Research Context

This qualitative case study was conducted in the context of a master's level education course for pre-service teachers at a university in a large city in the Southwestern region of the United States. The course was designed to equip teachers with the necessary skills and knowledge to effectively work with English Learners, with a particular emphasis on language use for academic purposes (Galguera, 2011), and was open to teachers across grade levels and

content areas. In the course, the teachers were divided into five smaller groups based on grade level for the simulation rehearsals, with the intention of maximizing the time available for teachers to observe and discuss their instructional practices (Guskey & Yoon 2009). To conduct a detailed analysis of the learning experiences, one focal group was selected for this study (Creswell & Creswell, 2017). Focusing on a specific group allowed for a more comprehensive examination of the phenomenon of interest, noticing, as suggested by Yin (2018). The focal group comprised of four pre-service elementary teachers, including three women and one man, who participated in all three simulations and debriefs. By selecting a group where all the teachers attended the simulations and debriefs (See Table 1), it was possible to explore shifts in teacher noticing over time and identify patterns across the simulations.

Table 1
Participant Descriptions

Pseudonym	Gender	Grade level	Race	Simulation Rehearsal: Focal Teacher Count	Debrief Participation Count
Etta	Female	Elementary	White	2	3
Preston	Male	Elementary	White	2	3
Brisa	Female	Elementary	Multiracial	3	3
Carrie	Female	Elementary	Hispanic	3	3

Course Design

The course was designed based on the theory of practice-based theory of professional education (Ball & Forzani, 2009; Grossman et al., 2009; Lampert & Graziani, 2009) that utilizes rehearsals (Horn, 2010; Lampert et al., 2013) to support teacher noticing (Jacobs et al., 2010; van Es & Sherin, 2008) of language use for academic purposes (Galguera, 2011; Walqui & Bunch, 2019) across a series of three connected simulation learning cycles (See Appendix A). Language use for academic purposes is defined as specific language skills and practices needed for success in academic contexts, such as reading and writing complex texts, understanding academic

vocabulary, engaging in academic discussions and debates, and using language to convey complex ideas and arguments (Bunch et al., 2012; Galguera, 2011; Zhou, 2009). The course design utilized Mursion (2021) software to create simulated teaching scenarios, with three avatars, Dev, Ava, and Jasmine, acting as fifth-grade students (See Figure 1). To account for the grade level variation amongst teachers, fifth grade avatars were chosen as the most suitable representation.

Figure 1

Mursion Avatars



A series of three simulations were embedded within the semester to provide teachers with the opportunity to practice implementing the *Amplifying the Curriculum: Designing Quality Learning Opportunities for English Learners* (Walqui & Bunch, 2019) three-part lesson model: preparing the learners (first simulation), interacting with the text (second simulation), and extending understanding (third simulation) (See Appendix B). To guide lesson planning for each simulation, teachers were presented with focal instructional activities connected to Walqui and Bunch's (2019) lesson model. The instructional activities (See Figure 2) were specifically aimed at supporting teachers to use language for academic purposes (Galguera, 2011). Additionally, teachers were given dedicated time during class to plan how to integrate the focal instructional activities into their lessons (See Appendix C & D). Each simulation cycle was allotted thirty minutes and Figure 2 provides an overview of the simulation sequence. The instructional design

was structured to provide opportunities for teachers to approximate teaching during the learning cycle. Of note, the design was modified based on feedback from the teachers, resulting in a change between the first and second simulation sessions to allow for more time for teachers to engage in enacting the instructional activities and discussing their practice.

Figure 2
Simulation Sequence

Simulation 1		Simulation 2		Simulation 3	
Preparing the Learner		Interacting with the Text		Extending Understanding	
<i>Instructional Activities</i> Hook the learner Focus the learner Activate Prior Knowledge		<i>Instructional Activities</i> Deconstruct or focus on a chunk/part of text Reconnect chunk to whole text		<i>Instructional Activities</i> Apply newly gained knowledge to novel situations or use it to problem-solve Connect ideas learned to ideas outside the text	
5 min	Teacher 1	7 min	Teacher 1	7 min	Teacher 1
4 min	Debrief	7 min	Debrief	7 min	Debrief
5 min	Teacher 2	7 min	Teacher 2	7 min	Teacher 2
4 min	Debrief	7 min	Debrief	7 min	Debrief
5 min	Teacher 3				
4 min	Debrief				

To facilitate productive discussion and engagement among teachers during the simulation rehearsals, a "notice and wonder" protocol was implemented (Anderson & Dobie, 2022). This protocol, which encourages teachers to share what they notice and what they wonder, has been shown to be effective in resolving common discourse-related obstacles in professional development settings (Dobie & Anderson, 2021) and in helping teachers develop their professional vision (Anderson & Dobie, 2022). During the debriefing sessions, each teacher, including the teacher in the simulator, was instructed to identify one thing they noticed and one thing they wondered about the instruction. The term "instruction" was defined broadly to facilitate an exploratory approach that encouraged teachers to notice a wide range of aspects

related to English Language Learners' text-based lessons with a specific focus on language use for academic purposes. While previous research on noticing has primarily focused on what teachers notice about children's mathematical thinking (Jacobs et al., 2010; Thomas et al., 2017), the goal of this study was to understand what teachers noticed about instruction and how their noticing changed over time. Pre-service teachers may notice different aspects in a simulated environment compared to a real classroom, such as the avatars' responses to specific teaching strategies. This focused noticing can enhance their understanding of how instructional practices impact student learning. Furthermore, the simulation provides a rapid feedback loop, enabling pre-service teachers to test out new strategies and refine their approach in real-time, facilitating the development of their noticing skills. Given the structure of the learning cycle, the debriefs were designed with time allotted for each teacher to share something they noticed; however, there was one time when a teacher was able to share more than one thing they noticed because there was extra time, as seen in Table 3. In addition, to support the diverse content areas of the participating teachers and the course's focus on supporting English Learners, a text-based discussion was selected as the high-leverage teaching practice as it spans grade levels and content areas while supporting academic language use (Ball et al., 2009; Galguera, 2011; Meneses et al., 2018). To facilitate consistency and cohesion, the same text was used across all simulations (See Appendix C). Moreover, the course was structured as a hybrid model, with the entire class meeting once every other week and engaging in online modules during off-weeks. The learning cycle comprised four parts:

In Class

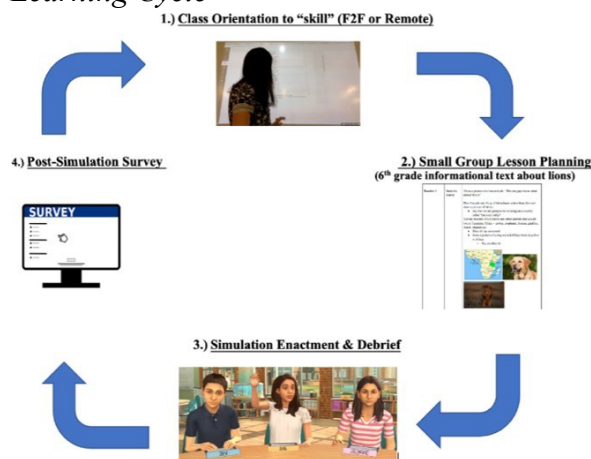
1. Introduction to part of the lesson model and their corresponding instructional activities (see Appendix A)
2. Lesson preparation in small groups to prepare for simulation rehearsals

Online Module

3. Small-group simulation with facilitator
4. Individual reflection survey immediately following the small group simulation session

Three of the seven online modules over the course of the semester included simulation rehearsals, and the author, acting as the teaching assistant, facilitated each discussion related to the simulations. I examined The simulation rehearsals were part of a larger learning cycle that occurred three times throughout the semester-long course, as depicted in Figure 3.

Figure 3
Learning Cycle



The simulations were embedded within the learning cycle as research indicates that professional learning that is ongoing, relevant, and purposeful is more effective for teachers (Desimone, 2011). Moreover, the simulations provide teacher educators with insights into how pre-service teachers interpret pedagogy and put it into practice. This study set out to answer the following research question:

RQ: What do teachers' notice about instruction across connected simulations, and how do their noticings shift over time?

Data Collection

The primary data source for this study was the debrief conversations that took place immediately following the simulation rehearsals. A total of three simulations (and their related debrief conversations) were recorded and transcribed, resulting in 90 minutes of data, with approximately 45 minutes devoted to debrief conversations, which are the focus of this analysis. Figure 2 outlines the structure of the simulation and debrief conversations for each lesson cycle. In addition to the debrief conversations, the four teacher candidates completed post-simulation surveys. Other artifacts, such as class recordings, lesson plans, and analytic memos, were also collected and used as points of triangulation with the debrief conversations.

Data Analysis

The primary analytic task was to identify what teachers noticed about instruction and how those noticings shifted across simulations; therefore, the analysis occurred in two stages:

Identifying what teachers noticed

To begin my analysis, I focused on identifying what teachers found noteworthy during the simulation rehearsals (van Es & Sherin, 2002). To accomplish this, I reviewed the transcribed debrief conversations and applied the "attend, interpret, and respond" conceptualization of noticing (Jacobs et al., 2010) to deductively code what the teachers had noticed during the debrief conversations (Jacobs et al., 2010; Saldana & Omasta, 2018; van Es & Sherin, 2008). This involved identifying what teachers viewed as the noteworthy aspects of a teaching scenario (attending), identifying how teachers reasoned about what they noticed—descriptive, evaluative, and interpretive (interpreting), and identifying how teachers decided to respond (responding). After conducting the initial coding, a second round of coding was performed to ensure that the codes aligned with the original codes and accurately reflected the data (Miles & Huberman,

1994). Following Crabtree and Miller's (1999) recommendation, a third round of coding was carried out, during which inductive codes, such as classroom environment and vocabulary, emerged as sub-codes of the deductive macro-codes: attending and responding. The macro-code of interpreting was further analyzed using additional deductive codes: describing, interpreting, and evaluating. This iterative coding process was adapted from Bingham et al.'s (2018) approach, which involved using deductive macro-coding to sort data into categories of attend, interpret, and respond, followed by inductive micro-coding to identify common themes, and categorize information (Bingham & Witkowsky, 2021).

Understanding noticing across simulations

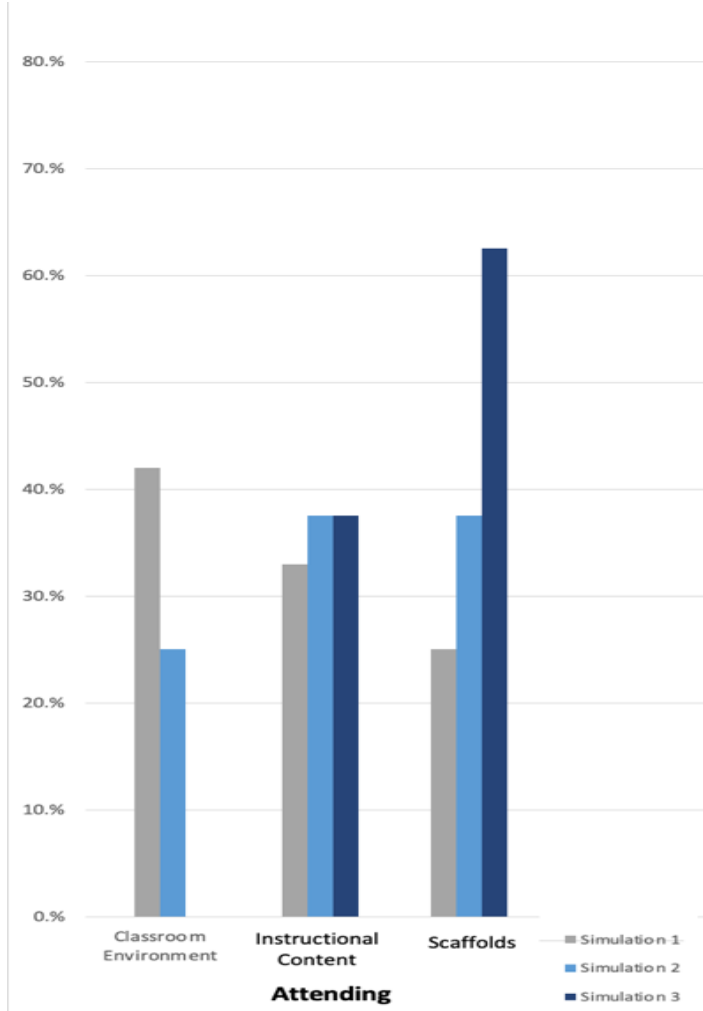
The second part of the analysis aimed to investigate teacher noticing across a series of simulations. The objective was to understand how teacher noticings developed over time by examining each instance where a teacher referred to a current, past, or future simulation to enhance their understanding of instructional practices. A priori coding (Charmaz, 2014; Miles & Huberman, 1994) was used to identify all instances where a teacher referenced a simulation rehearsal. The data was then manually reviewed, and the instances were labeled as either current, past, or future simulations based on the context of the reference. To clarify, a "current simulation" refers to the ongoing lesson cycle that the small group was enacting at the time, which included preparing the lesson, interacting with the text, or extending understanding. "Past simulation" refers to either of the previous simulation rehearsals (simulation 1 or simulation 2) within the learning cycle, and "future simulation" refers to any upcoming simulation (simulation 2, simulation 3, or any future planning after the lesson cycle). To strengthen the study's results, I used data triangulation and member checking techniques. Data triangulation involved analyzing multiple sources of data, such as analytic memos, class videos, lesson plans, and teacher surveys,

to identify conflicting evidence and ensure the validity of the findings (Creswell & Poth, 2018). All four teachers were emailed to review the article and provide feedback as a form of member checking (Brantlinger et al., 2005), two of those four teachers opted to review the article and verify the accuracy of my data analysis and interpretations.

Findings

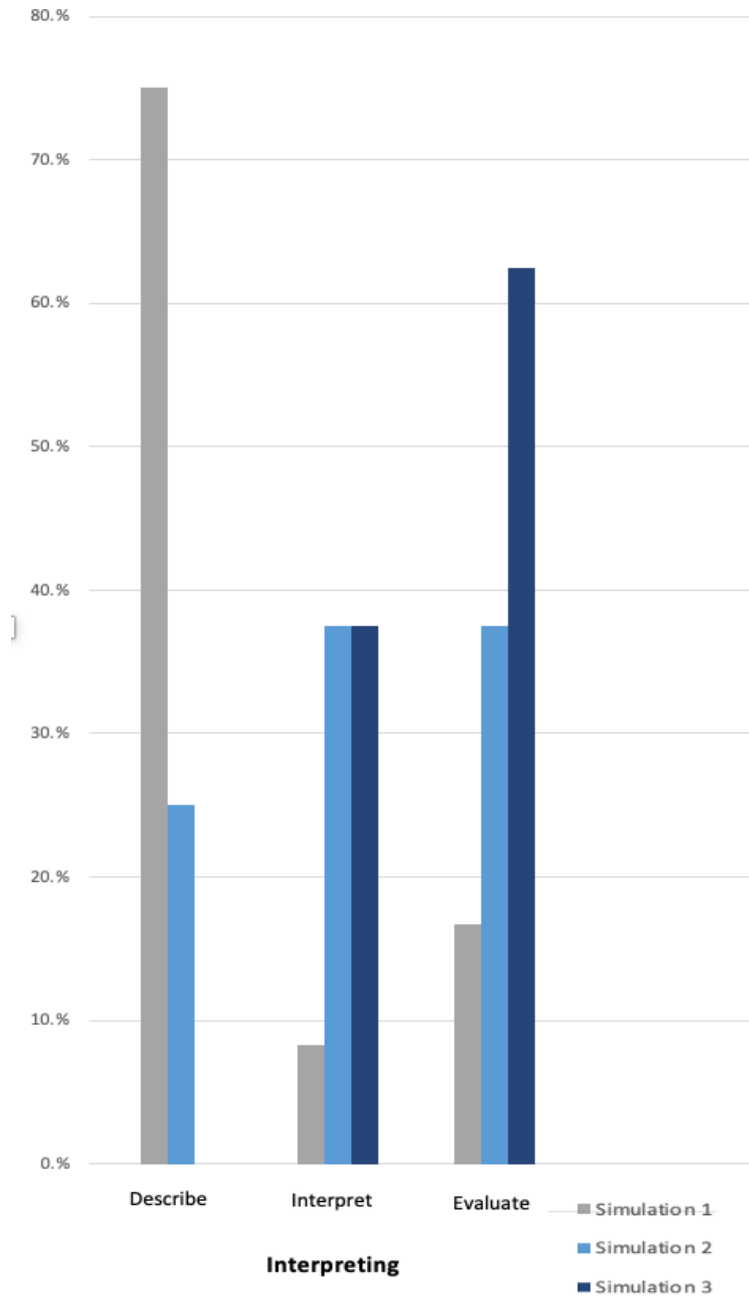
This section highlights the main findings of the study, starting with an overview of what teachers noticed through attending, interpreting, and responding, and then delving into the themes and shifts in noticing that occurred. Three primary categories were identified for what teachers attended to: classroom environment, instructional content for English Learners, and scaffolds. The first category focused on the classroom environment and comprised subcategories such as student participation and engagement. The second category centered on instructional content designed for English Learners and included subcategories such as topic introduction, text deconstruction, text-based connections, and vocabulary. The final category was scaffolds, which encompassed question framing, graphic organizers, sentence starters, and visual aids (See Figure 4). Interestingly, teachers did not attend to classroom environment at all during Simulation 3 whereas scaffolding increased incrementally as the simulations progressed.

Figure 4
 Dimensions of Teacher Noticing: Attending



Of the 29 noticings analyzed, teachers described 38% of the time, evaluated 38% of the time, and interpreted 24% of the time (See Figure 5). Of note, in Simulation One, the teachers described in the majority of cases, whereas in Simulation Three, they did not describe at all.

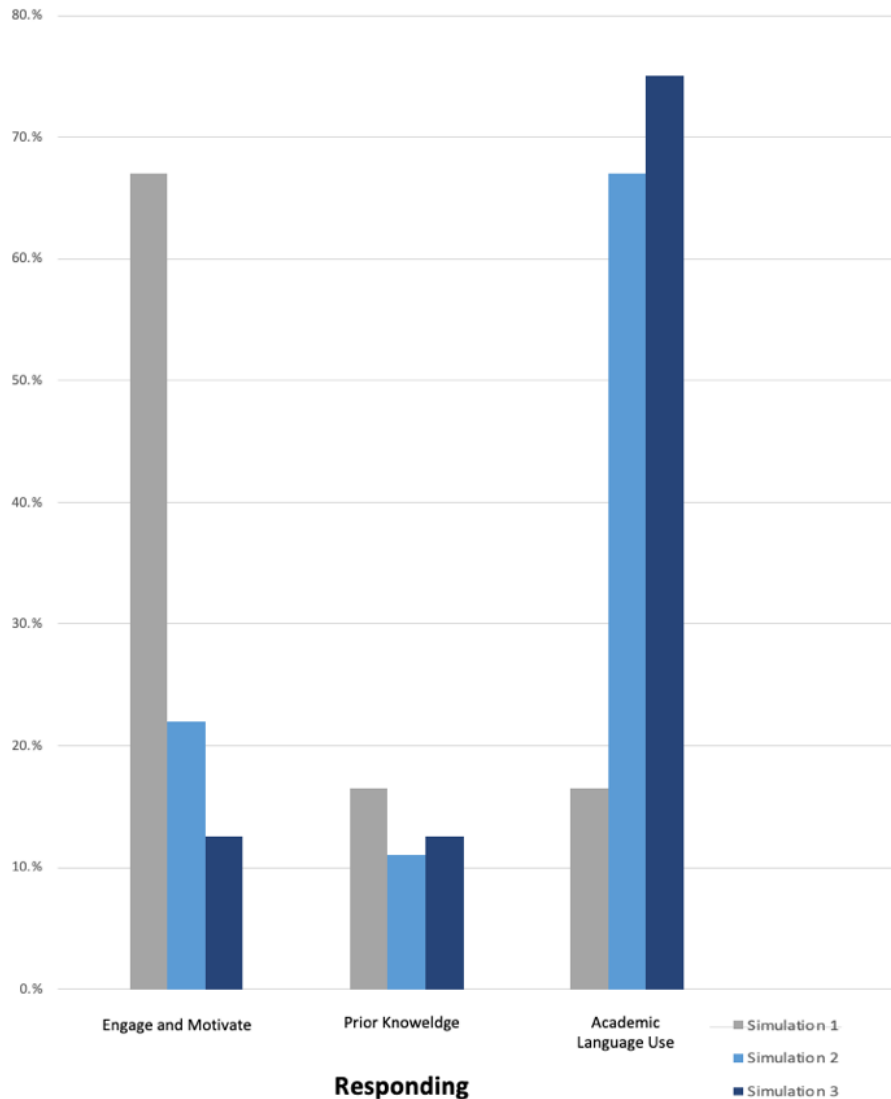
Figure 5
Dimensions of Teacher Noticing: Interpreting



Finally, during the debrief sessions, teachers discussed three different approaches to responding to their observations: engaging and motivating students, activating, and building on prior knowledge, and promoting academic language use. Figure 6 shows how teachers responses

shifted over the course of the simulations from heavily focused on engagement and motivation to more focused on academic language use.

Figure 6
Dimensions of Teacher Noticing: Responding



As illustrated in Figure 6, in Simulation 1, the data illustrates that in simulation one, teachers primarily focused on responding to their noticing by engaging and motivating students.

However, in Simulation two and three, there was a heavier focus on the use of academic language. The second part of the research question explored how teachers referenced their

current, past, and future simulation learning cycles during the debrief conversations. Table 3 illustrates that during the debrief conversations, teachers referenced their current simulation learning cycle seven times, past simulation learning cycles six times, and future simulations eight times. The table shows that during the debrief conversations for Simulation 1, Brisa referenced the current simulation learning cycle during the first enactment while both Brisa and Carrie referenced the current cycle during the second enactment. Etta referenced future simulations during the third enactment. For Simulation 2, all four teachers referenced past simulations during the first enactment while Brisa referenced a future simulation. During the second enactment, Brisa referenced the current and future simulation, while Carrie referenced a future simulation and both Etta and Preston referenced the past and current simulations. Finally, during Simulation 3, Brisa and Etta referenced future simulations during the first enactment while all four teachers referenced past simulations. For the second enactment, Brisa and Carrie referenced the current and future simulations, while Etta and Preston referenced future and current simulations respectively.

Table 3
Noticing across simulations

	Debriefs	Brisa	Carrie	Etta	Preston
<i>Simulation 1</i>	1 st enactment				
	2 nd enactment		Current	Current	
	3 rd enactment	Current		Future	Future
<i>Simulation 2</i>	1 st enactment	Future	Past	Past	Past
	2 nd enactment	Current	Future	Past & Current	Future
<i>Simulation 3</i>	1 st enactment	Future	Past	Past	Future
	2 nd enactment	Future	Current	Future	Current

In the next section, I will delve into the key themes that have emerged from our analysis of the data: moving from description to interpretation and evaluation, looking back and moving forward, and shifting attention to the use of academic language. By exploring these three themes, I aim to highlight the underlying trends and patterns within the data and provide insights for the

design of future learning cycles that incorporate connected simulations to develop teacher noticing.

Moving from description to evaluation and interpretation

van Es and Sherin (2020) identified three distinct stances that teachers used to interpret their observations: descriptive, evaluative, and interpretative. Figure 5 provides a breakdown of these stances, revealing a shift in the types of interpretations made by teachers over time, of the 29 teacher noticings, eleven were descriptive, eleven were evaluative, and seven were interpretative. For instance, during the first learning cycle, 75% of the noticings were descriptions, 16% were evaluations, and 9% were interpretations. In the initial learning cycle, teachers mainly provided descriptions of their observations, expressing statements such as, “she was not very talkative and required the teacher to call on her” or “he introduced the words first before going into the lesson”. However, in the second learning cycle, the percentage of descriptive noticings decreased to 22%, while the percentage of evaluative noticings increased to 44%, and the percentage of interpretive noticings increased to 33%. Teachers began to feel more comfortable making evaluative comments as the lesson cycle progressed, expressing their opinions and judgments about the observed simulation rehearsals. The findings are consistent with previous research by Miller and Zhou (2007) and van Es and Sherin (2020), which suggest that teachers tend to become more comfortable with making evaluative comments as a lesson cycle progresses. It is worth noting that these transformations correspond with repeated practice sessions in the simulation. For instance, teachers in this study began to provide feedback such as, "I thought it was good that you introduced the words that you thought would give them difficulty first" and "I feel like that was a good connection between the text and everyday life" as they gained more familiarity with the lesson. In the final simulation cycle, teachers' noticing

skills continued to develop, as reflected by the absence of descriptive noticings and an increase in interpretive and evaluative noticings. The increase in evaluative noticings indicates that the teachers had become more confident in making judgments and assessments of their observations, indicating a more advanced stage in their noticing development (Jacobs et al., 2010; van Es & Sherin, 2020). As teachers became more comfortable with making evaluative comments, they were able to provide more specific feedback that highlighted both successful areas and areas that needed improvement. This, in turn, helped teachers narrow their focus to more challenging instructional activities that they could practice within the mixed-reality simulation. Furthermore, the increase in interpretive noticings is noteworthy, as it demonstrates that the teachers were able to infer deeper meaning and significance from their observations, suggesting a more nuanced understanding of the instructional activities. In looking across these three approaches, the interpretative stance has been referred to as the most sophisticated of the three as it captures a way of examining classroom phenomena that is consistent with more expert sense making, which is often described as relying on a deep and substantive knowledge of the context (Berliner, 1994; van Es & Sherin, 2020). Examples of when teachers made interpretive comments include, “I wonder if you would have had the students go to a specific sentence or a part of the chunk that we were looking at, if maybe that would have helped them deconstruct the text because Dev showed that he understood the first part of the question, but not the second” and “I saw with the domestication question it started when Ava got the question wrong because she did not understand the vocabulary, so I think that we should pre-teach that vocabulary”. In these examples, teachers made inferences about students’ thinking and understanding, based off their observation of the simulation rehearsals. This shift from descriptive towards interpretive and evaluative noticings demonstrates the development of teachers' reasoning becoming more complex and nuanced, as they move beyond simply recounting events towards making judgments and inferences about what they

have observed. This trend is consistent with prior research on the development of teachers' noticing skills over time (Lew et al., 2020; Louie et al., 2021; van Es & Sherin, 2020), which suggests that with practice and feedback, teachers can become more adept at noticing critical features of teaching and learning that are fundamental for effective instruction.

Looking back and moving forward

Additionally, the findings suggest that the simulations provided a shared context for the teachers to make sense of their teaching together and that their noticings were influenced by the simulation rehearsals. For instance, the teachers consistently referenced past, current, and future enactments to identify patterns, anticipate what might happen next, and adjust their instruction. This consistent reference back to the simulation rehearsals shows how simulations are a powerful tool for providing a shared context to reason about what they noticed and identify how to respond in the future. One example of a teacher utilizing the shared context provided by the simulation and referencing past and future simulations to make sense of what was happening in the current enactment is illustrated in the following quote: “Maybe you could refer him back to the text and I... wondered this two weeks ago, because it is a difficult skill for Dev to use textual evidence in his reasoning. So, I think going forward, we can try and have the students reference the text with their answers by providing them with a graphic organizer.” This excerpt shows how Etta noticed it was difficult for a student to reference the text and provide evidence in their answer. To mitigate the problem of practice, she began talking about the future and gave an example of a possible instructional strategy they could try implementing. Additionally, the teachers used the shared context to pull on their observations and reflections from previous enactments to make sense of what was happening in the current simulation, which helped them identify areas for improvement and adjust their instruction. For instance, in Simulation 2, the teachers' noticings were grounded in all three: current, future, and past simulations. This

illustrates how teachers were able to draw on their experiences from both past simulations and their current simulation, along with planning for future enactments, to make sense of what was happening in the current enactment. For instance, Brisa said, “I noticed when they (avatars) were all discussing and then Jasmine came back and gave her answer, Jasmine said "Dev and I thought the shot." And I think the discussion between them was beneficial. So, I wonder how moving forward to our next simulation or how we could have done more activities in this simulation where they were able to discuss. Because, when Ava said, "Oh, I think it's the... " Or Jasmine said, "Oh, I think it's this." And, Dev was like, "Oh yeah, yeah." I just thought it was a beneficial interaction between them.” Brisa noticed that the discussion between the students was beneficial and wondered how they could incorporate more activities in future lessons where the students would be able to discuss. This noticing illustrates how Brisa referred to the current simulation to attend to an element of instruction, group discussion, and then apply it to how she would respond in the future. Interestingly, in Simulation 3, the teachers' noticings were primarily focused on future enactments, even though future simulations were not planned. This suggests that the teachers were developing the practice to anticipate what might happen next and get in the routine of planning how to adjust their instruction. Overall, the study highlights the importance of providing a shared context with opportunities for teachers to discuss teaching and reflect on how to refine and improve their skills. This can help teachers develop a more robust understanding of instruction and improve their ability to notice, interpret, and respond to students' needs.

Shifting attention to academic language use

The final key finding suggests that the teachers in this study demonstrated a notable shift in their instructional responses throughout the simulations, with an increasing emphasis on academic language use. This shift was evidenced by the teachers' use of content-specific

vocabulary, their references to the text to support more language output, and their provision of opportunities for students to use academic language in discussion. This is consistent with prior research that suggests pre-service teachers may initially notice more obvious or surface-level features before developing deeper noticing for learning and cognition (Estapa, 2016). This finding highlights the importance of considering the design of the learning cycle for simulations. The learning cycle progressed from preparing the learner in Simulation 1, to interacting with the text in Simulation 2, to extending understanding in Simulation 3. This shift likely contributed to the increasing academic demands placed on the teachers as they progressed through the simulations. Referring to Figure 6, the analysis shows that in Simulation 1, the teachers primarily focused on engaging and motivating students, with 67% of their instructional responses falling under this category. Activating and building on prior knowledge accounted for 16.5% of their responses, and academic support was only 16.5% of their responses. It is worth noting that this was the teachers' first time in the simulator, and they may have placed a high value on engagement with the avatar students. As the simulations progressed, the teachers' instructional responses shifted to a greater focus on language use for academic purposes, with 37.5% of their responses falling under this category in Simulation 3. This suggests that the design of the simulations can influence the type and level of instructional responses elicited from teachers. Further, looking at Simulation 2, the focus shifted, with academic support accounting for 67% of teachers' instructional responses. Engaging and motivating students, while still important, only accounted for 22% of their responses. In Simulation 3, the trend continued, with 75% of teachers' instructional responses focusing on academic support, while engaging and motivating students was only 12.5% of their responses. The shift in instructional responses is particularly evident in the academic support category, where teachers increasingly provided scaffolds to help students

access and understand the text. The strategies they used included splitting text into smaller pieces, providing graphic organizers and modeling, reframing questions to make them more accessible, and providing sentence starters. These strategies promote language for academic use by helping students understand the language and structure of academic texts. These findings suggest that teachers became more attuned to the language demands of an academic text over time and adjusted their instructional responses accordingly to better support the students. The shift towards providing more academic support aligns with research on effective instructional practices for promoting language and literacy development in content areas (Gersten & Baker, 2000; Shanahan & Shanahan, 2008). By providing targeted academic support, teachers can help students to develop the language skills necessary to access and engage with challenging texts. Overall, these findings have important implications for teacher professional learning and instructional practices. Teachers can benefit from professional learning that focuses on promoting language for academic purposes in content areas, including strategies for providing targeted academic support.

Discussion

This study indicates that the use of connected simulations can foster a supportive learning environment for teachers to enhance their ability to notice and attend to instructional practices. By drawing upon Walqui and Bunch's (2019) lesson model and the noticing framework (Jacobs et al., 2010; van Es & Sherin, 2008), this study demonstrates how teachers' noticing skills can be developed across multiple simulations that support English Learner instruction.

Utility of Connected Simulations

This study highlights the utility of connected simulations in supporting the development of teacher noticing skills. Specifically, the findings suggest that connected simulations aid

teachers in enhancing their noticing abilities by providing an immediate shared context to interpret and respond to what they observed. In particular, this study sheds light on the potential of connected simulations to support continued growth over time. The analysis revealed that across the three simulations, there were shifts in teachers' noticing skills across all three categories: attending, interpreting, and responding. It is worth noting that if the simulations had been isolated, teachers would not have been able to reference prior simulations when attending to instructional decisions or planning for future lessons. Thus, the connected simulation design allows for a continuous learning process and enables teachers to build upon their prior experiences and observations (Huang & Li, 2012).

Developing Scaffolding Skills

The study's findings suggest that the use of connected simulations can support teachers in developing their scaffolding skills for English Learners. The data showed that teachers attended to three primary categories during the simulation rehearsals: classroom environment, instructional content for English learners, and scaffolds. Notably, there was a steady increase in teachers' attention to scaffolding over the course of the simulation enactments. Based on the data, it can be inferred that participation in the simulations gradually helped teachers shift their attention to scaffolding as they recognized the importance of providing supports to help make the lesson material accessible for English Learners. The increased attention to scaffolding in the simulations is consistent with earlier research on pre-service teacher training for English Learners (Echevarria, Vogt, & Short, 2008; Walqui & Bunch, 2019), which emphasizes the importance of scaffolding for English Learners. This finding suggests that participation in simulation rehearsals can support teachers in developing their scaffolding skills, including the implementation of scaffolds such as sentence starters and graphic organizers, into their lessons.

Learning to Interpret

Additionally, the research revealed that teachers' developed skills to notice and interpret their observations as they participated in simulation rehearsals. This was shown, initially, with teachers using a descriptive lens, but as they progressed, adopting a more interpretive approach. This shift towards interpretation is noteworthy, as it indicates that teachers are moving beyond merely observing and describing a phenomenon to actively seeking to understand and address it. This shift in interpretation, as explained by van Es and Sherin (2020), involves adopting an inquiry stance, where teachers not only make sense of what they observe but also seek ways to address it. In order to cultivate an inquiry stance, teachers require opportunities to practice and improve their skills. Simulations, especially a sequence of connected simulations, can offer teachers such opportunities that can build inquiry through practice.

Moving Towards Content Specific Skills

Furthermore, the study found that as the simulation rehearsals progressed, teachers became more cognizant of their use of academic language in their instruction. This transition from an emphasis on engagement and motivation with a descriptive lens to a more content-focused approach, with an interpretive lens, highlights the utility of multiple simulations within a learning cycle to build teachers capacity to develop their noticing skills. Furthermore, the connected simulation approach can support teachers in developing a more inquiry-based approach and provide them with opportunities to practice more challenging teaching tasks, connected to content.

Limitations and Implications

Due to the small sample size and the limited number of simulations examined, this exploratory study would benefit from larger and longer connected simulations to observe how

teacher's teaching practice shifts over an extended period. Additionally, the study did not measure the long-term impact of the simulation rehearsals on teachers' instructional practices or student outcomes. While the study found that teachers' noticing skills and use of scaffolding improved over the course of the simulations, it is unclear whether these changes resulted in improved outcomes for English Learners. Future research should consider measuring how simulations connect to teachers' field experiences and ultimately to student outcomes to determine whether the use of connected simulations is an effective teacher training approach to improve Teacher's use of instructional activities to support English Learners.

Despite its limitations, this study emphasizes the potential of connected simulations in teacher education programs to offer practice teaching experiences that allow teachers to establish meaningful connections between coursework and the practice of responsive teaching. The study's implications for teacher education programs and professional development underscore the potential of mixed-reality simulations as an additional means of offering teaching practice during coursework. The findings on teacher noticing highlight the need for future research to investigate how teachers attend to, interpret, and respond to the needs of diverse student populations across content areas. Furthermore, additional research is needed to explore the optimal frequency and duration of simulation rehearsals to effectively support the development of instructional practices that cater to the needs of English Learners. The use of simulations can allow for greater flexibility in teacher education programs, particularly in cases where traditional in-person practice teaching experiences may not be feasible due to factors such as limited resources, time constraints, or public health concerns. As technology continues to advance, it is important for teacher education programs to explore the potential benefits and limitations of incorporating mixed-reality simulations into their curriculum. Overall, the study

highlights the potential of connected simulations as a tool for teacher education programs.

Incorporating simulations into teacher education programs can help teacher educators support teachers in enhancing their instructional skills to meet the needs of diverse student populations.

Future studies can build upon this work to further investigate the use of simulations in teacher education programs and their impact on student outcomes.

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Appendix A

Focal Instructional Activities for each Lesson Cycle

Preparing the Learners	Interacting with the text	Extending Understanding
Hook the Learner	Examine a chunk of text	Apply gained knowledge to novel situations
Focus the Lesson	Reconnect chunk to whole text	Connect ideas learned to ideas outside of text
Activate Prior Knowledge/Selective introduction to new terms		

Appendix B

Taken from: Walqui, A., & Bunch, G. C. (Eds.). (2019). *Amplifying the curriculum: Designing quality learning opportunities for English learners*. Teachers College Press.

(1) Are the themes and contexts ones that my English Learners can relate to from their prior experience and, if so, how can tasks help to activate that knowledge?

(2) Where my English Learners have little or no prior experience that enables them to relate to the themes, context, setting, or purpose of the text, how can tasks help to build the field of knowledge that will make it possible for them to connect more fully with the meaning of the text?

Start with the end in mind: What conceptual, analytic, and language disciplinary practices do you want your students to begin to develop? Remember that you are not after mastery, but gradual development.

Lesson 1 Plan: Preparing Learners

- 1.) What are the goals of your activity?
- 2.) What elements of scaffolding does your lesson entail?

	Purpose	Description
Teacher 1	Hook the learner	Map of Africa (mentioned in class – avatars already know) – already in folder Talk about the area and Continent <ul style="list-style-type: none"> - Serengeti, Tanzania - What they know Lead up for talking about animals in Africa
Observations	I notice...	
	I wonder...	
Teacher 2	Focus the lesson	So, we talked a little bit about Africa What is your favorite animal? / What kinds of animals do you see in the zoo? What types of animals do you think live in Africa?

		<p>Lions</p> <ul style="list-style-type: none"> - Second largest cat in the world (tiger is the first) - Social, live in groups called prides - Keep track of one another by roaring - Nearly all wild lions live in Africa <p>Lions being sick/getting the disease</p>
Observations	I notice...	
	I wonder...	
Teacher 3	<p>Activate prior knowledge / Selective introduction to new terms</p>	<p>Just referred to lions getting a disease Background of what they know about diseases/covid/doctors Background on going to the doctor The vet is a doctor for animals → Jasmine mentioned how the doctor comes to the animal's shelter What is keeping us from getting sick? A mask is keeping us from getting sick; What do you think could keep the animals from getting sick? A shot/vaccination is what is keeping the lions from getting sick</p> <p>How are people getting a disease right now? What is causing people to be sick? Have you gotten sick before? Do you know what a vaccination is? – shots keeping them and us healthy Heard a lot of that in the news or in the world from adults</p>
Observations	I notice...	
	I wonder...	

Appendix C



Name: _____ Class: _____

A Lifeline for Lions

By Pamela S. Turner
2016

In 1994, a concerning number of lions began to die in a wildlife park in Africa, known as the Serengeti. In this informational text, Pamela S. Turner discusses the cause of the lions' deaths and how people responded to the situation. As you read, take notes on the actions that were taken to end the rise in lion deaths across the Serengeti.

- [1] All over the Serengeti, the lions were in trouble.

Tourists in a hot-air balloon were the first to notice. As the tourists were flying low over the savannah,¹ they spotted a big cat lying on the ground. This lion wasn't lazing around, as lions do when they are not hunting. It was shaking and shivering.

The tourists called the park veterinarian, Dr. Melody Roelke. She watched the lion, but didn't know what was wrong.

The Serengeti is a large wildlife park in Tanzania where no hunting is allowed. The Serengeti might seem like a safe place, but wild animals face dangers other than guns. In this case, the danger was disease.

- [5] Lions began to die all over the park. "After ten days, it was clear something extraordinary² was going on," says Dr. Craig Packer, a biologist at the University of Minnesota. He has studied lions for 25 years. "We had no idea what it was, and we were afraid we might never know."



"Lions like this one were threatened by a disease called distemper," by Craig Packer is used with permission.

Usually, veterinary science focuses on the kinds of animals that are most important to people—pets and livestock.³ Wildlife diseases are not well understood. Dr. Packer and Dr. Roelke sent blood and tissue samples from dead lions to experts in different countries. One expert was able to solve the mystery. The lions were dying of distemper, a disease commonly found in pet dogs.

1. a grassy land, usually in Africa
2. **Extraordinary** (adjective): very unusual
3. farm animals



Small but Deadly

Distemper is caused by a virus. (Viruses cause many diseases, including measles, polio, and the common cold.) Sometimes an animal's body can fight off the distemper virus.

But if it can't, the virus invades the animal's nervous system.⁴ Distemper can cause fever, shaking, and finally death.

In 1994, just before the distemper outbreak, there were an estimated three thousand lions in the Serengeti. "Over ninety percent of the Serengeti's lions were infected," says Dr. Packer. "About one thousand lions died." Many other animals also died — leopards, hyenas, wild dogs, and bat-eared foxes.

- [10] How could a wild lion or leopard catch a disease from a pet? Serengeti National Park is huge — larger than the state of Connecticut — but there are farms and villages all around it. In those villages and on those farms are about thirty thousand dogs.

The disease is spread like a cold from dogs to wildlife. "We think hyenas are the key," says Dr. Packer. If a hyena looks for food in a village garbage dump, it may come into contact with an infected dog. Then the hyena may take distemper back into the park.

"Hyenas move over large distances and hang out around lions' kills," Dr. Packer says. From the hyenas, the distemper probably spread to lions and other animals.

Lion Lovers Respond

When people heard about the sick and dying lions, offers of help poured in from all over the world. Major funding came from the World Society for the Protection of Animals and several companies.

"We began vaccinating dogs around the Serengeti against distemper," says Dr. Packer. "That was the beginning of Project Lifelion." Why vaccinate dogs instead of the lions themselves? "It is a lot easier to catch and vaccinate thirty thousand dogs than three thousand lions," explains Dr. Packer. "Many lions are very shy, and live in remote⁵ areas. And vaccinating lions would do nothing for the other animals at risk — hyenas, leopards, wild dogs, and foxes."

Healthier Pets

- [15] Project Lifelion has been vaccinating dogs around the Serengeti since 1995. Before Project Lifelion, the Tanzanian Veterinary Service took care of cattle, goats, and sheep, but not pets. With funding from Project Lifelion, the veterinarians now offer free distemper shots for dogs. They also give rabies⁶ vaccinations. Although people can't catch distemper from dogs, they can get rabies.

4. the system of nerves in your body that sends messages for controlling movement and feeling between the brain and other parts of the body

5. **Remote (adjective):** far away from other people, houses, cities

6. a disease that causes abnormal behavior and death in humans when untreated



"Local people are happy with the program," says Dr. Packer. "We're saying, 'If you have a dog, let's make it a healthy dog.' We tell them it is for the lions, and that is OK, too. They know lions bring tourists, and tourism brings jobs."

A Circle of Protection

Project Lifelion aims to encircle the Serengeti with a ring of vaccinated dogs. This should prevent any future distemper outbreaks. New dogs are born or move into the area every year, so Project Lifelion will need to continue as long as lions roam the Serengeti.

The lions are now doing well — very well. Only three years after the terrible distemper outbreak of 1994, the lion population had rebounded⁷ to three thousand. Today, there are about four thousand lions. "There seem to be more lions than ever," says Dr. Packer. "The Serengeti is still a rich and robust⁸ place."

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7. **Rebound** (verb): to recover from a setback
 8. **Robust** (adjective): strong and healthy

Appendix D

Dimensions of Analysis for Teacher Noticing

	Brisa	Carrie	Etta	Preston
<i>Simulation 1: Preparing the Learners</i>				
1 st enactment	A: classroom environment I: describe R: connect students' prior knowledge to material	A: participation I: describe R: increase student involvement	A: topic introduction I: interpret R: provide more information on content	A: participation I: describe R: identify student interests
2 nd enactment	A: student engagement I: describe R: incorporate student responses	A: questioning I: describe R: ask follow-up questions	A: questioning I: describe R: ask follow-up questions and provide sentence starters	A: participation I: describe R: increase participation through think-pair-share
3 rd enactment	A: text-based connection I: describe R: activate prior knowledge	A: vocabulary I: evaluate R: pre-teach vocabulary	A: questioning I: describe R: ask open-ended questions	A: text-based connection I: evaluate R: make connections to students lives
<i>Simulation 2: Interacting with the Text</i>				
1 st enactment	A: student engagement I: interpret R: use student examples	A: questioning I: interpret R: ask text-based questions	A: student engagement I: describe R: incorporate student interests A: pacing I: evaluate R: map out key questions	A: text-based connections I: describe R: provide scaffolds to access text
2 nd enactment	A: text-based connection I: evaluate R: split text into smaller pieces	A: sentence starters I: interpret R: make connections between students' prior knowledge	A: graphic organizers I: evaluate R: provide scaffolds to clarify misunderstanding	A: vocabulary I: evaluate R: direct students to specific part of text
<i>Simulation 3: Extending Understanding</i>				
1 st enactment	A: lesson content I: evaluate R: Connect students' prior knowledge to text	A: questioning I: evaluate R: ask questions that are clear and concise	A: lesson content I: evaluate R: encourage students to expand on answers	A: lesson content I: interpret R: reconnect student responses to text
2 nd enactment	A: higher order questions I: evaluate R: provide activities to promote problem solving	A: scaffolding I: interpret R: incorporate graphic organizers and modeling	A: visual aid I: evaluate R: provide feedback consistently	A: question framing I: interpret R: reframe questions so they are accessible

A = attending, I = interpreting, R = responding

Appendix E

How teachers decide to respond

How Teachers Decide to Respond	Examples
Engaging and motivating students	<ul style="list-style-type: none"> • Identify student interests • Make connections to students' lives • Incorporate student interests • Increase participation through think, pair, share • Encourage students to expand on answers • Provide consistent feedback • Use student examples • Ask open-ended questions • Ask follow-up questions
Activating and building on prior knowledge	<ul style="list-style-type: none"> • Activate prior knowledge • Connect students' prior knowledge to text • Make connections between students' prior knowledge
Academic Language Use	<ul style="list-style-type: none"> • Provide scaffolds to access text • Split text into smaller pieces • Provide scaffolds to clarify misunderstandings • Direct students to specific part of text • Reconnect responses to text • Map out key questions • Incorporate graphic organizers and modeling • Reframe questions so they are accessible • Provide sentence starters • Provide activities to promote problem-solving

Chapter V: Discussion

In summary, this three-article dissertation investigated the use of mixed-reality simulations as a tool to support teacher development, with a specific focus on enhancing English Learners' language use for academic purposes. With the growing adoption of practice-based teacher education (Ball et al., 2009; Shaughnessy & Boerst, 2018) and the increasing prevalence of mixed-reality simulations (Dalinger et al., 2020; Straub et al., 2014), this work was situated within a sociocultural context (Vygotsky, 1978) that emphasized the importance of social interaction in the learning process. From this perspective, learning was seen as a collaborative and dynamic process that involved engagement with others. The analysis was conducted by examining post-simulation conversations through three different methods: 1) the topical code functions of coaches and teachers during one-on-one coaching sessions, 2) episodes of pedagogical reasoning during small group discussions, and 3) teacher noticing of instructional practices across a series of mixed-reality simulations. Across the three papers, there are three key insights that support the use of language for academic purposes in teacher training.

First Insight: Utility of Mixed-Reality Simulations

The first insight is that all three papers demonstrate the potential of using mixed-reality simulations for teacher training. Mixed-reality simulations offer a unique opportunity for teachers to rehearse and refine their instructional practices in a safe and supportive environment (Mikeska & Howell, 2020). Prior research suggests that simulation-based training can enhance the development of teachers' instructional decision-making skills (Kaufman et al., 2018). Across the three papers, mixed-reality simulations provided a shared context for teachers to practice and then reflect, reason, or notice certain aspects of their instruction. The immediacy of the shared context benefited the teachers, allowing them to promptly discuss next steps with their coach,

peers, and teacher educator, given the immediate shared context of the simulation. Additionally, the mixed-reality simulator offers a distinctive platform for evaluating the impact of various interventions on teaching practices (Cohen et al., 2020). With a consistent instructional task, the simulator allows for a focused examination of feedback practices, allowing teacher educators to zoom in on specific instructional decisions. This method can be especially beneficial in promoting differentiation in teacher education programs by moving away from a one-size-fits-all model for pre-service teachers. By providing individualized and targeted support, teacher preparation can become more specialized, equipping teachers with the skills they need to address the diverse needs of their students. In addition, the simulator offers researchers the opportunity to witness the progression of teaching practices at a much faster pace than in real-world classrooms, allowing for swift adjustments to instructional interventions and the ability to gain meaningful insights into the changes in teaching practices. Furthermore, the opportunity to repeat a simulation or practice a strategy multiple times, without any negative impact on students, allowed the teachers to refine their skills and practice instructional activities multiple times. The simulation also encouraged the teachers to focus on more granular aspects of teaching that may not be feasible in a large classroom and try out new instructional activities for the first time. Additionally, the adaptability of technology allowed for teachers to participate in them both in-person and remotely, making them accessible and flexible for different learning environments. This feature also enabled the teacher educator to customize the simulations to fit specific courses, ensuring that they met the unique needs and goals of their students. The adaptability of mixed-reality simulations is an affordance that teacher educators can harness, especially for working with diverse student populations, who might not be accessible during field experiences.

In conclusion, mixed-reality simulations offer a unique approach for enhancing teacher

training and development. They provide a safe and supportive environment for teachers to practice and refine their instructional practices, allowing for immediate feedback and reflection. The adaptability of simulations also allows for customization and flexibility, making them a versatile tool for teacher educators and educator preparation programs.

Second Insight: Reflective Practices

The second key insight from the three papers showed that reflective practices helped teachers identify areas of growth and plan for change. Reflective practices that identify areas of growth and consider new ideas or perspectives can support teachers to adapt their teaching strategies to better meet the needs of students (O'Hara et al., 2014; Schön, 1987). Regarding the second insight, collaborative conversations were purposively integrated into the design of the teachers' learning to support teacher reflection and growth after the simulation enactments. The collaborative conversations encouraged teachers to share their experiences, explore new ideas, and challenge each other's thinking (Dalinger et al., 2020; Straub et al., 2014; Zeichner & Liston, 2013). For example, across the papers, teachers engaged in conversations about specific instructional activities, discussed what worked well and what could be improved, and brainstormed strategies for addressing challenges in the classroom. Through these conversations, teachers gained new insights, refined their instructional practices, and supported each other's professional growth. This second key insight emphasizes that reflective practices that promote collaborative conversations can support teacher inquiry and reflection. Further, reflective practice has been recognized as an important component of pre-service teacher education programs (Daniel et al., 2013; Schön, 1987). Prior research has suggested that reflective practice can help pre-service teachers to develop a better understanding of their own teaching practices, as well as the needs and perspectives of their students (Korthagen, 2017; Schön, 1987). This is in

line with these three papers which show how reflective practice can also help pre-service teachers to identify areas for growth and improvement, and to develop strategies for addressing these areas (Korthagen, 2017).

Hence, incorporating reflective practice into pre-service teacher education programs can help bridge the gap between theory and practice (Daniel et al., 2013; Schön, 1987). By engaging in reflective practice after a practice-based simulation, pre-service teachers are provided the time and space to connect the theoretical concepts they learn in their coursework with the realities of teaching. This can support pre-service teachers in developing a more nuanced and sophisticated understanding of teaching, as well as the ability to adapt their practices to meet the needs of their future students (Bondie & Dede, 2020; Walker & Dotger., 2012).

Third Insight: Continuous Professional Learning

The third key insight focuses on the utility of having connected simulations within a course to maximize the potential of the technology and support teachers in developing their instructional capacity. Connected simulations can provide teachers with repeated opportunities for practice and feedback, which can help them build their knowledge and skills over time (Borko et al., 2002). This approach aligns with research that emphasizes the importance of ongoing professional learning for teachers to improve their instructional practices and ultimately enhance student learning outcomes (Garet et al., 2001).

Furthermore, connected simulations can help pre-service teachers develop their ability to reflect on their instructional practices and adjust their approaches based on feedback from both their peers and teacher educators. This iterative process can enhance teachers' capacity to engage in reflective practice and improve their instructional decision-making (Zeichner & Liston, 2014). By integrating simulations into the course sequencing of an educator preparation programs and

professional development, teachers can receive ongoing support to enhance their instructional practices, allowing them to gradually develop their expertise and ultimately become more effective teachers. Additionally, connected simulations can provide pre-service teachers with a safe space to experiment with new instructional strategies and receive feedback on their effectiveness. As teachers gain confidence in their ability to experiment with new approaches, they are more likely to try out new techniques in their actual classrooms, potentially leading to improved student learning outcomes (Grossman et al., 2009). By integrating connected simulations into teacher training, teachers can develop the skills and confidence needed to effectively experiment with new approaches in their current and future classrooms.

In conclusion, embedding connected simulations into the design of a course and integrating them into the course sequencing of an educator preparation program and professional development can maximize the potential of the technology and support teachers in developing their instructional capacity.

Limitations

While these articles shed light on the potential benefits of incorporating mixed-reality simulations into teacher training to support teacher development, there are important limitations to acknowledge. To begin, the researchers of these three papers had access to mixed-reality simulations and the teacher educators were able to design them to meet the needs of their coursework; however, the technology can be cost prohibitive and may not be accessible for all teacher training programs. Furthermore, the effectiveness of simulations in preparing teachers for real-world classroom situations may depend on various factors such as the quality of coaching, the level of trust and collaboration between the teacher and coach, and the complexity of the classroom context. In addition, it is important to recognize that the use of simulations in teacher

training programs should be viewed as a supplement to coursework and not a complete substitute for actual classroom experience.

Future Directions

Future research on the use of mixed-reality simulations in teacher training should investigate several areas. First, when teachers feel confident in their ability to implement new instructional practices, they are more likely to use them in the classroom (Bandura, 1997). By providing teachers with opportunities to practice new instructional practices in mixed-reality simulations, teachers can build their capacity to enact instructional activities that support English Learners. The field could benefit from future research that explores the relationship between the use of mixed-reality simulations and teacher's implementation of focal instructional activities during field experience for pre-service teachers or during classroom instruction for in-service teachers. For example, a study could examine whether teachers who participate in mixed-reality simulations focused on delivering language-rich instruction to English Learners are more likely to implement language-rich instruction into their own classrooms. By exploring the relationship between practice and enactment, future research could provide insights into the extent to which mixed-reality simulations can support teachers in implementing instructional practices that support English Learners.

Another area for future research is the impact of mixed-reality simulations on student learning outcomes. As teachers incorporate instructional practices that were practiced and refined through mixed-reality simulations into their teaching, it would be beneficial to investigate how these practices affect student learning outcomes. The use of mixed-reality simulations could potentially improve student learning outcomes by helping teachers develop more effective instructional practices that support the needs of diverse student populations (Gundel et al., 2019;

Lew et al., 2021). Hence, future research could explore the relationship between the use of mixed-reality simulations in teacher training and student learning outcomes and identify best practices for incorporating mixed-reality simulations into teacher training programs. Overall, the use of mixed-reality simulations in teacher training has great potential to support teacher learning and improve student learning outcomes. Future research can continue to investigate the optimal frequency and duration of simulation rehearsals, the types of instructional activities that best support teacher learning, the impact of mixed-reality simulations on teacher confidence and self-efficacy, and the impact of mixed-reality simulations on student learning outcomes. By exploring these areas, further refinement and development of mixed-reality simulation scenarios can help build a more robust tool to support teacher training and professional development.

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