Intellectual Emancipation and Embodiment in Early Mathematics Learning

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Abstract: To understand how embodied learning can provide more opportunities for emergent bilinguals in early mathematics classrooms, this paper reports findings on our design-based research in a Canadian urban school. By bringing Rancière's (1991) notion of intellectual emancipation into the learning sciences scholarship on teaching, we paid attention to spatial-temporal structures that can free learners' bodies and enrich mathematical discussion. Our findings show that, in regular routinized instruction, learning was streamlined and compressed to unidirectional acquirement. In contrast, designed embodied mathematics lessons offered a space of flexibility and spontaneity, which conceivably drove intellectual emancipation. Our research demonstrates how spatially and temporally expanded mathematics pedagogy can offer a complex system of iterative adaptation and decentralized learning. We discuss how integrating embodied mathematics learning and the perspective of intellectual emancipation can address equity issues in early mathematics education.

Background

In recent years, embodiment has garnered attention in mathematics education (e.g., Alibali & Nathan, 2012; Abrahamson & Sánchez-García, 2016; Hall & Nemirovsky, 2012; Ma, 2016). A set of proposals, loosely aggregated as embodiment discourses, has taken constructivists' rejection of mental and physical division, and offered insights about the intrinsic quality of embodied activity to learning (Hall & Nemirovsky, 2012). The social turn in mathematics education argues against the view of mathematics as being a set of abstract tasks and instead embraces it as socially related activities embedded in webs of meaning within a class or school (Lerman, 2000). Therefore, as embodiment discourses extend the learner's mind into environmental and sociocultural systems, mathematics thinking and learning become intimately tied to the body that is situated in a specific time and moves in space. This reconceptualization can promote teaching practices that open the horizon for mathematical imagination through the design of learning environments that can afford different representational media and can position bodies innovatively (Hall & Nemirovsky, 2012; Ma, 2016).

Previous studies on emergent bilinguals in mathematics classrooms suggest the need to examine their opportunities to learn in relation to instructional contexts which are embedded in power (Langer-Osuna, Moschkovich, Norén, Powell, & Vazquez, 2016 Takeuchi, 2016). Being positioned as outsiders in classrooms, emergent bilinguals can experience obstacles to meaningful engagement as a consequence of normative structures (Calabrese Barton & Tan, 2019).In this context, the need to adopt sociocultural perspectives that focus on identity and power becomes imperative because, by deconstructing taken-for-granted discourses and practices, more possibilities for teaching and learning school mathematics will be opened up (Philip, Olivares- Pasillas, & Rocha, 2016; Nasir & Hand, 2008). It is from this lens that we focused on emergent bilingual students' participation in a mathematics classroom wherein researchers and the teacher redesigned the space to mobilize students' bodies. We were particularly interested in how this redesign could facilitate the emergence of fluid or multiple identities in mathematics classrooms (Gutiérrez & Dixon-Román, 2010). Furthering this agenda at the intersection of embodiment and equity discourses in mathematics education research, this work shifts inquiries from "what do emergent bilinguals learn in mathematics class?" to "how can we design the classroom environment to enhance emergent bilinguals' mathematics learning?" Specifically, we consider how mobilizing learner bodies could lead to enhanced opportunities of participation and intellectual emancipation for emergent bilinguals.

Theoretical framework

One of the "norms" we problematize in mathematics classrooms is the notion of explication, that is, transmitting knowledge by the teacher to students by means of breaking down complex elements into simple elements (Rancière, 1991). Jacques Rancière (1991) found out in his observation of a schoolteacher, Joseph Jacotot, that knowledge is not a prerequisite for teaching, and explication is not necessary for understanding. Traditional instruction, wherein the teacher conveys knowledge through explication, prescribes the subjugation of student intelligence to that of a teacher. In this scenario, usually the teacher's will also dominates the students' will. Learning like this can be categorized as "enforced stultification" (Rancière, 1991, p.7). It is this post hoc fallacy

inherent in explication that works to create inequity because the authority of an explicator will be conserved by making up a temporal distance between the knowing and the ignorant (Rancière, 1991).

Whereas in Jacotot's classroom, even though the teacher's will was leading student's will as the maintenance of classroom order and study purpose, a student's intelligence only obeyed itself— that led to intellectual emancipation. The teacher's intelligence steps down where student's intelligence can be fully trusted and practiced, as long as their wills are linked. Without the master's explication, Jacotot's students experienced intellectual emancipation, where students had the same capability to understand and solve problems of a language unknown to them. Post-structuralists understand an individual's meaning making as the product of discourses and negotiations arising from power struggles with environment and others (Foucault, 1977; Peters & Burbules, 2004). Moreover, for Rancière, the axiom of equality is even grounded in the simplest communicative action (Barbour, 2010). Through displaying power circulation in discourses, post-structuralism works to resist the metanarrative of "norms" by creating space for new meanings. By understanding mathematics teaching from Rancière's (1991) theory of intellectual emancipation, we examined a learning environment design that afforded a different spatial-temporal configuration to open the horizon of mathematical imagination for emergent bilinguals.

Method

We framed this study using a design-based research methodology (Design-Based Research Collective, 2003). The following characteristics of our study were guided by this methodology. First, together with teachers, we designed the learning environment to mobilize learner bodies, guided by critical theories including Rancière's (1991) teaching theory of intellectual emancipation. Second, our research design experienced iterative cycles of development, enactment, reflection and refinement. Third, our design purpose was to compare and contrast pedagogies of regular and embodied mathematical sessions (e.g., the "Becoming Ozobot" session we examine in this paper) and to help practitioners understand the potential of embodied mathematics learning in a linguistically diverse classroom. Fourth, the enactment of embodied learning was situated in a partnership between the teacher and students of a classroom.

Video ethnography (Derry et al., 2010) worked as the method of data collection. We used video to capture an evolving narrative about mathematical discussion and body movement within certain spatial-temporal parameters. In the phase of analysis involving open coding (Strauss & Corbin, 1990), we carefully reviewed the video and transcripts many times in order to generate analysis corresponding to pattern codes. Next, we were able to organize the segments of video transcripts into meaningful units to offer a theoretical explanation for the learning experiences of students in different sessions. Throughout our analysis, two researchers individually coded data and then met to discuss the differences until a mutual interpretation was reached.

Our study was conducted in an urban elementary school in Canada, in an economically under resourced neighborhood. The Grade 1 mathematics class of Ms. Johnson had been the focus of our video ethnography from September 2018 to June 2019, because of our shared interest in embodied mathematics learning. We conducted fourteen classroom observations and we led four professional development sessions with teachers at this school. Approximately twenty-seven hours of video were recorded and analyzed. Ms. Johnson's mathematics class was typically structured with an opening routine session. Throughout our observation, the temporal configuration of the routine session followed a stable pattern of almost the same duration and same amount of activities under a fixed script created and enacted by the teacher for her mathematics class. During our project, several embodied mathematics activities were designed and implemented in collaboration between researchers and the teacher. The focal lesson of "Becoming Ozobot" was designed to let students perform as a robot, in order to facilitate a discussion about robots and programming, and also to promote a critical discussion about the difference between robots and humans. The Becoming Ozobot session and the routine session held heterogeneous characteristics in their temporal and spatial configurations. We compared and contrasted these two sessions (i.e., one Becoming Ozobot session and one routine session) by using the method of discourse analysis (Mehan, 1979; Sinclair & Coulthard, 1975). For example, the prevalence and absence of the Initiation-Response-Evaluation/Feedback (IRE/F) sequence of classroom discourse was chosen as the focal point of understanding the difference between these sessions (Mehan, 1979; Sinclair & Coulthard, 1975). We focused on this discourse sequence because the flow of information formulated by IRE/F is considered to have a direct association with practices of producing place in the classroom. In other words, different spatial-temporal configurations could potentially create a different flow of ideas represented as classroom discourse (Sheehy, 2004). Our analysis focused on the discourses of emergent bilinguals (Sophia, Samir, Rahul, Brody, Ethan and Sharik, all pseudonyms).

Results

In this section, we illustrate the difference between the spatial structure of the learning environment in a routine session versus a Becoming Ozobot session (or the embodied session), and its influence on the discourse pattern

and learning opportunities afforded to the emergent bilinguals. By juxtaposing normalized versus redesigned teaching, the following section illustrates how intellectual emancipation was tied with bodily emancipation. As we demonstrate in this section, when forms of stultification were altered, opportunities for participation and access to embodied mathematics discourse were afforded to emergent bilinguals. Discourses and negotiations between the teacher and students were examined to see whether there was a temporal delay, which would be an indication that there was an explication taking place, thus providing evidence of intellectual stultification and intellectual emancipation.

Routine session

The temporal structure of interactional events, in the routine session, was short and fast compared to the extensive interactions observed in the embodied session. Six distinctive activities of mathematical teaching and learning were arranged and completed in 21 minutes, with the longest span being 11 minutes and 10 seconds and the shortest being 25 seconds, with an average interaction time of around 3.5 minutes for each. The discourse observed during the routine session was characterized as being explication. As reflected in the following excerpt, the IRE/F sequence between the teacher and students was completed in as fast as a few seconds. Excerpt 1 shows that Ms. Johnson's *initiation* ("What is the equation [adding four to nine]?"), Sophia's *response* ("Nine plus four equals thirteen."), and Ms. Johnson's *evaluation* ("Yes. Good job.") lasted only seven seconds. And Thomas's idea, as an extension of Sophia's answer, was not given time to clarify, develop or even respond. Driven by the teacher's lead, they swiftly moved to another sequence of IRE/F.

Excerpt 1

1	Ms. Johnson	What is the equation? Grade one.	00:01:49
2	Students	(Three students raised their hands, including Sophia.)	00:01:49
3	Ms. Johnson	Sophia.	00:01:50
4	Sophia	Nine plus four equals thirteen.	00:01:51
5	Ms. Johnson	Yes (She thumbed up for Sophia.) Good job.	00:01:56
6	Thomas	And four plus four equals eight, and, and three plus three equals nine.	00:01:58
7	Ms. Johnson	Ok, ready? (She moved to the next topic.)	00:02:02

In addition to being streamlined and rushed, the classroom discourse between the teacher and students in the routine session also indicated that mathematical thinking was being reduced to unidirectional acquirement as opposed to providing opportunities for students to seek alternative understanding. For example, by looking at the subsequent segment of interaction in Excerpt 2, we can see that, after Samir provided his answer and explication to the question ("How many days have we been in school?"), Ms. Johnson asked the whole class to repeat Samir's reasoning. This knowledge reproduction constrained students' mathematical intelligence and suppressed their opportunities for agency (for example, as seen in the utterance 6 by Thomas in the above excerpt).

Excerpt 2

1	Students	(Zendaya pointed to the question posted on the wall and students read it.) How many days have we been in school?	00:03:35
2	Ms. Johnson	(Several students raised hands quickly, and Ms. Johnson talked to Zendaya.) So choose someone.	00:03:43
3	Zendaya	Samir.	00:03:44
4	Samir	A hundred and twenty.	00:03:46
5	Ms. Johnson	A hundred and twenty? Why do you say one hundred and twenty?	00:03:47
6	Samir	Yesterday is a hundred and nineteen, so today is a hundred and twenty.	00:03:55
7	Ms. Johnson	Ok. Did you hear him (what) he said?	00:04:03
8	Students	Yes. One hundred and twenty.	00:04:04
9	Ms. Johnson	What did he say?	00:04:06
10	Ms. Johnson and Students	(Students spoke after Ms. Jonson) Yesterday was one hundred and nineteen, so today is one hundred and twenty.	00:04:06

The teacher's adherence to a fixed script of interactions in the routine session restricted students to a limited amount of time to develop mathematical thinking through discussion.

The narrow physical space that characterized the learning environment of the routine session also restricted opportunities for students to think through physical movements. Figure 1 depicts how Ms. Johnson occupied a central physical position wherein she could monitor students' bodies and regulate them. For instance, when Thomas (in the third picture, from left to right) wanted to sit on a chair, he was stopped immediately by the teacher because students were only permitted to sit on the ground. The physical positioning between the teacher and students conjures up a power differential between them.

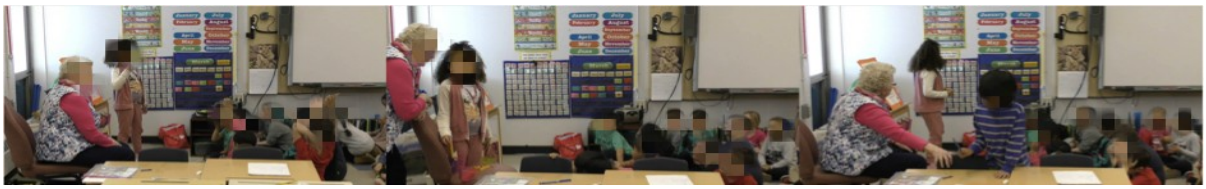

Figure 1. Spatial representation of bodily engagement in the routine session.

The closely monitored space not only disciplined those displaced bodies, but also corrected bodies that moved freely by singling out and exposing them in front of others. The ensuing dialogue in Excerpt 3 shows that Ethan and Rahul were called on to answer the question ("how far is it from nine to thirteen?") because they moved their bodies in a way that was not allowed. And both of their response (Ethan raised his four fingers, and Rahul said "Three" in the utterance 5 of Excerpt 3) did not receive an evaluation from the teacher.

Excerpt 3

1	Ms. Johnson	Ok. (Zendaya held up a number card.)	00:00:43
2	Students	Nine. (They read the number card.)	00:00:44
3	Ms. Johnson	And what number do we want? (She indicated today's date.)	00:00:47
4	Students	Thirteen. (They checked out the number on the calendar.)	00:00:48
5	Ms. Johnson	Thirteen. So, how far is it from nine to thirteen? Raise your fingers, show us how many fingers (Some students raised hands, showing their fingers. But Ethan extended his hand to a neighboring bookcase, playing with pencil and paper.) Ethan, how far is it from nine to thirteen? (Ethan stared at the calendar, and raised his four fingers halfway to the height of his face and cast his look at Zendaya.) A lot of people are saying…(turning to Rahul, who turned his head backward and sideward, and stretched his upper body to catch a glimpse of the calendar.) what do you think?	00:00:49
6	Rahul	Three.	00:01:07
7	Ms. Johnson	Three?	00:01:08

Embodiment session

Mathematical learning was streamlined and compressed to unidirectional acquirement between the teacher and students in the above routine session. In contrast, the embodied session of "Becoming Ozobot" was extended temporally and spatially. Temporal extension was seen in the intervals between the teacher utterance and student utterances as well as in the teacher's reservation of "evaluation" in the IRE/F sequence. Due to the flexibility of participatory norms, the acceptance of all contributions, and the promotion of creativity inherent in this context, a learning space was created wherein the teacher's authority became peripheral to the students' intelligence. Mathematical thinking and discussion involving emergent bilinguals evolved into a complexity of iterative adaptation within the community of learners, which flowed into a decentralized collective because of the lessened control of the teacher as an explicator.

The temporal structure of interactional events in the embodied session lasted much longer in general and alternated between longevity and shortness in its rhythm. Seven interactional events were identified and concluded in 39 minutes, with the longest span of interaction lasting 8 minutes and 32 seconds and the briefest span of interaction lasting 1 minute and 50 seconds, with an average of around 5.6 minutes for each interactional event. The "Becoming Ozobot" session was characterized by the organic unfolding of events, wherein only the first interactional event of "Introduction of Becoming Ozobot" was predetermined, which served to acquaint students with Ozobots, and their ways of reading and processing color codes. As this embodied activity asked students to walk on the coded tape around the classroom like robots, the remaining events spontaneously unfolded as a result of the student-initiated bodily performances that occurred at that time and in that space. The IRE/F sequences

afforded by this more liberal temporal structure facilitated the development and circulation of unique ideas between the teacher and emergent bilingual students that were never brought to light in the routine session.

The expanded spatial-temporal structure of instruction offered more space for students to exercise their agency, as shown in the following excerpt. Students were given opportunities to decide how to position their bodies before walking on the coded tape for robots (this is highlighted by the bolded utterances in Excerpt 4).

Excerpt 4

1	Ms. Johnson	**Do you think** we should all start one behind another, or should we find a different spot somewhere?	00:29:07
2	Students	(There were voices for both views.) Different spot. One behind another.	00:29:13
3	Ms. Johnson	Ah. Ok. I think that we maybe need to **take a vote**. Did I say go, George? Nope. If you think that we should all go in a line, one behind another, raise your hand.	00:29:18
4	Students	(Seven students raised their hands.)	00:29:32
5	Ms. Johnson	Ok. If you think we all try our own spot, raise your hand.	0029:38
6	Students	(Eleven students raised their hands.)	00:29:42

Ms. Johnson did not join the vote that she proposed in utterance 3 of Excerpt 4, because she was no longer the center of instruction. In this sense, her intelligence and body became peripheral, and the learning community became decentralized. Figure 2 captures what the Becoming Ozobot session looked like. Twenty-one students in the classroom together followed a map marked by the coded tape and walked on the classroom floor as if they were acting like Ozobot. Figure 2 also illustrates that, while students were reading and walking, Ms. Johnson stayed outside of their space, being a facilitator and observer, rather than an explicator.

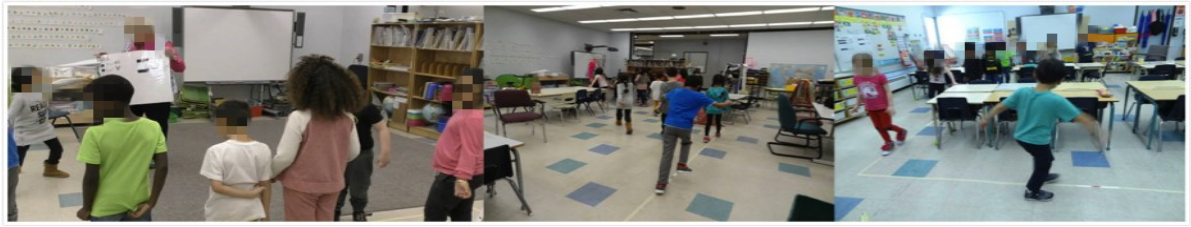

Figure 2. Spatial representation of bodily engagement in the embodied session.

During the first attempt of Becoming Ozobot, when all the students started from the same spot, they encountered the problem of failing to move due to a lack of direction and a dense bodily distribution. Ms. Johnson identified this problem as a "traffic jam" problem. In order to solve this problem, Ms. Johnson called on students to have a discussion about the problem and its possible solution. She initiated the question: "What can we do to solve the problem?" Students including four emergent bilingual students (Sophia, Ethan, Brody, and Sharik) contributed to the discussion as seen in Excerpts 5-9. Unlike what was observed in the routine session, Ms. Johnson merely affirmed students' suggestions ("you guys got some great ideas") but did not evaluate their responses. Within these five minutes, the four emergent bilingual students actively contributed their intellectual resources into solving the problem. The students engaged in interactions that drew upon multiple modes of discourses, including body language, hand gestures and speech. Sophia's preliminary understanding of the problem became the foundation for the teacher's identification of the exact issue (i.e., traffic jam). Ethan picked up Sophia's answer later but could not put his thinking into words. Sophia eventually refined her earlier responses by coming up with a more clarified response. This is an example of the iterative and adaptive thinking that took place between students, which did not occur in the routine session.

Excerpt 5

1	Ms. Johnson	What can we do to solve the problem? What should we try? Ok, what do you think, Sophia?	00:35:18
2	Sophia	Make more tape. We can do it right here (pointing to the spot) because…over here (jumping to the spot) we actually do a U-turn again.	00:35:25

The above segment in Excerpt 5 shows that Sophia implied that two U-turn codes produced a high concentration of "robots" (in this case, students) at some point and suggested increasing the volume of their path. But she was

not able to name the problem in English; hence she moved to the site and represented her idea using body language. We may guess that even Ms. Johnson did not know what exactly the problem was before Sophia's answer (which could justify the lack of evaluation and response seen in the above excerpts).

Excerpt 6

1	Ms. Johnson	(They returned to the carpet area and sat on it) So how can we solve the problem of **traffic jam** that was taking place here, seems like it was really getting bunched up. (Several students raised their hands) Brody, what do you think?	00:36:38
2	Brody	(He made a sound and "talked" using hand gesture.)	00:36:50
3	Ms. Johnson	No, don't do hand gestures. Use your words and use your voice that everyone can hear.	00:36:52
4	Brody	(Being silent and move his body back and forth)	00:36:57
5	Ms. Johnson	Turn the other way? How?	00:37:01
6	Brody	(Keep being silent and point his figure again swiftly)	00:37:07
7	Ms. Johnson	How do we get everybody turned that way? What are you thinking about, Brody? Stand up and come here and describe what you think quickly, please.	00:37:11
8	Brody	(He moved slowly to the front and murmured to Ms. Johnson.)	00:37:24
9	Ms. Johnson	Pardon?	00:37:31
10	Brody	(He continued murmuring with the help of hand gesture.)	00:37:32
11	Ms. Johnson	**Oh, just, just go that way?**	00:37:34
12	Brody	(Nod his head in the agreement.)	00:37:35
13	Ms. Johnson	And, then what? When we come to a code, then what? (No response) Not sure?	00:37:37

In Excerpt 5, Ms. Johnson classified the problem as a "traffic jam" when she finished the first I-R (Initiate-Response) exchange with Sophia. Then in Excerpt 6, the teacher passed the question along to Brody, who completely relied on hand gestures in his response. Spontaneity was even reinforced when Brody neglected Ms. Johnson's urge not to use hand gestures but performed out of his own inclination. Here, in Excerpt 6, the teacher's absence of authority could be observed again because of the shift from an IRE/F to an IR pattern.

In Excerpt 7, Ethan picked up Sophia's answer (putting more tape to increase the volume) but was unable to describe his thinking in words. In contrast to the routine session, the flow of thoughts happened between two emergent bilinguals, rather than just between the teacher and students.

Excerpt 7

1	Ms. Johnson	Ethan, what are you thinking? Stand up, honey, stand up, Ethan.	00:37:50
2	Ethan	(Stand up and come to the front) More tape.	00:37:55
3	Ms. Johnson	Ah, more tape? (Ethan nodded his head) And do what with more tape? (Ethan scanned the tape on the ground) As we got lots of tapes around the room. (He kept scanning.) Ok, you can think about it, think about it more.	00:37:58

Another case of iterative adaptation showed up in the following IR discourse in Excerpt 8. Acknowledging and developing Brody's response in Excerpt 6 (i.e., going one way) further, Sharik gave her feedback both in words ("we should make a line of people" in the utterance 2 of Excerpt 8) and through her body language.

Excerpt 8

1	Ms. Johnson	Sharik, what are you thinking? Come on up.	00:39:05
2	Sharik	(Stand up and come to the front) **We should make a line of the people.**	00:39:11
3	Ms. Johnson	Make a line of the people, and not everybody start from their own spot? But everybody follow one another?	00:39:14
4	Sharik	(She explained her idea by walking on the tape, pointing her feet to the spots where people should stand in a line.)	00:39:23

Eventually, after Sophia was given another chance to restate her initial idea, she demonstrated her ability to deepen it with more details on her own without the teacher's explication (as seen in Excerpt 9). The idea of building an

alternative route to distribute the load of traffic started to give shape to a mathematical solution that could address the issue of the traffic jam. This series of discussions allowed students to enter into complex mathematical thinking, beyond what was expected in the local Grade 1 curriculum.

Excerpt 9

1	Ms. Johnson	What are you thinking, Sophia?	00:40:11
2	Sophia	We could put tape **right here** (walking to the spot she meant), **right here**.	00:40:13
3	Ms. Johnson	And where would it go? Where would you put the tape? Oh, straight through this side?	00:40:22
4	Sophia	**(She walked from one side of the tape to another side) Yea**	00:40:29
5	Ms. Johnson	So, there is alternative route?...So how would the robot know to turn there?	00:40:31
6	Sophia	(She shrugged shoulder and did not answer.)	00:40:36
7	Ms. Johnson	How would the robot know whether to turn or whether to go straight through? (No response) Not sure, think about it some more, **because you guys got some great ideas.**	00:40:38

Discussion

Our study demonstrates how spatial and temporal expansion in a designed session freed learner bodies more compared to a routine classroom activity. By examining the IRE/F pattern of classroom discourse, we were able to gauge how the presence of the teacher's authority impacted mathematical thinking and discussion among emergent bilinguals. Our findings demonstrate that pedagogies in the routine session and the embodied session were fundamentally different in terms of temporal and spatial structure. In the routine session, where the teacher's authority and will prevailed over that of students', the IRE/F sequence was streamlined and tightened, and mathematical thinking was compressed to unidirectional acquirement. In contrast, the embodied learning environment offered a space of flexibility and spontaneity, wherein the teacher's explication gave way to students' intelligence. Mathematics pedagogy in this spatial-temporal expansiveness facilitated a system of iterative and adaptive discourses between students. In this pedagogical context, learning was decentralized and collective problem solving.

Our comparison of the routine session versus the embodied session does not intend to make a value judgment or a generalizable statement on mathematical teaching in these two environments. We acknowledge the limitations in this study, including time constrains which limited our collaboration with schools as well as the small number of participants in the study. Our examination of the relationship between mathematical thinking and bodily movement from the perspective of spatial-temporal configurations does not mean that we wish to invalidate regular classroom practices as being sites for meaningful mathematics learning. Our focus on the IRE/F sequence of classroom discourse as the focal point of scrutinizing the mathematical understanding of emergent bilingual students does not intend to abolish this discursive pattern in early mathematics education.

Instead, this study strives to show that teachers' and students' identities in the mathematics classroom are fluid, in a constant state of flux depending on the spatial-temporal structure and power dynamics operating within sites of social interaction. By drawing from Rancière's (1991) notion of intellectual emancipation that ties with bodily emancipation and by focusing on spatial-temporal expansion as a design principle of teaching, we add to the ongoing discussion on power and identities in mathematics education (Gutiérrez & Dixon-Román, 2010; Philip, Olivares-Pasillas, & Rocha, 2016; Nasir & Hand, 2008) and also to the discussion on emergent bilinguals' participation in mathematics learning (e.g., Langer-Osuna, Moschkovich, Norén, Powell, & Vazquez, 2015; Takeuchi, 2016). Our findings challenge the folk idea that the younger students are, the more supervision that is needed. By bringing Rancière's theory of intellectual emancipation to the floor, we can investigate the power of "ignorant schoolmaster" in emancipating the minds and bodies of young learners from excessive restraints. We paid particular attention to equity issues around emergent bilinguals by deconstructing spatial-temporal structures of different learning environments and considered the intertwinement between body, mathematics learning, and equity. By investigating cases of equity and embodied learning in early mathematics classrooms within a linguistically and racially diverse school, this study attempts to diversify embodiment discourses within the community of the learning sciences (e.g., Abrahamson & Bakker, 2016; Hall & Nemirovsky, 2012; Ma, 2016). Our findings demonstrate the potential for pedagogical redesign that focuses on embodied learning for spatial and temporal expansion, which provides an additional step towards equity in early mathematics education.

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