

Virtual learning communities as contexts for pre-service teacher learning and development: A design thinking approach

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ARTICLE INFO

Keywords:

Teacher learning
Pre-service
Design thinking
Virtual communities
Collaboration
Online learning
Teacher preparation

ABSTRACT

This study examines how pre-service teachers described their participation in an online teacher learning environment guided by a design thinking framework during field placements. The aim was to explore (a) how participation in a virtual Teacher Learning Community (TLC) supported social learning and connection in an online context, and (b) how pre-service teachers used design thinking to interpret and respond to instructional and classroom challenges encountered in their practicum settings. Seven pre-service teachers participated in four facilitated online sessions in which they identified practice-based dilemmas, engaged in collaborative discussion, and reflected on strategies they attempted in their placements.

A qualitative thematic analysis of session transcripts and participant reflections examined interactional patterns using the Community of Inquiry framework and traced participants' engagement across the phases of the design thinking process. Participants described the virtual TLC as supporting social presence through emotional expression, validation, and reciprocal peer mentoring, contributing to perceived psychological safety and reduced isolation. Participants also described using the design thinking structure to organize discussion, reframe challenges, and consider instructional responses, particularly related to classroom management and instructional decision-making.

Findings suggest that intentionally designed online teacher learning communities may function as spaces for collaborative sensemaking alongside field-based learning, rather than as interventions producing direct instructional outcomes. By centering pre-service teachers' perspectives, this study highlights how virtual environments can support reflective dialogue and practice-oriented discussion during clinical experiences and informs the design of technology-mediated supports in teacher preparation.

1. Introduction

Teacher preparation programs are charged with helping candidates translate university coursework into responsive classroom practice, yet many pre-service teachers enter clinical placements feeling underprepared for the emotional, relational, and instructional demands of teaching [1,2]. Candidates frequently report limited opportunities for guided reflection, inconsistent mentoring, and a sense of professional isolation—conditions associated with burnout and early attrition [3–6]. Although Teacher Learning Communities (TLCs) and Professional Learning Communities (PLCs) have been shown to support in-service teachers' growth, far less is known about how virtual learning communities can support pre-service teachers during field placements, particularly within U.S. teacher education contexts.

Existing research related to online and collaborative teacher learning has emphasized several adjacent areas, but it has not fully examined structured, practice-centered virtual communities for pre-service teachers during clinical placements. For example, studies of online learning environments have examined factors that shape participation, interaction, and course completion [7], while research on teachers' online discussions suggests that digital spaces can support collaboration, reflection, and professional identity development within course-based contexts [8]. In addition, Ostovar-Nameghi and Sheikahmadi's review highlights the broader importance of moving teachers from isolation toward collaboration, particularly through professional dialogue and shared problem solving [9]. Research specific to pre-service teachers similarly suggests that online collaborative spaces can support peer connection, reflection, and perceived professional growth; however, this

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<https://doi.org/10.1016/j.caeo.2026.100382>

Received 25 July 2025; Received in revised form 20 May 2026; Accepted 25 May 2026

Available online 26 May 2026

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work often emphasizes participants' general experiences or perceptions rather than examining how collaborative processes lead to instructional decision-making during field-based practice [e.g., 10]. Consequently, limited research explains how virtual learning communities can support pre-service teachers' social learning, collaborative problem solving, and instructional decision-making during clinical placements, particularly through facilitation structures that help candidates transform shared classroom challenges into iterative instructional responses.

This study addresses that gap by examining a fully virtual TLC designed around a design thinking process and interpreted through the Community of Inquiry (CoI) framework. While CoI explains the social and cognitive conditions that enable online learning [11], it does not specify how participants translate those interactions into changes in classroom practice. Design thinking was selected because, unlike broader collaborative discussion frameworks, it provides an explicit, iterative structure for moving participants from problem identification to solution development, implementation, and refinement in authentic instructional contexts [12]. In this way, design thinking extends CoI by operationalizing how cognitive and social engagement can lead to practice-based experimentation and refinement.

Together, these frameworks provide a coherent lens for examining both (a) the conditions of learning within the TLC (social, cognitive, and teaching presence) and (b) the processes through which that learning is enacted in practice (design thinking cycles). Within this study, social presence supported relational trust and openness among participants, cognitive presence supported collaborative inquiry and sensemaking around classroom dilemmas, and teaching presence structured facilitation and guided reflection within the TLC. These conditions created opportunities for participants to engage in collaborative problem solving, instructional experimentation, and reflective refinement through the design thinking process. This alignment enables analysis of how participation in a virtual TLC supports pre-service teachers' development of collaborative problem solving and instructional decision-making during clinical placements. In analysis, CoI constructs (social, cognitive, and teaching presence) are examined through indicators such as knowledge sharing and collaborative sensemaking [11], while engagement in design thinking is analyzed through participants' problem framing, solution generation, and instructional experimentation.

The study is exploratory and focuses on the experiences of seven pre-service teachers within a single program; it does not aim to produce generalizable claims, but to provide a theoretically grounded account of how a design thinking-oriented virtual TLC can function as a practice-based support structure in teacher preparation.

This study extends prior work in three ways. First, it shifts attention from virtual learning communities and online PLCs for practicing teachers to pre-service teachers navigating clinical placements. Second, it moves beyond documenting participants' perceptions of online collaboration by examining how social learning, collaborative sensemaking, and instructional decision-making developed within the TLC. Third, it extends research on design thinking in teacher education by examining design thinking not only as a course activity or instructional strategy, but as the organizing structure for a virtual community intended to support practice-based problem solving.

1.1. Pre-Service teacher challenges

Clinical placements are widely recognized as pivotal yet vulnerable periods in teacher development [e.g., 13]. Pre-service teachers often struggle with classroom management, instructional planning, and assessment while simultaneously negotiating relationships with mentors and students [14–16]. Many describe their preparation as fragmented, with limited opportunities to rehearse teaching moves or receive timely feedback [e.g., 17,18]. Such conditions can foster a “sink-or-swim” mentality in which candidates view teaching as an individual endeavor rather than a collaborative practice [16].

1.2. Teacher learning communities as support structures

Collaborative teacher communities have been associated with improved instructional practice and professional persistence [19,20]. PLCs create spaces for mutual inquiry, feedback, and identity development, enabling educators to test ideas and make sense of complex classroom events [21–23]. Yet most evidence derives from in-service contexts; pre-service teachers often report limited access to such reflective collaboration during preparation [8,9].

Research on PLCs emphasizes that productive communities depend on trust, shared goals, and facilitated dialogue [24–28]. For teacher candidates, these communities can provide more than pedagogical guidance—they offer emotional support and a sense of belonging during formative professional transition [29–32]. Through collective sense-making, participants may strengthen pedagogical content knowledge and the capacity to translate theory into practice [33,34]. At the same time, time constraints, uneven participation, and interpersonal dynamics can undermine community effectiveness without intentional structure [35–38].

1.2.1. Expanding access through virtual PLCs

Virtual PLCs leverage digital platforms to overcome scheduling and geographic barriers, enabling synchronous and asynchronous collaboration [39–42]. When anchored by clear goals and skilled facilitation, online communities can support meaningful professional learning [43, 44]. However, challenges such as building trust at a distance, sustaining participation, and varying digital fluency remain significant [45,46].

For pre-service teachers who balance coursework, employment, and field placements, virtual formats may be particularly valuable because they reduce logistical barriers while preserving opportunities for dialogue [7]. Nevertheless, empirical work examining practice-centered virtual PLCs for teacher candidates is limited. This study investigates such a community, called a Teacher Learning Community (TLC) to better understand how online interaction can be organized to support candidates learning during placements. We use *TLC* to refer to the study context, while drawing on *virtual PLC* research to situate the work.

1.3. Theoretical framework: community of inquiry and design thinking

Two complementary frameworks guide this study. The Community of Inquiry (CoI) model conceptualizes online learning as the intersection of social presence (relational trust and open communication), cognitive presence (collaborative construction of meaning), and teaching presence (design and facilitation) [47–50]. CoI explains the conditions under which participants are willing to share dilemmas, engage in inquiry, and integrate new understandings.

Design thinking provides a process for translating those interactions into action. Through the iterative phases of empathize, define, ideate, prototype, and test, participants analyze authentic problems, generate solutions, and refine them in context [51,52]. Prior students have used design thinking to enhance creativity and efficacy in coursework [53–55], yet its use as a core organizing structure within virtual communities for pre-service teachers remains underexplored.

In this study, CoI is used to interpret how participants interacted and learned together, while the design thinking process structures how participants worked through practice-based challenges. CoI supports the collaborative interaction and sensemaking that occur within the TLC, while design thinking provides an iterative process through which those interactions are translated into instructional action. The relationship between the CoI framework and the design thinking process within the TLC is summarized in Fig. 1.

1.4. Purpose and research questions

The purpose of this exploratory qualitative study is to examine how participation in a design thinking-oriented virtual TLC was perceived to

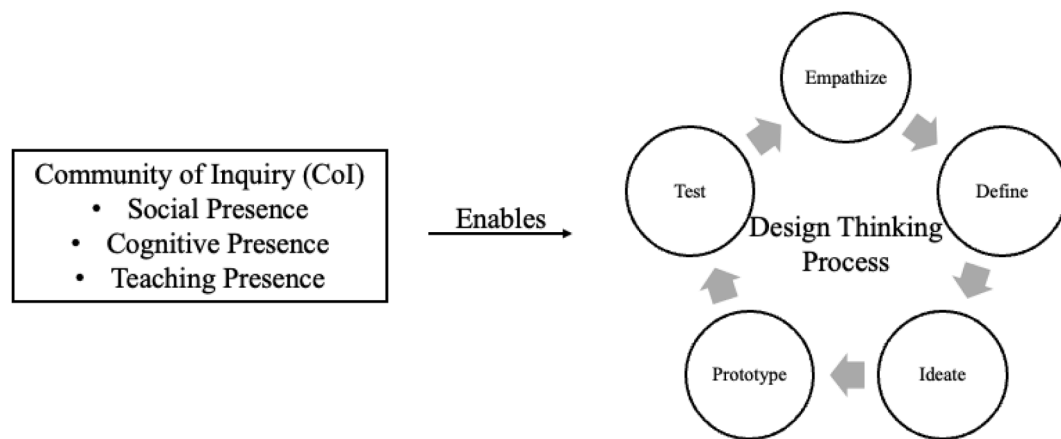


Fig. 1. Conceptual framework linking community of inquiry and design thinking.

support pre-service teachers' collaborative problem solving and instructional decision-making during clinical placements. Specifically, the study explores how social and cognitive learning processes within the TLC were translated into instructional action through engagement in design thinking.

The study centers pre-service teachers' perspectives on the social learning, collaborative problem solving, and practice-based decision-making that occurred within the virtual TLC.

The study addresses the following research questions:

1. How did participation in a virtual TLC support pre-service teachers' social learning, including opportunities for knowledge sharing and connection in an online environment?
2. How did pre-service teachers use the design thinking framework within the TLC to interpret and respond to instructional and classroom challenges encountered during their clinical placements?

Together, these questions examine how structured virtual collaboration and design thinking supported pre-service teachers' movement from shared reflection to practice-based instructional action during clinical placements.

2. Methods

2.1. Study context and design

This study was conducted at a large public university in the southeastern United States and used an exploratory qualitative design to examine how participation in a virtual Teacher Learning Community (TLC) supported pre-service teachers during clinical placements. The study focused on participants' experiences of social learning and practice-based problem solving rather than on measuring causal effects. Data sources included transcripts from TLC sessions, researcher memos, and open-ended pre- and post-survey responses, allowing for triangulation across interactional and reflective data.

2.2. Participants, recruitment, and sample characteristics

Eligibility criteria required that participants: (a) be enrolled in the undergraduate teacher education program (TEP), (b) have completed at least three semesters in the program, and (c) be currently placed in a practicum or student-teaching setting in elementary or special education.

A recruitment email describing the study purpose, time commitment (four 60-minute virtual sessions over eight weeks), and voluntary nature of participation was sent to approximately 120 eligible candidates through the program listserv. The email invited interested candidates to

complete a brief interest form and confirm availability for scheduled session times. Participants were selected on a first-come, availability-based basis, resulting in a voluntary convenience sample.

Seven candidates enrolled (response rate = 5.8%). No students who expressed interest were excluded, and no enrolled participants withdrew after the first session. Two additional candidates inquired about participation but declined due to scheduling conflicts. Participants represented multiple grade levels and programs (Table 1). To protect confidentiality, all names are pseudonyms.

2.3. Data sources and collection procedures

2.3.1. TLC sessions and facilitation structure

Four 60-minute virtual TLC meetings were held over eight weeks via Zoom. Sessions were structured using the design thinking phases (empathize, define, ideate, prototype, test) [51], with each session emphasizing one or more phases while allowing iterative movement across phases as participants revisited challenges over time.

A consistent facilitation protocol was used for each meeting:

1. Opening check-in (5 min): relational prompt (e.g., "What felt most challenging this week?")
2. Problem surfacing (10 min): participants described a current classroom dilemma (empathize/define)

Table 1
Participant demographic characteristics.

Participant Pseudonym	Major	TEP Semester	Placement Grade Level	Race/Ethnicity	Gender
Taylor	Elementary Education	Semester 3	4th Grade	White, non-Hispanic	Female
Nicole	Elementary Education	Semester 3	3rd Grade	Black, non-Hispanic	Female
Rory	Special Education	Semester 4	Preschool	White, non-Hispanic	Female
Olivia	Special Education	Semester 4	Preschool	White, non-Hispanic	Female
Lucy	Elementary Education	Semester 3	5th Grade	White, non-Hispanic	Female
Amelia	Elementary Education	Semester 4	3rd Grade	Black, non-Hispanic	Female
Emma	Elementary Education	Semester 4	2nd Grade	White, non-Hispanic	Female

3. Collaborative ideation (25 min): peers proposed strategies and asked clarifying questions (ideate)
4. Action planning (10 min): each participant selected one strategy to try (prototype)
5. Reflection and closure (10 min): participants anticipated implementation challenges or reflected on prior attempts (test)

Across sessions, participants revisited previously discussed challenges, allowing for iterative cycles of testing and refinement rather than a strictly linear progression through phases. Sample prompts and discussion protocols are included in [Appendix A](#). The overall TLC process and its alignment with the design thinking phases are summarized in [Fig. 2](#).

The lead author facilitated all sessions, maintained field notes, and wrote analytic memos within 24 h documenting group dynamics, emerging ideas, and researcher reflections. Sessions were audio-recorded and professionally transcribed verbatim.

2.3.2. Pre- and post-surveys

A brief survey collected demographics and expectations for the TLC (three open-ended items). The post-survey included four open-ended questions about perceived instructional impact, sense of connection, and usefulness of the design thinking process. Survey responses were used to triangulate session data and to capture reflections that may not have surfaced in group dialogue.

2.4. Data analysis overview

Analysis proceeded in two analytic phases. Phase 1 used deductive coding based on the Community of Inquiry framework to characterize interactional qualities of the TLC. Phase 2 involved first mapping relevant segments of talk to the design thinking phases, then inductively coding within each phase to identify recurring categories, which are summarized in [Table 2](#).

Transcripts from TLC sessions and open-ended survey responses were organized in NVivo 14 for data management and coding. NVivo was used to store transcripts and survey responses, apply deductive and inductive codes, organize coded excerpts into nodes, compare patterns across data sources, and generate node summaries used during theme development. The lead author conducted initial immersion readings of all transcripts prior to formal coding and wrote analytic memos to

capture emerging patterns, questions, and disconfirming evidence. These memos were linked to relevant coded excerpts in NVivo and revisited throughout analysis to document how early observations informed later code refinement, theme development, and interpretation of findings.

2.4.1. Analytic approach and coding procedures

Coding was conducted by the lead author. The coding process combined deductive and inductive approaches. Deductive coding was used first to apply theoretically informed codes from the CoI framework and the design thinking phases. Inductive coding was then used within and across these categories to identify recurring patterns in participants' language, interactions, and reflections that were not fully captured by the initial framework. To support analytic consistency and reduce individual bias, a detailed codebook with operational definitions and inclusion/exclusion criteria was developed and iteratively refined throughout analysis. The initial codebook included a priori codes, definitions, and sample indicators; as analysis progressed, the lead author added emergent codes, revised definitions, and documented decision rules when excerpts overlapped categories or required clarification. Codes were then grouped into broader categories and themes by comparing related NVivo nodes, reviewing coded excerpts within each node, and examining how patterns appeared across TLC transcripts, survey responses, and analytic memos.

The second author, who was not involved in TLC facilitation, served as both peer debriefer and analytic reviewer. During debriefing meetings, the second author examined sample excerpts alongside preliminary codes to evaluate alignment with the Community of Inquiry framework and to consider alternative interpretations.

The second author also independently reviewed a subset (25%) of transcripts using the codebook to assess conceptual alignment between excerpts and assigned codes. Areas of disagreement were discussed until consensus was reached, resulting in clarification of several code definitions and decision rules. An audit trail documented these revisions, analytic decisions, and reflections on discrepant cases. NVivo node reports, code summaries, and memo-linked excerpts were used as part of this audit trail to track how coded data moved from initial identification to broader analytic categories. Together with triangulation across TLC transcripts and survey responses, these procedures enhanced the credibility and dependability of the analysis without reliance on formal intercoder coefficients.

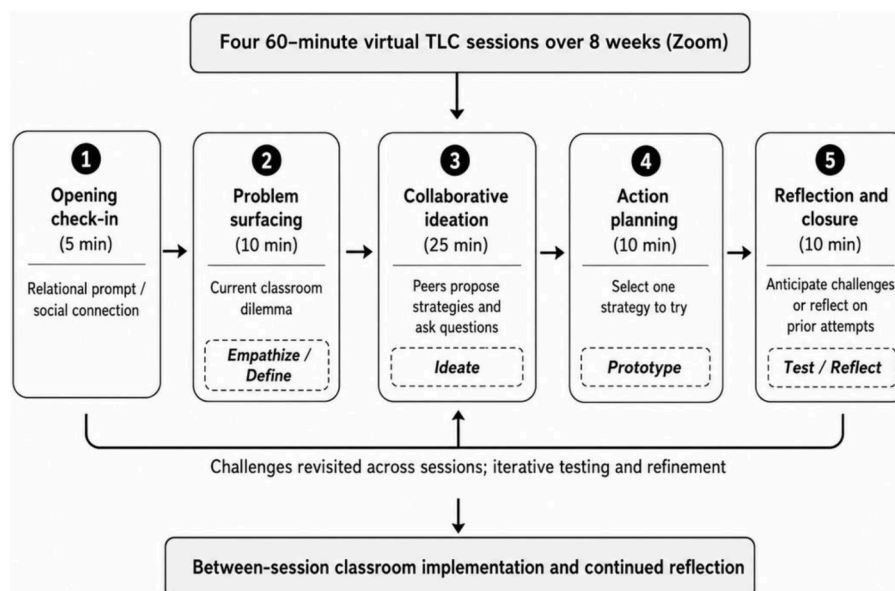


Fig. 2. Virtual TLC session flow and design thinking alignment.

Table 2

Inductive categories illustrating participants' Engagement in design thinking across TLC sessions.

	Inductive category	Category definition	Sample participant quote
<i>Empathize</i>	Emotional coping, validation, and shared strain	References to emotional strain, support, validation, or shared experience among participants.	"I need, like, a support group... someone that actually understands, because...they're not education majors, so they don't have the full understanding." (Lucy)
	Emotional responses to teaching literacy	Affective responses connected to literacy instruction, including frustration, passion, overwhelm, or perceived competence.	"Upper grades teaching literacy makes me feel passionate...lower grades...sometimes discouraged because CKLA is not the most age appropriate." (Rory)
	Empathy toward students' behavior and experiences	Interpretations of student behavior through contextual, developmental, relational, or experiential factors. Challenges linked to classroom routines, expectations, organization, scheduling, or consistency.	"We suspect that he just doesn't get a lot of face-to-face interaction." (Emma)
<i>Define</i>	Behavioral problems rooted in classroom structure	Challenges arising from differences in students' skills, attention, independence, or responsiveness.	"It's the tone that my teacher has set for the classroom." (Taylor)
	Instructional complexity due to learner variability	Limited autonomy to design, lead, or adapt instruction due to intern status, mentor expectations, or restricted opportunities.	"Some kids already know their letters, and some kids still struggle a lot." (Olivia)
	Constraints on instructional agency	Concrete instructional or management routines proposed to support engagement, attention, or behavior.	"As an intern... there's not a ton that I myself can do." (Taylor)
<i>Ideate</i>	Proactive instructional and management routines	Strategies intended to strengthen teacher-student relationships, connection, or belonging.	"I go over expectations every time I teach a lesson." (Amelia)
	Relationship-based strategies	Use of prior teaching, placements, observations, or attempted strategies to support proposed ideas.	"Ask what he's doing for the weekend... maybe that would work." (Rory)
	Ideas justified through prior experience	Participants affirming, extending, or building on peers' ideas to refine strategies collaboratively.	"I did that last semester, and it worked." (Taylor)
<i>Prototype</i>	Collective strategy refinement through peer talk	Selection of a specific strategy to enact, often with attention to timing, duration, or repetition.	"That goes hand in hand with what Rachel said." (Amelia)
	Committing to a strategy trial		"I'll try doing that tomorrow and the next day and seeing if that works." (Rory)

Table 2 (continued)

	Inductive category	Category definition	Sample participant quote
<i>Test</i>	Anticipating failure points before implementation	Predictions about where a planned strategy may break down because of student responses, context, timing, or task demands.	"That's the part that might go wrong." (Olivia)
	Instructional risk-taking as professional growth	Framing experimentation, uncertainty, and trial-and-error as part of professional learning.	"Even if it crashes and burns, it's your opportunity to learn." (Nicole)
	Interpreting student response as evidence	Use of observed student behavior, engagement, or participation to evaluate a strategy's effectiveness.	"He stayed focused because of the timer." (Amelia)
	Expectation of iterative refinement	Framing instructional responses as provisional and adjustable through continued revision or experimentation.	"If it doesn't work, we'll try something else." (Emma)

2.4.2. Analysis of community of inquiry (Research question 1)

A priori codes from the Community of Inquiry framework guided analysis of social, cognitive, and teaching presence [47]. Subcodes included: social presence (affective expression, open communication, group cohesion); cognitive presence (triggering event, exploration, integration, resolution); and teaching presence (design/organization, facilitating discourse, direct instruction). In NVivo, these subcodes were represented as parent and child nodes, allowing coded excerpts to be reviewed both within each CoI construct and across sessions. For example, excerpts coded as open communication were compared with excerpts coded as group cohesion to examine how participants' relational interactions supported broader patterns of social presence. Coded segments were compared across sessions and surveys to identify recurring interactional patterns. Analytic matrices were used to link themes to illustrative excerpts and data sources.

After deductive coding, segments that did not fit existing CoI subcodes were reviewed inductively to determine whether they reflected emergent interactional patterns or contextual detail unrelated to the research questions. Three additional subcodes were added based on this analysis: safe space (descriptions of emotional or psychological safety), reciprocity (mutual giving and receiving of support, ideas, or resources), and boundary crossing (linking learning between coursework, fieldwork, and peer collaboration). These emergent subcodes were retained when they appeared across multiple participants or data sources and when analytic memos indicated that they helped explain patterns not fully represented by the original CoI categories.

2.4.3. Analysis of design thinking processes (Research question 2)

Analysis began with a deductive pass-through of TLC transcripts and open-ended survey responses to identify participants' self-reported challenges, contextual constraints/resources, and proposed or enacted instructional/management strategies. Each segment was then provisionally mapped to the design thinking phases (empathize, define, ideate, prototype, test) based on its primary discourse function (e.g., emotional processing and perspective-taking; problem framing; strategy generation; commitment to a planned trial; reflection on classroom implementation). These design thinking phases were also organized as NVivo nodes, which allowed the researchers to retrieve all excerpts associated with each phase and compare how participants moved from describing challenges to planning, testing, and revising instructional responses.

Within each phase, we conducted inductive coding to identify the recurring interactional patterns and categories represented in participants' talk. These inductive categories were iteratively refined into the set reported in Table 2 (e.g., emotional coping/validation; structural framing of behavior; relationship-based strategies; anticipatory failure points; interpreting student response; expectation of iterative refinement). Category definitions and decision rules were updated during analysis to improve conceptual clarity and ensure that categories reflected the participant talk for each phase. For example, excerpts initially coded broadly as "strategy sharing" were later separated into more specific categories, such as *relationship-based strategies* and *anticipatory failure points*, when memo review and node comparisons showed that participants were using peer dialogue both to generate instructional ideas and to anticipate barriers to implementation.

To examine process over time, we then traced participant-level trajectories across sessions. For each participant, we documented: (a) the focal challenge or dilemma raised, (b) strategies generated during group discussion, (c) the strategy the participant indicated they intended to try (prototype), and (d) subsequent reflections on implementation and perceived student response (test), when available. These trajectories were used to examine the extent to which each participant contributed data across the five phases and to support the vignette-based illustration in the Results section. NVivo-coded excerpts were exported into participant-level analytic matrices in Excel so that each candidate's movement through the design thinking cycle could be examined across time rather than only as isolated coded segments.

Finally, we created individual analytic figures to visualize each participant's progression across the design thinking phases and to support memo writing and cross-case comparison. These figures and accompanying narrative memos were used for analytic purposes (e.g., checking alignment between coded excerpts and phase assignment, identifying missing phases, and comparing patterns across participants). To avoid redundancy in the manuscript, only consolidated representations are included in the Results. Although NVivo outputs are not presented as standalone findings, they directly supported the organization of the analysis by structuring the node hierarchy, retrieving coded excerpts for comparison, and informing the thematic matrices and participant trajectories used to develop the findings.

2.4.4. Credibility and saturation

Credibility was supported through method triangulation (transcripts, surveys, memos), peer debriefing across four analytic meetings, and the search for negative cases. Saturation was assessed retrospectively during final analysis. Later sessions yielded few new categories of CoI interactions or design thinking actions, and post-survey responses largely reinforced existing categories. On this basis, the dataset was judged to provide adequate depth for addressing the research questions.

2.5. Reflexivity and ethical considerations

The study was approved by the university IRB. Participants provided informed consent and could withdraw at any time without penalty. Pseudonyms were used in all records.

The lead author had previously taught or supervised three participants, creating potential power dynamics. To mitigate bias, the TLC was framed as a peer community rather than evaluation space; no course credit or assessment was involved. Reflexive journals were maintained after each session to bracket assumptions, and analytic decisions were reviewed with a second researcher unaffiliated with participants.

Given the emotional nature of teaching discussions, the facilitator emphasized psychological safety and provided information about campus support services. No adverse events were reported.

3. Results

This section presents findings in two parts. First, we examine how

participants described the virtual TLC in relation to social learning, knowledge sharing, and connection using the Community of Inquiry (CoI) framework. Second, we explore how participants engaged in the design thinking process to address challenges encountered in their clinical placements.

Across TLC sessions and survey responses, participants described the TLC as a collaborative, supportive space for discussing instructional dilemmas. The sections below report participants' accounts of these experiences and illustrate how participants' interactions aligned with CoI domains and the design thinking phases.

3.1. Social learning, knowledge sharing, and connection

Participants reported that the virtual TLC provided opportunities to reflect on practice and to connect with peers facing similar challenges. This pattern appeared across session transcripts, post-survey responses, and analytic coding of CoI-related interactions, particularly within the social presence codes of *affective expression*, *open communication*, *group cohesion*, *belongingness*, and *safe space*. Although participants emphasized distinct challenges, all seven described the TLC as supporting either peer connection, reflection on practice, or access to strategies from others.

Several participants emphasized that the TLC allowed them to speak openly about difficulties in their placements while also learning from peers' successes. For example, Rory described the TLC as a space for reflection and accountability, while Amelia emphasized that peer suggestions helped her identify strategies to try during literacy instruction. These accounts reinforce the TLC as a context for perceived collaboration and practice-based reflection.

3.1.1. Social presence: relationships and emotional support

Participants' dialogue reflected features of social presence, including emotional expression, affirmation, and group cohesion. Evidence of social presence appeared across all four TLC sessions, though participants varied in how they engaged: some used the space primarily to vent and seek validation, while others moved quickly into offering strategies, asking follow-up questions, or connecting peers' experiences to their own. Emma referred to the TLC as "teacher therapy," and Taylor stated, "I just don't have anywhere else to talk about it," highlighting participants' perceptions of the group as a rare space for candid conversation. Others described feeling "tired," "overwhelmed," or "nervous," and peers frequently responded with validation and encouragement.

Conversations included accounts of frustrations with student behavior, curriculum constraints, and mentor communication. For example, Amelia expressed concern about limited feedback from her mentor and received affirming responses from peers who reported similar experiences. Rather than functioning as isolated complaints, these exchanges often prompted participants to compare placement contexts, normalize uncertainty, and identify possible next steps. Moments of humor and celebration also appeared to strengthen cohesion; when Lucy reported a successful poetry lesson, peers offered congratulations and follow-up questions about her approach.

Over time, participants increasingly referenced one another's prior ideas (e.g., "I'll definitely try that") and engaged in spontaneous dialogue beyond facilitator prompts. Coding notes indicated that later sessions required less facilitator prompting, with participants more often jumping in to ask clarifying questions, affirm peers' concerns, or extend one another's ideas. Olivia noted that hearing from peers outside her program block was "very beneficial in education," and Rory described the group as a place to "talk, connect, vent, validate, and laugh." These accounts suggest that participants experienced the TLC as a psychologically safe environment that supported engagement in subsequent reflective and problem-focused discussions.

3.1.2. Cognitive presence: collective sensemaking and resource exchange

Participants' exchanges also reflected elements of cognitive presence, as they framed classroom dilemmas, explored options, and

reported on attempted strategies. Discussions often began with triggering events, such as difficulties with transitions, pacing guides, or mentor expectations. Emma described challenges with moving students between activities, and Lucy questioned the fit between the pacing guide and her students' "actual needs." Across coded data, these triggering events commonly emerged from immediate classroom concerns rather than abstract coursework questions, which positioned the TLC discussions around authentic problems of practice.

During exploration, participants exchanged concrete strategies including countdown routines, movement games, phonemic chants, and partner reading structures. Amelia modeled language for setting expectations, and Rory suggested daily check-ins to support behavior. These ideas were grounded in participants' immediate classroom contexts. The evidence showed variation in the kinds of resources exchanged: some participants shared management routines, others shared literacy-specific strategies, and others drew from prior placements or mentor practices to justify possible approaches.

Some participants later reported integrating peer suggestions into their teaching. Nicole described shaping her writing unit after group brainstorming, and Taylor expressed interest in using EdPuzzle following a peer recommendation. In several cases, participants returned to describe perceived resolution, such as Rory noting improved behavior after trying a check-in routine or Lucy attributing a successful observation to strategies discussed in the TLC. These accounts suggest that participants experienced the group as a venue for moving from problem articulation to action, while remaining self-reported rather than independently verified outcomes.

3.1.3. *Teaching presence: structure and shared leadership*

Although the TLC was intended as a peer space, aspects of teaching presence were visible through session design and emerging peer leadership. The recurring cycle of check-ins and follow-ups provided continuity, while allowing conversations to be participant-driven. Emma and Nicole often modeled engagement by taking notes and summarizing ideas verbally; Rory and Lucy shared planning resources; and Amelia frequently posed clarifying questions that advanced discussion. Across coding, teaching presence was reflected not only in facilitator prompts, but also in peer leadership, including participants who initiated follow-up questions, offered concrete strategies, summarized ideas, or encouraged others to test possible responses in their placements.

Participants described this distributed leadership as helpful for developing collaborative habits. Rather than formal instruction, the structure appeared to function as light scaffolding that enabled participants to guide one another's learning. This pattern was especially evident in later sessions, when participants more frequently referenced prior conversations, credited peers' ideas, and adopted informal mentoring roles with one another.

3.2. *Addressing practice-based challenges through design thinking*

Across TLC sessions, participants drew on the design thinking structure to surface, interpret, and respond to practice-based challenges encountered during their clinical placements. Analysis suggested recurring patterns of engagement across the empathize, define, ideate, prototype, and test phases. Rather than functioning as a strictly linear problem-solving sequence, design thinking appeared to operate as a shared discourse framework that participants used to organize discussion and connect emotional processing with instructional action. Table 2 summarizes the inductive categories that characterized participants' talk across these design thinking phases, along with representative excerpts.

3.2.1. *Empathizing and defining practice-based challenges*

During the empathize phase, participants articulated emotional strain associated with clinical teaching, particularly in relation to literacy instruction and classroom management. This pattern appeared

across all four TLC sessions and was reflected in both session transcripts and post-survey responses. Across participants, emotional strain was most often connected to feeling isolated in placements, lacking opportunities to discuss teaching challenges with peers, and needing affirmation that their struggles were not unique. Participants described feelings of exhaustion, discouragement, and isolation and frequently validated one another's experiences. These exchanges created space for participants to name shared stressors and to recognize that their challenges were not unique.

For example, Rory described the TLC as a space that reduced isolation and supported reflection: "I would recommend virtual teacher learning communities to other pre-service teachers because they are a great way to voice opinions and struggles that me and other teachers are going through. It made me feel less alone, and it was an opportunity to reflect on specific aspects of my internship and held me accountable to make the necessary changes to my instruction and teaching strategies." This response illustrates how social connection and reflective accountability were intertwined rather than separate outcomes.

Emotional responses were often situated within participants' experiences teaching literacy. Participants referenced feeling overwhelmed by pacing expectations, constrained curricular materials, and perceived mismatches between instructional demands and students' developmental needs. These concerns were not uniform across the group; some participants emphasized literacy curriculum constraints, while others focused more heavily on behavior management, mentor feedback, or uncertainty about their instructional authority as interns. These affective responses frequently served as entry points for discussion, prompting peers to listen, acknowledge shared experiences, and begin reframing challenges collectively rather than individually.

As discussions progressed, participants increasingly defined challenges in structural terms. Behavioral concerns were often attributed to classroom organization, unclear routines, inconsistent expectations, or limited follow-through, rather than to student defiance or individual teacher shortcomings. Participants described how the absence of predictable systems shaped student behavior and engagement, reflecting a tendency toward shared problem framing grounded in instructional context.

Participants also named instructional complexity related to learner variability, including wide ranges in skill level, attention, and student responsiveness. These discussions emphasized the difficulty of differentiating instruction within rigid pacing structures and limited instructional autonomy. At the same time, several participants described constraints on instructional agency linked to their intern status, restricted decision-making authority, and feedback that identified problems without offering actionable guidance. For instance, participant-level coding showed that at least three participants' focal challenges centered on behavior or engagement, while others focused on literacy lesson design, transitions, mentor feedback, or adapting scripted curriculum. Together, these defining conversations reflected a movement from emotional expression toward collective articulation of practice-based challenges that informed subsequent strategy discussions.

3.2.2. *Ideating, prototyping, and testing instructional responses*

Following shared problem definition, participants engaged in collaborative ideation of instructional and management strategies intended to address identified challenges. Ideas often focused on clarifying expectations, strengthening classroom structure, and supporting engagement through explicit modeling and timing tools. Participants proposed concrete routines such as reviewing expectations prior to lessons, modeling desired behaviors, using visual or auditory timers, and maintaining consistent follow-through.

In addition to procedural strategies, participants generated relationship-based approaches aimed at supporting student connection and belonging. Suggestions included informal check-ins, community-building routines, and increased use of proximity or teacher table

interactions. These ideas reflected participants' interpretations that relational trust could play a role in supporting engagement, particularly for students perceived as disengaged or disconnected.

Ideas were frequently justified through prior experience. Participants drew on previous placements, observed classroom practices, or strategies they or their mentors had used, using these experiences as warrants for proposed approaches. Ideation was typically interactive rather than additive, with participants explicitly building on one another's suggestions and refining strategies through peer talk. There was evidence of peer-to-peer strategy exchange across all sessions, with participants offering ideas, reporting whether they tried them, and revisiting prior suggestions in later meetings. These exchanges supported collective strategy development rather than isolated problem solving.

As discussions moved into the prototype phase, participants identified specific strategies they intended to try, often naming a concrete timeframe or plan for repeated implementation. These commitments were commonly accompanied by anticipatory discussion of potential challenges, such as difficult times of day, partner dynamics, or developmental constraints. Participants articulated where they anticipated strategies might break down, reflecting attention to instructional contingencies rather than reluctance to experiment. For example, one participant planned to try a morning check-in with a student whose behavior had been difficult, while another planned to use a timer and transition strategy after noticing that transitions were taking too long.

Experimentation was frequently framed as a learning-oriented process. Participants used language that normalized trial-and-error and emphasized reflection and adaptation rather than performance evaluation. Rather than seeking definitive solutions, participants described strategy testing as part of an ongoing process of "figuring out what works," acknowledging uncertainty while remaining willing to try new approaches.

In the test phase, participants discussed student responses as indicators for evaluating whether strategies appeared workable within their contexts. Reflections referenced changes in engagement, focus, participation, or task completion, often accompanied by caveats about the provisional nature of these observations. Participant trajectories showed variation in the degree of implementation. Some participants reported clear classroom application and perceived improvement, while others described partial implementation, limited opportunities to try strategies, or the need for continued adjustment. Participants frequently emphasized the need for continued adjustment, noting that strategies could be revised, abandoned, or adapted over time.

Several post-survey responses further supported this movement from discussion to action. Amelia explained, "My biggest problem in the classroom was figuring out how to get my students to listen to instructions, and this community helped by suggesting strategies I could use. As a result of trying the strategies they suggested, I got my students on the right track during my literacy instruction." Similarly, Taylor connected the TLC to adapting curriculum in practice: "Through our discussions, this community helped me understand how to make literacy curriculum your own rather than following it to a tee. I was able to apply this while creating a lesson based on CKLA. Instead of following it word for word, I used it as a guide. This helped to make the lesson more engaging and interesting for the students." These examples provide evidence that participants did not only discuss challenges but, in several cases, translated peer dialogue into instructional decisions during placement.

Taken together, these patterns suggest that design thinking functioned as a shared conversational and analytic structure through which participants organized discussion, interpreted challenges, and considered instructional action. The strongest evidence of this cycle appeared in participants who returned across sessions to the same classroom dilemma, reported a strategy trial, and then reflected on student response or next steps. Other participants showed more limited or indirect movement through the cycle, suggesting that the TLC supported instructional action unevenly depending on placement opportunities,

role constraints, and the nature of each participant's focal challenge.

3.2.3. Design thinking in action

Each participant contributed evidence of movement across the design thinking phases, though the completeness and depth of these cycles varied by placement context and opportunity for implementation. To illustrate how participants engaged in the design thinking process, we present one example that reflects the broader interactional patterns summarized in Table 2. This vignette traces a single participant's movement through empathizing, defining, ideating, prototyping, and testing across multiple TLC sessions.

Taylor. "I would love for students to work in groups, but they're not ready because my cooperating teacher doesn't let them." Taylor raised a challenge related to instructional agency, expressing interest in incorporating group work while describing constraints associated with her cooperating teacher's expectations and students' limited experience with collaborative routines. Her initial framing reflected uncertainty about both student readiness and her role in shaping instructional practice.

Peers responded by offering strategies drawn from their own placements, including explicitly modeling expectations and procedures prior to lessons. Taylor asked clarifying questions and identified modeling and pre-teaching expectations as strategies she was willing to try in an upcoming lesson.

As Taylor moved into the prototype phase, she outlined a plan to implement a structured group activity and identified potential challenges related to transitions and student focus. In a subsequent TLC session, she reflected on the lesson and reported increased on-task behavior during the activity. She also noted that the approach was compatible with expectations set by her cooperating teacher.

Rather than presenting the outcome as a definitive solution, Taylor characterized the experience as informative for future planning and indicated interest in continuing to refine her use of structured group work. This vignette illustrates how design thinking functioned as a shared framework for collaborative problem framing, strategy testing, and reflection.

3.2.4. Summary

Taken together, these examples illustrate how participants used the TLC as a space to collaboratively examine and respond to instructional challenges encountered in their field placements. Design thinking provided a shared structure through which participants articulated problems, exchanged ideas, and reflected on attempts to enact new strategies. Across discussions of curriculum constraints, lesson planning, and classroom management, participants used this framework to organize sensemaking and consider instructional action in relation to their specific contexts.

Rather than functioning solely as a venue for idea sharing, the TLC supported ongoing cycles of discussion and reflection in which participants revisited challenges, reported on classroom experiences, and adjusted strategies over time. Participants frequently referenced peer input when describing subsequent instructional decisions, suggesting that the group served as a point of reference for continued reflection. The virtual format appeared to facilitate sustained participation across varied placements and schedules, allowing these conversations to unfold across sessions despite participants' physical separation. Table 3 presents a summary of the findings in accordance with the study's research questions.

4. Discussion

This study examined how pre-service teachers described their participation in a virtual Teacher Learning Community (TLC) during clinical placements, with particular attention to social learning, collaborative sensemaking, and the use of design thinking as an organizing framework for discussion. Building from the results, the

Table 3
Summary of findings by research question.

Research Question	Main Finding	Supporting Evidence
RQ1: How did participation in a virtual TLC support pre-service teachers' social learning, including opportunities for knowledge sharing and connection in an online environment?	The TLC supported peer connection, emotional validation, knowledge sharing, and collaborative sensemaking.	CoI coding; session transcripts; post-survey reflections; participant examples of validation, peer support, and shared strategy exchange
RQ2: How did pre-service teachers use the design thinking framework within the TLC to interpret and respond to instructional and classroom challenges encountered during their clinical placements?	Participants used the design thinking process to name challenges, generate strategies, try selected responses, and reflect on outcomes.	Design thinking phase coding; Table 2 categories; participant trajectories; examples of strategy testing and refinement

discussion considers two related but distinct findings: first, that the TLC functioned as a perceived space for connection and sensemaking, and second, that design thinking provided a structure for organizing practice-based dialogue. While prior research highlights the importance of collaboration and reflection in teacher preparation, fewer studies have examined how emotional, social, and pedagogical dimensions intersect within digitally mediated professional learning spaces for pre-service teachers. Importantly, the findings should be understood as participants' self-reported experiences within one small, exploratory study rather than as evidence of measurable instructional improvement or causal effects. The study's contribution lies in showing how virtual TLCs, CoI, and design thinking can be integrated to examine the interactional processes through which pre-service teachers make sense of clinical-placement challenges.

4.1. Virtual learning communities as supportive communities for pre-service teachers

Participants consistently described the virtual TLC as a supportive context for reflection and peer connection. These findings align with prior research emphasizing the role of collaborative communities in reducing isolation and supporting professional identity development in teacher preparation (e.g., [56,57]). Participants described the TLC as a space to openly discuss instructional dilemmas, share experiences, and feel understood by peers navigating similar challenges. However, these findings should be interpreted cautiously, as participants self-selected into the study and may have been more inclined toward collaboration, reflection, or peer support than candidates who did not volunteer. It is also possible that participants' perceptions of support were influenced by the opportunity for structured peer discussion itself, rather than by the virtual TLC format or design thinking framework specifically.

Participants' accounts suggest that bringing candidates together across program stages may have supported informal mentoring and peer-to-peer learning. This pattern is consistent with research indicating that mixed-cohort communities can foster richer dialogue and distributed expertise (e.g., [58]). More experienced participants shared strategies or contextual insights that others drew upon, although the study did not compare mixed-cohort groups with same-cohort groups. Thus, these findings suggest a possible benefit of cohort diversity rather than a confirmed effect.

Participants' descriptions of emotional strain—particularly feelings of overwhelm, uncertainty, and isolation—mirror patterns documented among novice and pre-service teachers more broadly (e.g., [19,59,60]). In this study, participants described the virtual TLC as one of the few spaces where such concerns could be expressed without judgment. The convenience of the online format, which allowed participants to join

from home shortly after field placements, was frequently noted as supporting sustained participation and candid discussion. These accounts suggest that virtual formats may reduce some logistical barriers to peer connection, but they do not establish that online communities are inherently more supportive than face-to-face or hybrid formats.

The TLC's structure aligned with the Community of Inquiry (CoI) framework [47], particularly in participants' descriptions of social presence. Emotional expression, validation, humor, and peer affirmation were prominent features of interaction, consistent with findings linking social presence to engagement and satisfaction in online learning contexts (e.g., [61–63]). Within this study, social presence appeared to function as more than emotional support; participants' accounts suggest that relational trust and open communication helped make instructional sensemaking possible.

A recurring theme across participants' accounts was limited or inconsistent mentor support during field placements. Participants described feeling constrained by unclear feedback, limited autonomy, or minimal guidance from mentor teachers—concerns well documented in the teacher education literature (e.g., [64]). In this context, the TLC appeared to function as an alternative space for sensemaking and affirmation, rather than a replacement for formal mentoring.

Participants also frequently foregrounded classroom management concerns, often prior to content-specific planning. This emphasis aligns with research showing that novice teachers commonly prioritize management as a marker of instructional competence (e.g., [65,66]). The TLC provided a forum for collectively discussing these concerns, helping participants reframe them as shared and contextual rather than individual failures. However, similar reframing may also occur in other structured peer discussion formats, including seminars, reflective supervision groups, or professional learning communities without design thinking. Thus, the findings point to the value of structured, facilitated peer dialogue while also suggesting that design thinking may be one useful way—but not the only way—to organize that dialogue.

Overall, this subsection highlights the TLC as a perceived relational and reflective support structure. Participants' accounts suggest that virtual professional learning communities may support pre-service teachers' sensemaking during complex field experiences, without presuming direct instructional or developmental outcomes.

4.2. Design thinking as a structure for collaborative sensemaking

While the first finding emphasizes the TLC as a supportive community, the second finding concerns how participants organized their discussions once that community was established. Virtual learning communities are often most effective when they include structures that support inquiry, interaction, and reflection (e.g., [67]). In this study, design thinking served as one such structure, providing a shared language through which participants organized discussion about classroom challenges. Rather than functioning as a prescriptive model or instructional intervention, design thinking appeared to operate as a flexible discourse framework, consistent with its theoretical emphasis on iterative problem framing and solution refinement in context. Because this study did not compare design thinking with other collaborative frameworks, the findings cannot determine whether the observed patterns resulted from design thinking specifically, the structured peer discussion format, facilitator prompts, or the relational support created within the TLC.

Participants' use of the design thinking phases aligned closely with dimensions of cognitive presence within the CoI framework, particularly during moments of problem articulation, exploration of alternatives, and reflection on attempted strategies [47,68]. Participants moved fluidly across empathizing, defining, ideating, prototyping, and testing, often revisiting earlier phases as new insights emerged. This movement reflects design thinking theory, which conceptualizes these stages as iterative and recursive rather than linear [12]. The theoretical contribution is not that design thinking caused instructional improvement, but

that design thinking provided an analytic and conversational structure through which CoI dimensions became visible in participants' interactions: social presence during empathizing, cognitive presence during problem framing and exploration, and teaching presence through facilitation structures that sustained reflection.

Although design thinking originated in innovation and STEM contexts (e.g., [69]), it has increasingly been examined as a tool for supporting collaboration and reflective practice in education (e.g., [70]). This study contributes to that literature by illustrating how pre-service teachers used design thinking language and practices to make sense of pedagogical and relational challenges within a virtual TLC. The framework was applied to issues such as behavior management, curriculum constraints, and instructional agency, serving as a structure for discussion rather than a tool for producing definitive solutions.

The empathize phase was closely tied to social presence, as participants listened to and validated one another's experiences. The ideate phase created space for multiple perspectives and encouraged participants to contribute contextually grounded strategies, consistent with research linking design thinking to divergent thinking and collaborative idea generation (e.g., [71]). Participants also justified proposed strategies by referencing prior placements, observed practices, or prior attempts, illustrating how experiential knowledge shaped group discussion. Together, these patterns suggest that design thinking may have helped organize a progression from emotional validation to strategy generation, although similar movement may also be supported by other collaborative inquiry models.

The test phase aligned with the TLC's recurring structure, as participants returned to share reflections on strategies they had tried. These reflections were framed as provisional and context-specific rather than as evidence of effectiveness. Participants discussed student responses as indicators for future adjustments, emphasizing ongoing refinement rather than resolution—consistent with research on reflective practice and teacher inquiry (e.g., [72–75]). Because classroom implementation was self-reported and not independently observed, these reflections should be interpreted as evidence of participants' perceived instructional decision-making and sensemaking, not as evidence that student learning or classroom outcomes improved.

Taken together, these findings suggest that embedding design thinking within a virtual TLC may offer a useful framework for organizing collaborative reflection among pre-service teachers. Rather than serving as an intervention with measurable effects, design thinking functioned as a shared structure for discourse that supported collective interpretation of practice-based challenges within a supportive online community. The study's contribution is therefore theoretical and descriptive: it shows how CoI and design thinking can be integrated to examine the relational conditions, collaborative inquiry processes, and iterative problem-solving routines that shape pre-service teachers' self-reported experiences in a virtual TLC.

4.3. Limitations

This study has several limitations. First, the participant pool was small ($n = 7$) and drawn from a single teacher preparation program, which limits the transferability of the findings to other contexts and may reflect institution-specific structures and experiences. Additionally, participants were self-selected volunteers, which may reflect a group more inclined toward collaboration, reflection, or engagement in professional learning contexts, potentially introducing sampling bias and limiting the range of perspectives represented.

Second, although the virtual format offered flexibility and convenience, the TLC met only four times due to scheduling constraints. A longer duration or additional sessions may have provided more longitudinal insight into participants' evolving perspectives, including the development of sustained professional relationship, deeper instructional reflection, and the sustainability of these processes over time.

Because the study relies on participants' self-reported experiences,

the findings reflect participants' perceptions of their engagement and learning rather than independently verified changes in instructional practice. As such, interpretations should be understood as accounts of participants' experiences rather than direct evidence of instructional impact.

Another consideration is the prior relationship between the lead author and some participants. As an instructor in the teacher preparation program, the lead author had previously worked with three participants. While this familiarity may have contributed to openness and trust within the TLC, it also introduces the potential for response bias or participant deference. Steps were taken to mitigate this risk by emphasizing voluntary participation, participant autonomy, and the non-evaluative nature of the TLC, and by intentionally centering participants' voices during both sessions and analysis. Nevertheless, this dual role—particularly within an online setting where interactional cues may be attenuated—should be acknowledged as a possible influence on participant interaction and interpretation of the data.

Despite these limitations, the study offers insight into how pre-service teachers described their participation in a virtual learning community structured around relational dialogue and collaborative sensemaking. The findings contribute to understanding how pre-service teachers interpret emotional and instructional challenges during field placements within digitally mediated contexts, an area of increasing relevance as teacher education programs expand online and hybrid learning opportunities.

4.4. Implications

4.4.1. Theoretical implications

The findings contribute to research on teacher learning and professional communities by illustrating how interactional processes within virtual environments support collaborative sensemaking. Consistent with the CoI framework, participants' accounts highlight the central role of social presence in enabling engagement with instructional challenges. At the same time, the integration of a design thinking framework extends existing understandings of virtual learning communities by demonstrating how structured, iterative processes can support movement from sharing experience to instructional reflection.

Together, these findings suggest that virtual professional learning environments may be effective when they integrate both relational conditions for dialogue (CoI) and process-oriented structures for inquiry (design thinking). This integration offers a conceptual lens for examining how collaborative interaction is translated into practice-based reflection within digitally mediated teacher education contexts.

4.4.2. Practical implications for teacher education

The findings suggest several practical considerations for teacher education programs seeking to supplement traditional coursework with collaborative, practice-oriented learning experiences [8,76]. Participants described feelings of isolation, uncertainty, and limited instructional autonomy during clinical placements—experiences that are well documented among novice teachers. The virtual TLC examined here illustrates one possible approach programs may consider when designing additional spaces for peer interaction and reflection alongside field-based learning.

Leverage Virtual Formats for Accessibility and Flexibility. Participants described the online format as reducing logistical barriers, particularly related to travel and scheduling. The ability to join sessions from campus housing or immediately following field placements appeared to support participation within existing responsibilities. These accounts align with research calling for technology-enabled structures that respond to the practical realities of teacher candidates' schedules [77]. Virtual learning communities may be more effective when they include interactive elements and are designed around participants' needs [7].

Prioritize Social Presence and Psychological Safety. Findings

suggest that social presence in virtual environments is not automatic and requires intentional facilitation [78]. Participants noted that opening prompts, check-ins, and informal dialogue helped establish a welcoming tone and encourage participation. Prior research similarly emphasizes the importance of relational communication for trust-building and engagement in online settings [79–81]. Teacher educators designing virtual learning communities may wish to foreground these practices as part of instructional design.

Embed Reciprocal Mentoring. Participants described patterns of reciprocal mentoring, with members alternately offering and receiving feedback based on their experiences across placements and program stages. Such structures may support professional learning and reduce isolation among novice educators [82,83]. Programs may consider how peer-to-peer mentoring can be intentionally supported within virtual or co-curricular learning spaces, particularly when placement-based mentoring is inconsistent [64].

Design for Structured Flexibility and Agency. Engagement appeared to be supported by a balance of structure and flexibility, including predictable meeting schedules, a consistent agenda, and participant choice in identifying challenges and strategies. These features align with recommendations for effective professional learning communities [27,76,84–86]. Bi-weekly sessions may also provide sufficient time for participants to reflect on and discuss classroom experiences between meetings.

The design thinking framework appeared to provide a shared structure for organizing discussion and reflection. Participants used this structure to articulate challenges, consider responses, and reflect on instructional decisions within their contexts. Rather than prescribing solutions, the framework offered a common language for iterative inquiry. Embedding similar inquiry-oriented structures in coursework or co-curricular learning opportunities may support candidates in interpreting challenges as opportunities for reflection and adaptation rather than as individual shortcomings [87,88].

4.5. Conclusion

This study examined how pre-service teachers described their experiences participating in a virtual Teacher Learning Community during clinical placements. Participants characterized the TLC as a space for connection, collaborative discussion, and reflection on instructional and emotional challenges associated with early teaching experiences. Their accounts highlight how intentionally designed virtual communities may serve as contexts for shared sensemaking alongside field-based learning.

The integration of a design thinking framework appeared to offer participants a shared structure for organizing discussion and reflecting on practice. Rather than functioning as a linear problem-solving model, design thinking appeared to operate as a conversational framework that supported iterative reflection across sessions.

Together, these findings extend research on technology-enhanced teacher education by illustrating how pre-service teachers engage with virtual professional learning spaces. As teacher preparation programs continue to expand online and hybrid offerings, virtual TLCs represent one approach for facilitating relational dialogue and collaborative reflection in support of teacher candidates' ongoing development. These findings also contribute to ongoing efforts to design effective, relational, and practice-oriented learning experiences in digitally mediated teacher preparation contexts.

CRedit authorship contribution statement

Kristin Johnson: Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Alison Hooper:** Writing – review & editing.

Declaration of competing interest

The authors declare no conflict of interest.

Acknowledgements

The authors thank the participating teacher candidates for sharing their time, experiences, and reflections.

Appendix A

Facilitation Prompts and Session Protocol Session Structure

- Opening check-in (5 min)
- Problem surfacing (10 min)
- Collaborative ideation (25 min)
- Action planning (10 min)
- Reflection and closure (10 min)

Sample Facilitation Prompts *Opening Check-In (Empathize)*

- “What felt most challenging in your classroom this week?”
- “What is one moment that stuck with you from teaching this week?”

Problem Surfacing Prompts (Empathize/Define)

- “Can you describe a situation that didn’t go as planned?”
- “What do you think students were experiencing in that moment?”

Collaborative Ideation Prompts (Ideate)

- “What are some different ways this could be approached?”
- “What might happen if you tried __?”

Action Planning (Prototype)

- “What is one strategy you’re willing to try before next session?”

Reflection (Test)

- “What did you notice when you tried the strategy?”
- “What would you adjust next time?”

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