Guide on the Side or Sage on the Stage?: Exploring the Relationship between Teachers' Spatial and Verbal Discursive Strategies

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Abstract. How teachers move through and position themselves in classroom spaces, relative to students, plays a critical role in structuring classroom interactions. While research in Multimodal Learning Analytics (MMLA) has explored these socio-spatial behaviors, less work has examined their intersection with verbal discursive strategies. This study investigates how teachers' movement patterns and classroom design could be used to contextually interpret dialogic teaching strategies. Using data from the TIMSS 1999 Video Study, this paper presents an analysis of four U.S. mathematics and science lessons featuring distinct classroom layouts (row-desks and grouped-desks). Using Ordered Network Analysis (ONA), the study explores (1) how teachers' spatial proximity to students relates to patterns of verbal teaching moves and (2) how classroom design influences these relationships. The findings contribute to a deeper understanding of teaching strategies, showcasing how ONA could be used to interpret how spatial and dialogic pedagogical strategies interact to shape classroom discourse. By comparing lessons across different subjects and configurations, this study aims for a richer understanding of how teacher movement and dialogic discourse relate and highlights the need for more systematic studies of multimodal teaching.

Keywords: Teachers, Socio-spatial Behaviors, Teaching Strategies, Multimodal Data, Ordered Network Analysis.

1 Introduction

In recent years, the concept of spatial pedagogy [1], or how teachers move through and position themselves in classroom spaces, has received growing attention in the learning sciences, particularly as interest in Multimodal Learning Analytics (MMLA) expands [2, 3, 4, 5, 6]. Although MMLA methods offer the possibility of bringing multiple modalities into the analysis of learning [7]—speech, movement, gesture—few studies have looked closely at how teachers' spatial pedagogy and dialogic teaching strategies intersect. If we consider both spatial and verbal discursive strategies as forms of pedagogy, then mapping their relationship may reveal how teachers coordinate instructional intent across multiple modalities.

To explore this relationship, this study draws on data from the TIMSS 1999 Video Study [8] which documented eighth-grade mathematics and science instruction across seven countries. From this extensive dataset, 53 lessons were made publicly available, including video recordings, transcripts, curricular materials, and teacher interviews. Building on the work of Shapiro et al. [9], who analyzed teacher movement maps for a subset of these lessons, this study focuses on four lessons from the United States. Specifically, this paper investigates how Ordered Network Analysis (ONA) can be used to explore (1) what patterns of discursive teaching moves are linked with different spatial strategies (i.e., when a teacher is near or distant from students) and (2) what patterns of discursive teaching moves are linked with different classroom designs (i.e., grouped desks or row desks).

2 Background

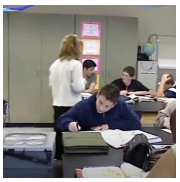
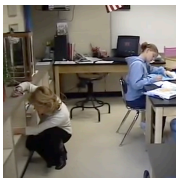
2.1 Socio-spatial Behaviors

Spatial pedagogy refers to how teachers' physical positioning within a classroom, not simply where they stand or walk, but how teachers move with pedagogical intent, structures how they teach. Lim et al. [1] identify four distinct socio-spatial behaviors: authoritative space, where teachers position themselves to command attention or deliver instruction to the whole class; supervisory space, where they circulate and check in briefly with students; interactional space, marked by sustained engagement with individual students or small groups; and personal space, in which teachers momentarily disengage from student interaction, for example, to review materials or manage classroom resources (Table 1).

MMLA studies have used location data to infer meaningful instructional practices concerning spatial pedagogy. For instance, Martinez-Maldonado et al. [2, 3] found that educators' spatial movement in open learning spaces could be connected to the structure of their lessons, and in follow-up work, these patterns were also linked to student collaboration and group cohesion [10]. In both these cases, teachers' spatial behavior is treated not just as absent-minded movement, but as pedagogy—a way of distributing attention and structuring interaction.

Yet even with these, much of the existing literature analyzes teacher movement in isolation, without systematically examining how spatial strategies interact with dialogic teaching strategies. Zhao et al. [6] begin to bridge this gap by incorporating teacher movement and dialogue in their use of Epistemic Network Analysis (ENA) to study collaboration in different learning environments and creating visualizations for end-users (teachers). However, in their approach, spatial data is primarily used to define conversational segments, confining analysis to singular spaces, rather than to interrogate socio-spatial behaviors as sequential instructional behaviors. This distinction matters: if teacher movement is pedagogical, then understanding when and how spatial behaviors shape dialogic strategies is critical to uncovering how classroom spaces are used to shape multimodal (verbal and spatial) teaching practices.

Table 1. Socio-spatial behaviors and examples from TIMSS 1999.

Behavior	Description	Example
Authoritative Space	Positioning to regard the whole class; often in the front of the classroom; sometimes among students, but repositioned to maintain distance from closer students	
Supervisory Space	Moving around between students, supervising, and making quick check-ins with students	
Interactional Space	Proximity to a single or group of students, particularly when the teacher is interacting with objects in front of a student, or leaning in to talk to the student	
Personal Space	Teacher preparing materials for the next stage of class; behind the teacher's desk; organizing materials	

2.2 Classroom Design and Teaching Practices

Closely related to teachers' movement and socio-spatial behaviors is the design of classrooms. Research on flexible learning spaces has shown that physical design shapes collaboration, student engagement, and perceptions of teaching. Byers et al. [11] found that students perceived teachers in flexible classrooms as more responsive and engaging, suggesting that the design of the space may shift pedagogical approaches in ways that students recognize. These effects are not merely perceptual: other studies suggest that classrooms with affordances like movable furniture and multiple settings for interaction enable deeper, more collaborative learning experiences [12]. Barrett et al. [13] offer additional evidence that physical classroom design matters—not only in necessities like air quality and lighting, but in how specific design elements influence learning and social engagement. Importantly, their research also calls attention to the concept of affordances: the idea that spaces offer (or limit) certain types of interactions. Reinius et al. [14] and Goodyear [15] similarly emphasize that design attributes, such as the presence or absence of barriers, flexibility of furniture arrangements, or the visibility of shared resources, play a central role in shaping instructional practices. In Goodyear's

framework of analysis, this requires zooming in on practice itself—attending not only to what teachers say and do, but also to the temporal and material patterns through which they accomplish their work. Such a perspective highlights the interdependence of the spatial, the material, and the discursive in understanding how teaching unfolds.

Despite this, few studies have systematically linked socio-spatial behaviors, classroom design, and conversational discourse. Teachers may adapt their spatial strategies in response to a classroom's physical constraints or affordances, but how these adaptations affect verbal teaching, especially in relation to proximity to students, remains underexplored. By comparing classrooms with different layouts, this study seeks to better understand how spatial positioning, classroom design, and discursive patterns interact to form complex, multimodal teaching strategies.

3 Methods

3.1 Data Preparation

The TIMSS 1999 Video Study documented eighth-grade math and science instruction across seven countries, offering insights into teaching practices through synchronized video, transcript, and contextual data (e.g., teacher interviews, interviewer notes, lesson materials). All names documented in the transcript were also given pseudonyms in the original study. The following videos and transcripts were collected from the TIMMS Video website[1]: US1_Science, US4_Science, US1_Math, and US4_Math (Table 2). These lessons were selected for complexity of teacher movement during student work time, offering rich ground for studying how spatial patterns might provide context to verbal ones. The sample also reflects a balance of classroom layouts: one math and one science lesson with row desks, and one math and one science lesson with grouped desks. The transcripts were converted so that each line of data was one second, and each line of conversation was included as metadata, for ease of coding.

Table 2. Metadata of each dataset.

	Room Design	Length	Lines	Teacher Talk (%)	Distant (%)	Near (%)
Weather (Sci1)	Grouped	55m 53s	958	54%	48%	52%
Secant and Tangent (Math1)	Grouped	44m 55s	939	52%	17%	83%
Rocks (Sci4)	Row	40m 57s	511	62%	71%	29%
Graphing Linear Equations (Math4)	Row	44m 31s	581	68%	82%	18%

[1] https://www.timssvideo.com

3.2 Analyzing Teachers' Discursive Moves

This study examines how teachers' socio-spatial behaviors are linked to specific dialogic discourse patterns. To analyze these patterns, the dataset was coded along two dimensions, spatial position of teachers (Table 1), drawn from Lim et al. [1], and teacher discourse moves (Table 3), iterated from Chin [16].

Table 3. Codebook for dialogic teaching moves.

Code	Description	Examples
Direct Instruction	Includes content explanation, direct, "matter-of-fact" responses to student questions, and task instructions	"What it shows is that that tube gets split and splits up this way, and that's the beginning of a funnel cloud. It's very cool."
Elicitation	Posing questions to students to elicit participation and recall of previous knowledge, and inviting students to share new thoughts or answers to questions	"What do you notice about the fronts and the high pressure; and the fronts and the low pressure?"
Pressing	Asking a student to articulate or verify their own or another student's ideas, challenging students' ideas for further elaboration	"So that means?" "Okay. It looks like you made a nice table here, though. You understand what you did there?"
Evaluating	Assesses student progress by affirming or correcting student work, providing direct suggestions to further students' work or ideas	"Okay. Oh by the way guys, I like how you labeled them, like that." "That's it. You got it. You got it. Ben, see what Chris did there."
Check In	Checking in on student work, checking in on student(s) during instruction (e.g., checking for attention)	"Okay. So you're gonna make a X Y table. Do you agree, Ben?" "Who's done?"
Classroom Management	Keeping students on task, organizing seating arrangements, and managing student behaviors	"Two more? You might finish if you don't talk." "Everybody. Ladies and gentlemen, listen up."

First, the teachers' socio-spatial behaviors were coded manually using the video data (Table 1) for each lesson. Due to the relatively limited use of *personal* and *supervisory* spaces, the socio-spatial behaviors were condensed into when teachers were near students (*supervisory* and *interactional*) and distant from students (*authoritative* and *personal*). Then, dialogic discourse codes (Table 3) were applied to each line of conversation. This scheme began with a deductive scheme based on Chin [16], who categorized teacher questioning and feedback into three primary functions: *draw out*, *cue and provoke*, and *reinforce*. Specifically, this work focuses on how teacher talk shapes student reasoning in science classrooms using discourse analysis. These categories were adapted to three initial codes that better aligned with this study's goal of understanding teaching behaviors: *elicitation*, *pressing*, and *evaluating*. Elicitation captures moments

when teachers ask open or recall-based questions to draw out student ideas. Pressing includes prompts for elaboration, clarification, or reasoning, often framed as follow-up questions to invite deeper reasoning. Evaluating includes affirmative or corrective feedback and scaffolding suggestions to guide student work. Additional categories emerged inductively to account for other relevant aspects of teaching practice: direct instruction, check-in, classroom management, and student talk.

The codebook was validated through inter-rater reliability (IRR). Two researchers independently coded 200 lines of data. The constructs that did not meet Cohen's Kappa of 0.7 were further discussed between the researchers and resolved through social moderation and descriptive changes to the codebook (Direct Instruction = 0.79, Elicitation = 0.81, Pressing = 0.75, Evaluating = 0.73, Checking In = 0.76, Classroom Management = 0.76, Student Talk = 1.00). The author then completed coding the data. In total, 2989 lines of conversation were coded.

3.3 Ordered Network Analysis

Epistemic Network Analysis (ENA) and Ordered Network Analysis (ONA) offer affordances for modeling the complexity of teaching by tracing how elements, such as knowledge and discourse, can provide context to interpret teaching practices. Previously, ENA has been used to analyze teachers' lesson planning [17], online collaboration around teachers' Technological Pedagogical Content Knowledge [18], and the epistemic frames shaping instructional decision making [19]. These studies reveal how teaching involves coordinated networks of reasoning, not just isolated actions.

While ENA captures the structure of co-occurrences, ONA adds to the temporal layer, visualizing the *sequence* of teaching moves. This makes it particularly useful for examining classroom discourse, where sequencing carry pedagogical weight. This study explores how instruction unfolds across space and time by applying ONA to a dataset that combines teachers' socio-spatial behaviors with dialogic teaching moves.

For this study, two ordered networks were generated using the ENA Web Tool[2]. Both networks consider the lessons as the conversational variable to ensure connections are contained within respective contexts. For both models, window sizes of 4 and 5 were tested and found to show no meaningful visual or statistical differences. Ultimately, a window size of 5 was chosen for both models.

The first model compares the dialogic teaching patterns while teachers are distant or near students. Thus, the unit of analysis is the spatial behavior of teachers (distant or near students), subset by classroom types and lessons. The Pearson and Spearman co-registration correlation for the first model is r = 1.00 for the first dimension and r = 0.99 for the second dimension, indicating a strong goodness of fit. The second model compares dialogic teaching patterns within different classroom types. The unit of analysis is the classroom type (row or grouped), subset by spatial behaviors and lessons. The Pearson and Spearman co-registration correlation for the second model is r = 0.98 for the first dimension and r = 1.00 for the second dimension, indicating a strong goodness

[2] http://app.epistemicnetwork.org/

of fit. For both models, a Mann-Whitney test was calculated to test if the mean difference between the two groups (distant or near; row or grouped) was statistically significant. Additionally, all connections with edge weights less than 0.03 were hidden in both ordered networks to maintain visual clarity in the models.

4 Findings

In the findings, I examine how teachers' socio-spatial behaviors—whether near (interactional/supervisory) or distant (authoritative/personal) from students—shape dialogic patterns. Specifically, this section explores (1) what patterns of dialogic teaching moves are linked with different spatial strategies and (2) what patterns of dialogic teaching moves are linked with different classroom types.

4.1 Dialogue and Socio-Spatial Behaviors: Distant vs. Near Students

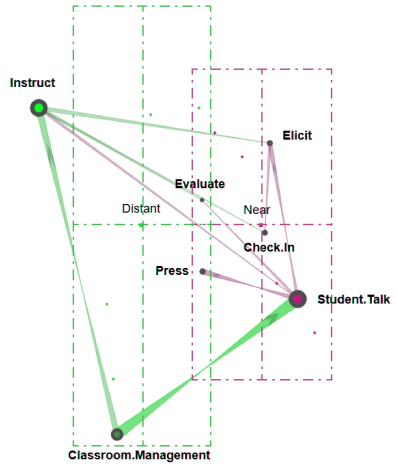


Fig. 1. Difference model of dialogic discourse moves between *distant* socio-spatial behaviors (green) and *near* socio-spatial behaviors (purple).

When teachers are physically near students, their discourse tends to be more responsive, fostering student reasoning through sustained questioning, whereas distance correlates with more directive instruction and classroom management. The first model (Figure 1) compares dialogic patterns between when a teacher is near students and when a teacher is distant from students. Along the X axis (MR1), a Mann-Whitney test showed that the dialogic patterns when teachers are distant from students (Mdn = -0.18, N = 4) was statistically significantly different from the dialogic patterns when teachers are near students (Mdn = 0.15, N = 4, U = 0, p = 0.03*, r = 1.00).

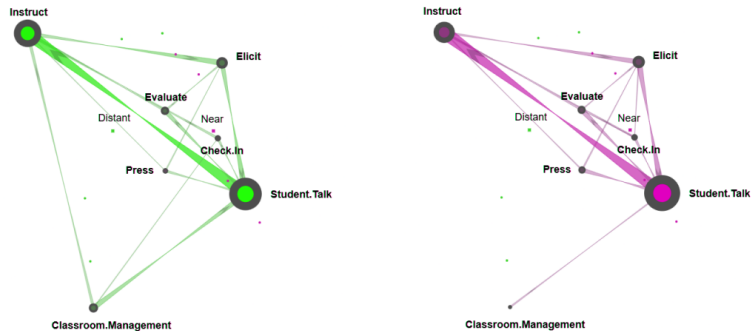


Fig. 2. Grouped means models of dialogic discourse moves in *distant* socio-spatial behaviors (green, left) and *near* socio-spatial behaviors (purple, right).

Elicitation and Pressing as Responsive vs Attention-Oriented Moves. The ordered network reveals stronger links between *Student Talk* and teacher questioning moves (*Elicitation* and *Pressing*) when teachers are near students, often occurring during one-on-one or small-group interactions. In these instances, teachers built on student responses in real time, using pressing questions to sustain a chain of reasoning and guiding students towards conceptual understanding. For example, in the *Weather* lesson (US1_Science), a student quietly asked: "Miss Anderson? Is the higher the humidity where a high pressure is or low pressure?"

Rather than answering the question directly, the teacher engaged in a sustained exchange of responses:

> **Teacher: [*Elicitation*]** "Good question. Where would the most humidity be? **[*Direct Instruction*]** Think about a weather map…" (pause) **[*Pressing*]** "Precipitation is behind the front or in front of the front?"
> **Student:** "It's in front of it."
> **Teacher: [*Pressing*]** "So what is higher humidity gonna tell you?"
> **Student:** "Precipitation."
> **Teacher: [*Pressing*]** "So where would it be located in relationship to the front? What will be by the precipitation?"
> **[...]**

This one-on-one exchange, lasting 63 seconds, included 8 instances of *Pressing* and 8 instances of *Student Talk*, illustrating that, when near students, the teacher responsively scaffolded the student's reasoning through targeted, sequenced questioning.

In contrast, when teachers were distant, *Elicitation* and *Pressing* moves were more often directed at the whole class or larger groups. These questions still served a pedagogical purpose but were often oriented toward maintaining attention or prompting surface-level participation. For instance, in the *Rocks* lesson (US4_Science), the teacher posed a question during a lecture-like segment of *Direct Instruction*:

> **Teacher: [*Elicitation*]** "How could granite be above the surface?"

[…]
Student: "Maybe it was underground pushing up, the surface cracked and came up."
Teacher: [*Pressing*] "You mean—what are you saying? It really did cool underground but now you see it above ground?"
Student: "Maybe it cracked the ground and kept rising."
Teacher: [*Pressing*] "So you mean something pushed it up?" (pause) **[*Direct Instruction*]** "It was pushed up… but at one time it was an intrusion…"

Though this exchange included *Elicitation* and *Pressing*, the dialogue was less sustained (1 instance of *Elicitation* and 2 instances of *Pressing* over 58 seconds), and the teacher quickly transitioned back into explanation. ONA shows that these sequences, when occurring at a distance, are less frequently followed by additional *Student Talk*. While the teacher may be trying to involve students, their authoritative position in the class limits opportunities for prolonged interaction. In these distant behaviors, *Elicitation* and *Pressing* seem to function more as instructional pivots—checking for understanding or directing attention—rather than means for helping students develop ideas.

Classroom Management as a Distant Move. The ordered network (Figure 1) shows that when teachers assume a distant socio-spatial behavior, there were stronger connections from *Classroom Management* to *Student Talk* and *Direct Instruction* than when they are near students. Even in lessons where the teacher primarily engaged students up close, classroom management was frequently handled at a distance. In the *Secant and Tangents* (US_Math1) lesson, for example, the teacher was initially in an interactional space (near), helping a student one-on-one (Figure 3A): **[*Direct Instruction*]** "That's why we always said they had a positive slope because the positive number in front of X, all right?"

But as the lesson wrapped up, the teacher stepped back into an authoritative space, using distance to manage the whole class and transition announcing (Figure 3B): **[*Classroom Management*]** "All right, ladies and gentlemen. Listen up."

A. US_Math1 (38m 08s)
Interactional Space

B. US_Math1 (38m 12s)
Authoritative Space

Fig. 3. Teacher shifting from *interactional* (A) to *authoritative* (B) for classroom management.

This shift suggests that distance can serve as a resource for teachers to reframe or reorient the learning activity. ONA shows patterns that distant classroom management often precedes or co-occurs with discursive moves that re-establish *Direct Instruction*.

4.2 Dialogue and Classroom Design: Row vs. Grouped

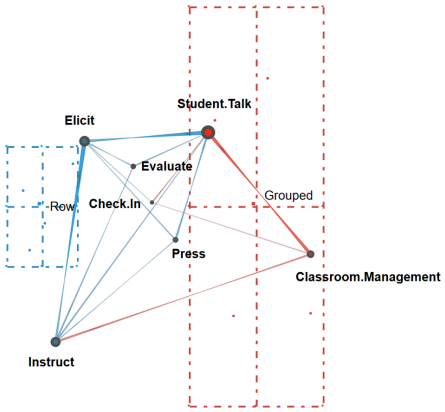


Fig. 4. Difference model of dialogic discourse move between classrooms with row-desks (blue) and grouped-desks (red).

When classrooms are arranged with grouped desks, student dialogue tends to be more interactive and peer-driven, whereas row-desk layouts correlate with more centralized, teacher-led instruction and limited student exchange. The second model (Figure 4) compares dialogic patterns between lessons in classrooms with row-desks and lessons in classrooms with grouped-desks. Along the X axis (MR1), a Mann-Whitney test showed that the dialogic patterns when lessons were in classrooms with grouped-desks (Mdn=0.24, N=4) were statistically significantly different from the dialogic patterns when lessons were in classrooms with row-desks (Mdn = -0.26, N = 4 U = 16.00, p = 0.03*, r = -1.00).

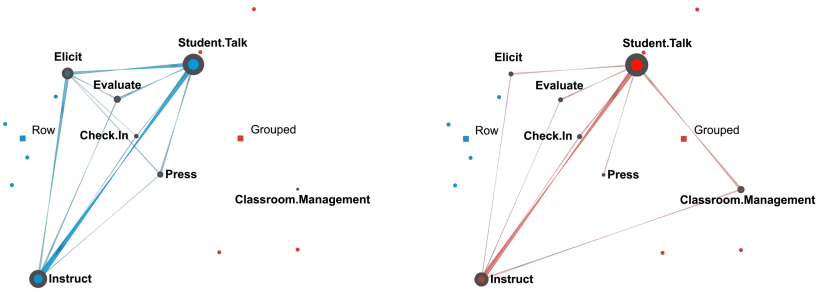


Fig. 5. Grouped means models of dialogic discourse moves in classrooms with row-desks (blue, left) and grouped-desks (red, right).

In row-desk classrooms, the dialogic structure reflects a more traditional, teacher-centered dynamic (Figure 5). *Student Talk* leads into *Direct Instruction* and *Evaluation,* suggesting that student contributions are often used to prompt further instruction, clarification, or assessment from the teacher. The strong connection from *Direct Instruction* to *Elicitation* implies that teachers may pause instruction to check for understanding or re-engage students, maintaining a cycle of control. This layout may encourage more whole-class interactions led by the teacher.

In contrast, grouped-desk classrooms reflect a more interactive dynamic (Figure 5). Here, *Student Talk* leads into *Evaluation* and *Classroom Management*, which might suggest that small-group conversations create opportunities for teachers to step in with feedback or behavior guidance. The connection from *Direct Instruction* to *Student Talk*, rather than the other way around, could indicate that teachers use instruction to launch discussions that unfold among students. The weaker connection from *Elicitation* and *Pressing* to *Student Talk* might mean that teachers rely less on formal questioning and more on monitoring or spontaneous exchanges as students work collaboratively.

Collaboration in Classrooms with Grouped-Desks. In classrooms with grouped desks, *Student Talk* shows strong self-connections, indicating more frequent peer-to-peer dialogue. At first glance, the difference model (Figure 4) suggests that grouped desks require more classroom management. However, a closer look at the data reveals that this management is distinct from disciplinary management—it is often oriented toward facilitating collaboration and steering students back into peer-supported learning.

In the *Secant and Tangent* (US1_Math) lesson, for example, students working together have trouble with a problem:

> **Student 1:** "I know how to do regular ones. I don't know how to do the one with fractions. That's confusing."
> **Student 2:** "Those are the ones I have trouble with."
> **Student 3:** "Was he—were you listening when Mr. Ormsby was saying this?"

To this confusion, the teacher encourages distributed expertise from peer students, rather than taking control directly:

> **Teacher [*Classroom Management*]:** "Well okay. Well maybe you ought to go to Nick. Sounds like Nick knows what he's doing."
> **Student 2:** "No, I said that I have trouble on it."
> **Teacher [*Classroom Management*]:** "Okay… maybe we ought to go to Ashley."

In this instance, the teacher acts more like a facilitator, or a guide on the side, prompting student interdependence and helping students locate knowledge among peers. The spatial configuration affords a shift in classroom management: less about supervision and more about organizing collaboration.

5 Discussion

This study supports and extends Lim et al.'s [1] framework of socio-spatial behaviors, showing that teacher movement shapes the dialogic quality of teacher talk. While many MMLA studies engage with socio-spatial behaviors [2, 3, 4, 5, 6], few engage in understanding the validity of this theoretical construct. ONA provides an avenue for this type of methodology and analysis, beyond observational studies. Here, we find that proximity did indeed enable teachers to sustain questioning and scaffold reasoning from their students while distance often signaled shifts into directive talk. Movement and discourse operate as interdependent aspects of pedagogy, highlighting that spatial pedagogy should be studied alongside patterns of talk.

Further, this work considers the contrast between row and group desk arrangements. While prior studies on flexible learning environments measured correlations between space and learning through surveys of student and educator's perceptions [12, 13, 14] or standardized assessments (i.e., test scores) [11], this study introduces a more direct method of analyzing the connection between spatial configuration and teaching practices. As Goodyear [15] notes, such inquiry benefits from "zooming in" on practice—attending closely to the doings and sayings through which teachers accomplish their work, and to the interdependence of material, spatial, and discursive patterns.

This study demonstrates the potential of ONA to advance the analytical methods for multimodal data. Prior ENA work has mapped co-occurrences of verbal discourse and spatial location [17, 18, 19]. By incorporating socio-spatial behavior at the level of analysis (unit variable), rather than segmentation (conversation variable), in ONA, it is possible to capture a more nuanced view of the *sequential* interactions between movement and talk.

5.1 Limitations and Future Work

Notably, this study is limited by its small sample size (N = 4) and use of archival data from the TIMSS 1999 Video Study, which may not reflect current instructional practices. With the small sample size relative to the number of codes, or model complexity, there is high risk of overfitting. Nonetheless, this work contributes a proof of concept of how the connections between spatial discourse and verbal discourse could be jointly interpreted using ONA. Furthermore, while lessons were selected for variation in layout and subject, differences in teacher style and classroom context introduce variability that this analysis cannot fully control. The binary coding of teacher proximity (near vs. distant), while necessary due to the limited data in *personal* and *supervisory* spaces, also simplifies more nuanced spatial behaviors. Future research could tackle these limitations using automated methods for motion detection [20, 21] and discourse analysis [22, 23], enabling the analysis of contemporary classrooms at larger scales and finer levels of detail. Additionally, similar work could be analyzed using Transmodal Network Analysis [24] for more nuanced considerations of temporality for multimodal data. By expanding the scope of this line of inquiry, future work can further clarify how space, movement, and dialogue interact to shape teaching. Finally, following the work

of Zhao et al. [6], future work might explore real-time applications that help end-users (i.e., teachers) reflect on their own socio-spatial pedagogy.

6 Conclusion

This paper examined how teachers' spatial positioning and classroom layout shape dialogic teaching strategies. This study examined two questions: (1) how teachers' spatial proximity to students and (2) how classroom design shapes dialogic discourse in four U.S. mathematics and science classrooms. While prior research has acknowledged that teacher movement and classroom design shape instruction [1, 3, 5], few have examined how socio-spatial behaviors structure dialogic discursive patterns to form multimodal teaching strategies.

Here, classroom discourse patterns were significantly different when teachers were near students compared to when they were distant from students. When the teachers were physically near students, they were more likely to engage in dialogic moves such as *Elicitation* and *Pressing*, which in turn fostered *Student Talk*. These local interactions often take the form of responsive, back-and-forth exchanges that support student engagement and, importantly, reasoning. In contrast, when teachers are in authoritative or personal spaces, positioned far from the students, their talk shifts toward *Direct Instruction* or *Classroom Management*, leaving fewer opportunities for sustained student participation. These findings support research in MMLA that assumes teacher movement as pedagogical [2, 10] by demonstrating how uses of different socio-spatial behaviors are linked to different discursive strategies.

Grouped-desk arrangements supported more peer-to-peer talk, and student contributions more often led to continued discourse, rather than immediate teacher intervention. Interestingly, while these classrooms also saw stronger connections to *Classroom Management*, these shifts were often about facilitating collaboration rather than asserting authority. In contrast, row-desk classrooms concentrated discourse around the teacher, with stronger patterns from *Direct Instruction* to *Student Talk*, and limited student-initiated interaction. These initial findings are consistent with broader research that emphasizes the affordances of flexible layouts for dialogic instruction [11, 12, 13, 14] and suggest that layout has a meaningful effect on teaching strategies.

This work contributes to a growing recognition that space is not a neutral element in instruction. Teachers in this study appeared to use distance to regain control or deliver content broadly, while using proximity to engage students more responsively. Layout influenced how feasible these strategies were: grouped desks invited movement and made interaction logistically easier, while rows reinforced a centralized model of instruction. While limited in generalizability due to small sample size and model complexity, this work points to the value and feasibility of ONA for examining how teaching happens across space and time. For educators and designers, it raises questions about how classroom configurations can support or limit different forms of interaction. Treating space as a resource—alongside talk and content—can help inform the design of learning environments that are responsive to instructional strategies.

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