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# Learning Across Levels: Conceptualizing Transitional Space

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**Abstract:** This paper conceptualizes *Transitional Space* as a framework for understanding how learning moves between individual and collective levels in *CSCL*. While prior research has revealed how groups construct shared meaning, how these collective advances become personally meaningful for individual learners is less articulated in a systematic way. *Transitional Space* reframes this relationship by conceptualizing learning as a relational movement in which collective knowledge construction and individually understanding continuously influence one another. The framework comprises two complementary facets: *enacted Transitional Space* capturing the interactional moments when group constructed ideas surpasses/below some members' current understandings and *supported Transitional Space* highlighting the designable conditions that support these moments through tools, scaffolds, and structured activities. Two facets link the emergent and designed dimension of cross-level learning, emphasizing how *Transitional Space* makes visible and actionable the dynamic processes through which collective knowledge becomes individual sense-making, and how design supports these movements across levels.

## Introduction

Collaborative learning brings numerous benefits, yet classroom enactment remains difficult. Teacher must adopt unfamiliar practices, students must invest effortful participation, and assessment mostly privileges individual products, creating tension with collective work (Hakkarainen, 2009). Design guidance to address these persisting challenges is likewise fragmented, though research offers insights about task sequencing and tools (Celepkolu et al., 2017). Such practical considerations also reveal deeper theoretical challenges. First, how students internalize knowledge, artifacts, or other resources that are constructed in collaboration (Lawrence & Valsiner, 1993). Second, whether, and in what ways, individuals advance their own understanding when they externalize thinking in relation to the group's activity (Scardamalia, & Bereiter, 2021). Third, what are sufficient support to mediate social interactions in ways that enhance learning (Zhang et al., 2018). These questions are intricately linked, requiring a coherent framework that guides the design of learning environments. This work conceptualizes the framework of *Transitional Space* to addresses this challenge by reviewing existing perspectives, identifying their limitations, advocating for a more integrated approach that foregrounds the interdependence of individual and collective level of learning, and discussing the implications for supporting learning environment design and in-school collaborative learning practices.

## What is cross-level learning in CSCL?

### Define cross-level learning and its empirical evidence

Collaborative learning requires learners to participate in activities with others to achieve a desired goal (Rogoff et al., 1995). Individuals make sense of ideas of others while bringing theirs (Scardamalia & Bereiter, 2021). Thus, they constantly shift between individual and collective level of thinking (Stahl, 2013), no matter in a sequence of deliberately design activities or just within one activity. For the former, individual students may need to participate in one activity that requires them to think alone first followed by a shared-out or group work (Celepkolu et al., 2017). This requires them to switch the planes of activities through the structure of activities. For the latter, individuals engage in temporal transitions between individual thinking and collective reasoning and negotiating (Damşa et al., 2019). Therefore, learning across levels is the process through which knowledge, practice, and understanding emerge and transform through continuous transitions between individual and collective levels. Through participation in shared activity, personal recourses are externalized and reconstructed in social plane (Rogoff et al, 1995). Simultaneously, collective discourse serves as mediating structures through which individuals internalize shared meaning and extend their personal understanding (Vygotsky, 1978; Wertsch, 1991). As such, collaborative learning is neither exclusively internal nor purely social. It is co-constituted through dynamic coupling of individual sense-making and interactions at the collective level.

A substantial body of CSCL research also provides empirical evidence that learning unfolds across level, though often without explicit theorization of how learning traverse levels. Knowledge Building grounded studies

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unpack how knowledge is constructed collectively through individuals' continuous contribution. For example, Zhang et el., (2018) reveals that community knowledge influenced both their personal understanding and the collective advancement of ideas. Group cognition perspective illustrates that the shared meaning emerges through the coordination of ideas in discourse. Through the construction of shared problem spaces, collective reasoning is built upon the articulation and uptake of individual perspectives (Stahl, 2013, 2016). Research unpacks productive interactions show that effective collaboration depends on how individuals align contributions to sustain shared inquiry and joint problem solving. When coordination fails, even capable individuals may not benefit from group work (Barron, 2003). In addition, studies using Socially Shared Regulation and Group Awareness adds another layer to this evidence. Järvelä and Hadwin (2013) demonstrated that regulation process, including planning, monitoring, and adapting strategies, can occur collectively and support both group productivity and individual metacognitive development. Tools that visualize group progress foster awareness that connects individual engagement to collective outcomes (Schnauber & Bodemer, 2022). Together, these suggest that collaborative learning constantly requires students across levels through mediation of other, tools or the environment itself.

### Why need to emphasize learning across-level?

Despite this empirical progress, we grapple with theoretical gaps that stem from the underlying assumptions of these studies, which can be considered as major approaches. First, the individual-centered approach mainly investigated how individual learning occurs as a result of collaborative learning. These studies usually root in cognitive and individual constructivist traditions, assuming that learning is the mental restructuring within individual (Chi, 2009). Therefore, individual is usually the unit of analysis with the assumption that collaboration provides stimuli or create condition for conceptual change. Consequently, the transition between group participation and individual understanding is treated as an implicit byproduct without theorized. Second, the group-focused approach emphasizes that the collectively constructed knowledge products/artifacts as the main indicator of learning. Studies usually ground into sociocultural, socio-material, socio-technical or distributed cognition perspectives (Pea, 1993; Vygotsky, 1978). They posit that learning is inherently social and knowledge does not belong to individual's mind. Therefore, learning is evidenced in group-level achievement, such as co-regulated actions, group cognition or knowledge advancement (Järvelä & Hadwin, 2013; Scardamalia & Bereiter, 2021; Stahl, 2016). Individual variability in participation is usually overlooked. Group-level success becomes the main unit of analysis, and sometimes, the endpoint of analysis, masking the diverse individual trajectories that underlie it. Third, the learning ecology perspective attempts to reconcile these views by treating individuals and collectives as interdependent, and learning occurs through their coordination and co-development (Damșa et al., 2019; White, 2018). However, many studies still examine individual learning after group work, rather than the transitions linking them. The challenge remains to explain how individual actions become part of collective work, and how collective achievements transform personal understanding.

Across these approaches, the persistent gap lies in the lack of systemic theorization of transitions across levels in CSCL. Existing models describe learning within levels or eventually reduce cross-level learning to one level. Without a theoretical framework to capture these transitions, design and analysis remain limited: educators may observe uneven participation or divergent learning outcomes but lack conceptual tools to interpret or support effectively. This motivates a framework that theorizes the relational, iterative, and mediated learning across levels.

## *Transitional Space*: A conceptual framework

### Theoretical grounding

Learning across levels is inherently relational (Lawrence & Valsiner, 1993; Stahl, 2016). Vygotskian sociocultural theory provides the foundation for this stance by locating learning as originating in social interaction and becoming internalized through participation in shared activity (Vygotsky, 1978). Higher mental functions first emerge between people on the inter-psychological plane before being reconstructed within the individual, on the intra-psychological plane. This view foregrounds interaction, language and cultural tools as mediators of learning: the mechanisms through which collective meaning-making becomes individual understandings (Bakhtin, 2010; Wertsch, 2001). Yet Vygotskian also implied reciprocity in this movement: individual development, once achieved, re-enters the social plane as learners contribute new ideas and practices, reshaping the collective environment from which their learning emerged. In summary, it reveals internalization and externalization as intertwined and continuously negotiated across levels of activity. Development occurs not within the boundaries of individuals or groups alone but through the transition that connects them to the spaces where social interaction and personal understanding intersect. This theoretical stance forms the foundation for the framework proposed here. By building on this perspective, *Transitional Space* captures the conditions, mechanisms, and supports that make such movement across levels observable and analyzable in a collaborative learning environment.

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## Theorizing the framework: *Transitional Space*

We define it as a condition that an individual learner encounters and works with ideas generated in collaboration to refine their own thinking when students are in the discourse of the collaborative work. It can occur whenever a learner engages with group's ideas during collective discussion or when the learner independently synthesizes the group's contributions in a subsequence activity. It captures the relational process that links collective knowledge advancement with individual sense-making, emphasizing that learning occurs not solely within social interaction or internal cognition but in the movement between them (Rogoff et al., 1995; Wells, 2015). *Transitional Space* therefore provides a lens for understanding how learners traverse the boundaries of between collective and individual levels: how collective ideas are externalized, taken up and internalized in diverse ways in the discourse.

### Enacted *Transitional Space* (interactional)

It responds to a central limitation in existing approaches to collaborative learning: the account of how collective progress becomes available for individual learning in the very moments when it occurs. It brings this invisible process into view by capturing the interactional junctures in which group reasoning advances beyond the understanding of some participants, creating openings for new forms of participation and sense-making. In these moments, the collective generates conceptual resources that individuals can draw on, reinterpret, or resist, and the resulting exchanges determine whether group level advancement contributes to individual transformation. In this way, enacted *Transitional Space* provides a theoretical and analytical means to observe the movement learning across levels as it unfolds in real time, rather than inferring it from outcomes after collaboration ends. It has two defining features that together explain how such cross-level movement becomes available.

First, it is enacted because it does not pre-scripted in the design or structure of the task but emerges dynamically from collaboration. When individuals encounter understandings that challenge their current understanding and invites reorganization of their thinking as a result of the group's discourse, a zone of possibility for transitions is created (Cang et al., 2024). Within this process, articulation and uptake play a central role. Articulation occurs as individuals externalize their thinking, through talk or contribution to shared artifacts, making internal processes and ideas accessible to others and expanding the group's joint knowledge constructing (Scardamalia & Bereiter, 2021). Uptake occurs as participants respond to, adapt or extend these articulated ideas, appropriating them in ways that connect collective insights with personal understanding (Stahl, 2013). The interplay of articulation and uptake thus makes the transitions observable through these cycles that ideas circulate, evolve and bridge the space between group-level meaning and individual sense-making. Second, it is interactional because the existence and accessibility of this space depend on how participants relate to one another. Some learners enter the discourse actively, integrating group ideas into their own reasonings, others remain peripheral or even disengaged, limiting their ability to benefit from collective advancement (Cang et al., 2024). The interactional patterns, which are revealed by the reciprocal moves of articulation and uptake, determine who can access the evolving collective understandings and how deeply they can engage with it (Lawrence & Valsiner, 1993). Both features indicates that *Transitional Space* is fragile and contingent. It arises only under specific discursive and social conditions that are often in unpredictable ways (Damşa et al., 2019). Its presence depends on the deviate or alignment between collective knowledge construction and individual participation trajectories (see another paper by Cang et al., 2026 in the same volume of this proceeding). Recognizing this fragility clarifies why collaborative learning cannot be assumed to produce reciprocal benefit: learning occurs when individuals successfully traverse enacted space, not simply by being present in groups.

### Supported *Transitional Space* (design)

As the second facet, it complements the emergent nature of *Enacted Transitional Space* by emphasizing the intentional design conditions that make cross-levels learning possible and sustainable. While enacted dimension captures the spontaneous emergence of opportunities for learning within interactions discourse*, Supported Transitional Space* addresses a different but equally critical challenge, how to create environments enabling learners to reorganize, revisit and work productively with these chances. Collaborative learning does not automatically produce such transitions. Even when group work generates collective advances, learners may not have the time, structure, or tools to engage deeply with them (Celepkolu et al., 2017). *Supported Transitional Space* responds to this gap by focusing on how design features (, including tasks, scaffolds and representational resources, shape the conditions through which collective ideas can become personally meaningful.

It is featured by, first, supported because transitional processes rarely arise or persist on their own productively. Without structured opportunities to re-engage with group ideas, learners may leave collaborative activity without integrating the collective knowledge they helped generate. It thus depends on carefully designed scaffolds that bridge the gap between collective and individual understanding (Puntambekar, 2015; 2022). These scaffolds may take the form of sequenced activities that alternate between group and individual work, prompts

that encourage reflection on shared ideas, or tools that preserve and visualize group reasoning for later use (Zeng et al., 2024). Moreover, within these designed conditions, the processes of articulation and uptake that drive *Enacted Transitional Space* are intentionally extended and maintained. Opportunities for articulation, such as prompts to explain claims, annotate group products, or summarize evolving ideas, help learners externalize and refine their thinking after the group interaction. Opportunities for uptake, such as reflection tasks, comparison activities, or revisiting shared artifacts, encourage learners to interpret, adapt, and sense-making the group's collective work at their own pace. The temporary moments of understanding can be transformed into continued participation with shared knowledge, allowing individuals to advance and personalize what was collectively constructed (Cang et al., 2024). These designed features function also serve as mediating structures that make collective understanding traceable, accessible, and revisitable over time (Tissenbaum & Slotta, 2019), which is second key feature that create condition for ongoing articulation and uptake across levels of activity.

In this sense, *Supported Transitional Space* addresses the fragibility of enacted dimension by providing external conditions that support the movement of knowledge across levels. Whereas *Enacted Transitional Space* emerges unpredictably through discourse, *Supported Transitional Space* embeds opportunities for transition within the design of the learning environment. It stabilizes collective advances while creating new zones for articulation and uptake, enabling learners to return to and work with group ideas until they become personally meaningful. If *Transitional Space* is theorized only interactionally, then its existence is confined to observable high-quality group talk and participation. But this misses how unevenly individuals may benefit: some remain peripheral, unable to internalize. Conversely, if *Transitional Space* is framed only as a matter of design, the analysis risks overlooking the emergent dynamics of group discourse itself: one cannot scaffold a process without knowing when and how it arises spontaneously in interaction. Each facet reveals dimensions of the collaborative learning situation, providing a focused lens on aspects that are most relevant to the corresponding perspective. Together, these two facets foreground *Transitional Space* as both an emergent property of interaction and a product of design, providing a lens for analyzing and supporting how learners traverse the levels in learning.

## Discussion and conclusion

Although few learning environments have been created explicitly to support *Transitional Space*, research provides insights into how particular design features enable across-level learning. Several guiding principles can be inferred to support transitions: (1) allow continuity and revisitation of previous ideas (Zhang et al., 2018), (2) enable visibility and accessibility of group knowledge (Schnabert & Bodemer, 2019), (3) enable reflection and interpretation of shared knowledge into personal understanding (Strauβ et al., 2024), and (4) integrate individual and collective activities (Celepkolu et al., 2017). These inferred principles do not prescribe fixed features but highlight how learning environments can be designed to make the transitions identified in *Transitional Space* more durable, observable, and actionable (see another paper .

In facilitating for cross-level learning, teachers may face additional challenges in guiding the temporal flow and interactional dynamics of collaborative learning. Some groups advance rapidly while others stall, and connections between levels are often left implicit (Olsen et al., 2021). Discourse quality varies widely: students may engage in procedural talk or remain hesitant to challenge peers (Clark, 2015). Decisions on when and how to intervene without interrupting its emergence are inherently challenging. From a *Transitional Space* standpoint, such orchestration problems arise because transitions themselves are under designed pedagogically. Instruction typically emphasizes maintaining talk within levels rather than linking them meaningfully across levels. When collaborative work moves forward, its potential to inform subsequent learning is often lost due to a lack of explicit bridging mechanisms. Studies point to sone strategies for design: flexible collaboration scripts can support coordination without over-regulating interaction (Strauß et al., 2024), awareness tools help teachers identify moments of imbalance or conceptual progress (Janssen & Bodemer, 2013). Yet these tools are most effective when coupled with *Transitional Space* thinking: when teachers treat the support of transitions as learning opportunities rather than logistical shifts. For example, a teacher might pause group discussion when new reasoning emerges, label the idea and prompt reflection before moving on (Clarke, 2015). These small interventions stabilize enacted *Transitional Space* and transform them into supported opportunities for continued learning. However, *Transitional Space* cannot by itself resolve all orchestration demands. Timing and sensitivity to students' affective and disciplinary contexts remain matters of teacher decision. It provides a conceptual lens for noticing and designing transitions but does not substitute for the improvisational expertise required to facilitate meaningful discourse.

Future work should empirically trace how transitional moments unfold, examine how different designs support their uptake, and explore how tools and instruction together support these cross-level movements. By treating learning as a continuous process that flows between social interaction and personal understanding, *Transitional Space* aims to provide a coherent foundation for linking theory, method and design in CSCL.

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