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Continuity in Disparate Spaces: Opportunities to Learn with Your Full Self in Mathematics Classrooms

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Abstract: This paper explores the mathematical participation of one kindergarten student, Quentin, across two differing settings: whole-group instruction versus small-group play centers. Leveraging Gee's (2000) definition of identity as an act of recognition, we examine how Quentin's bids for social interaction were more or less recognized by his peers across these varying contexts. We highlight the potential role of play in facilitating a space for Quentin's ways of being to be taken up as *part of,* rather than *separate from,* mathematics.

Introduction and significance

> "Context is not a fixed entity to Adam, for its shifts with the interactional winds. Each new second produces new possibilities along with severs constraints on what is possible...Where is [Adam's] LD [Learning Disability]? Behaviorally, the answer is clear. It is all over the classroom as an interactional a possibility. Everyone stands in some relation to it. Everyone is part of the choreography that produces moments for its public appearance. LD is distributed across persons, across the moment, as part of the contextual work members do in different scenes. Neither Adam, nor his disability, can be separated from the contexts in which they emerge" (McDermott, 2001, p. 290).

In an analysis of a school-aged child named Adam, McDermott (2001) proposes a conceptualization of learning disability as a cultural category that *acquires* children, as opposed to a 'developmental lapse' that is acquired *by* children. By following Adam across everyday life, cooking clubs, classroom lessons, and testing sessions, McDermott illustrates how these four differing contexts present a continuum of interactional, identity-based, and competency-related possibilities for a single individual, Adam. In other words, the label of 'learning disability' does not merely exist *within* Adam, but is instead made possible by the interactional affordances and constraints of varying contexts. For instance, as McDermott highlights, the constrained nature of schooling and classroom lessons often puts the "spotlight on those who are doing less well than the others" (p. 287), thereby rendering the construction of a 'less competent' Adam, as opposed to a 'more competent' Adam, more visible.

In this analysis, we turn our attention to a context that has historically constructed rigid conceptions of competency and, consequently, labeled and stratified students along these narrow lines: mathematics. With its history of exclusion and limited perspectives over what 'counts' as legitimate mathematical participation (Gresalfi et al., 2009; Powell & Frankenstein, 1997), scholars have long called for more liberatory contexts that shine an asset-based spotlight on, and therefore make visible, the expertise and forms of participation that children often *already* bring to mathematics spaces (Yeh et al., 2021). Through the examination of one child, Quentin, we explore a specific context that has been heavily theorized for its liberatory potential (Joseph et al., 2019; Parks, 2015), but understudied empirically within formal K-12 mathematics classrooms: play.

In what follows, we consider not Adam and Adam, but Quentin (and Quentin), a Black boy in a play-integrated kindergarten classroom whose proclivity for social interaction and movement, though fully present across two differing interactional contexts, were recognized in distinctive ways as mathematical. We pay particular attention to the function and trajectory of Quentin's interactional bids across these two mathematics settings—a whole-group lesson versus play-integrated tasks—by exploring the following research questions: *How does Quentin participate across two differing mathematics contexts? How is his participation recognized by members within these contexts and, relatedly, what are the mathematical implications?*

Literature review

The role of context in shaping recognition possibilities

Scholars have argued that being recognized as mathematical is constantly negotiated within broader discourses and reinforced through norms and interactions in classrooms (Gresalfi et al., 2009; Shah & Leonardo, 2016). Mathematics contexts are especially prone to narrow visions of legitimate participation, particularly for students of color, given the discipline's historical ties to exclusionary practices (Bullock, 2019; Cobb & Russell, 2015). Consequently, the disconnect between how students may wish, and even choose, to participate, versus the forms of participation that are recognized and rewarded in these spaces, frequently results in students' dismissal from learning opportunities and erasure as mathematical doers (Tate, 2013). For example, Gresalfi et al.'s (2009) analysis of agency and accountability in two middle school mathematics classrooms highlights mathematical competency as it relates to classroom interactions, whereby the taking up of only select forms of mathematical strategies reinforces a "system of competence" (p. 58) that spotlights singular modes of participation.

On the other hand, research has also pointed to the role of more transgressive contexts in expanding possibilities for mathematical recognition. For example, in their analysis of elementary mathematics curricula, Land et al. (2019) highlight the role of "open curriculum spaces" in facilitating children's opportunities to leverage personally meaningful contexts and preferred forms of participation. Jasien and Gresalfi (2021) investigate similar questions, but at the level of mathematics tasks. They refer to tasks that enable these personal connections as "hybridization-inviting" (p. 681) and call for future work into the potential affordances of allowing children to engage in self-driven activity in school mathematics. Moreover, such expansive norms and participation structures can work to redistribute authority between students, which in turn supports their recognition as competent mathematical sense-makers by others (Dunleavy, 2015), as well as their own ability to recognize a linkage between the self and given mathematical activity (Nasir & Hand, 2008). However, while prior research has made the case for more liberatory K-12 mathematics environments, in which opportunities for recognition and humanization might be expanded, few empirical examples exist that illustrate what such expansive contexts might look like, particularly for young learners (Yeh & Otis, 2019).

Play and mathematics

Research on children's play points to its potential in challenging narrow visions of participation and facilitating more humanizing experiences that engage children's whole selves (hooks, 1994; Ladson-Billings, 1994). For example, Joseph et al. (2019) explicitly call for further work into the role of play in reshaping mathematics settings where students can be "happy, gregarious, social, and goofy" (p. 149). By inviting students to be their full selves through more humanizing experiences, play may challenge and reposition the forms of participation that are recognized in mathematics settings. Ginsburg (2006) provides further evidence of this need through an articulation of the "everyday mathematics" that shows up in students' natural, free play. Using informal examples of children competing to see who can jump the highest or pointing to numbers while playing teacher, Ginsburg demonstrates that "children's everyday mathematics is ubiquitous and competent" (p. 145) and is "so fundamental and familiar that we seldom think of it as mathematics" (p. 148). Although mathematics and play are often pitted against one another (Clements & Sarama, 2017), mathematicians regularly characterize their own work as a form of play (Bergen, 2009; Su, 2020). Taken together, this work suggests that playful mathematics contexts could invite students to participate in ways that are more aligned with their more natural, everyday ways of being and, in turn, invite *others* to recognize their participation as worthy and mathematical.

Although prior work has positioned play as a promising path towards transgressing traditionally exclusive mathematics contexts and practices, further empirical research is needed to support these conjectures. This is especially true given that formal school learning is often devoid of playful learning opportunities (Miller & Almon, 2009). As a result, the vast majority of what is known about play derives from informal and early childhood contexts, leaving the field with unanswered questions surrounding the potential affordances of play in, arguably, the *most* exclusive context: formal K-12 schools. The present analysis seeks to address this gap by exploring the possibilities of play for one kindergartener, Quentin, through the ways in which exploratory, playful mathematics contexts enhanced his opportunities to do mathematics and allowed for his ways of being to thrive.

Theoretical framework

We situate our analysis in sociocultural perspectives of learning, in which individual activity is inextricably linked to contexts and the opportunities afforded by those contexts (Lave & Wenger, 1991). As a result of its attention to context and participation, sociocultural theory is particularly attuned to questions surrounding what it means for practices to be authentic, positing that "*how* one comes to know something is inseparable from *what* one ultimately comes to know" (Danish & Gresalfi, 2018, p. 36). Put differently, and for the purposes of this analysis, *how* one gets recognized as 'knowing' is inseparable from *what* gets counted as knowledge. Thus, we take up this

perspective to not only examine *what* practices are considered 'authentic' in mathematics contexts, but also *how* those same practices can be recognized as legitimate, or not, in differing mathematical environments.

In doing so, we turn to Gee's (2000) conceptualization of identity as an act of recognition, where, as an individual interacts in a given context, "others recognize that person as acting and interacting as a certain 'kind of person'" (p. 99). Here, identity is both what an *individual* does, but also the meaning that *others* recognize and ascribe to that individual and their activity. While it is generally understood that children's behavior is interpreted within a broader context of schooling, and that a shift in the culture of schooling could change the ways that we conceptualize children's activity (Hand 2010; McDermott 2001), this perspective has rarely been taken up as an empirical invitation to make sense of children's experiences and positionings across differing mathematical contexts. Therefore, in this paper, we turn to a single day and a single child as an entry point to exploring the possibilities of play for expanding opportunities for mathematical recognition.

Methods

Data for this analysis comes from the first of a multi-year longitudinal study exploring the integration of play in elementary mathematics classrooms at a public charter school in the southeastern United States. Within this larger project, participating kindergarten through second grade teachers engaged in several professional development sessions with the goal of supporting their use of play during mathematics instruction. Each year of the study, participating teachers enacted several play-inspired units with varying mathematical content-related goals. In line with the literature on play, tasks within these play units featured opportunities for students to explore mathematical ideas, manipulate tools, and engage socially with peers (Lifter & Bloom, 1998). The vast majority of these tasks took place at small-group tables of three to four students. While the teachers had agency in selecting and crafting their playful tasks, most lessons utilized a launch-explore-discuss model, in which each teacher opened and closed their small-group playful tasks with a brief whole-group introduction and closing.

Data collection

Data for this analysis comes from one kindergarten classroom. To capture student participation during the play-integrated tasks, 360 cameras were placed at small-group tables, capturing all students at the table. We also collected data on teacher activity using a movement-tracking camera, which followed the teacher. Finally, we conducted weekly visits within each classroom, including weeks that were outside of the designated play-integrated units. The goal of these weekly visits was to build rapport with participating teachers and students, while also generating understandings around the typical classroom norms outside of the play weeks.

Case selection

Our observations attuned us to one student, Quentin, who seemed to be positioned by his peers and teachers in distinctive ways across whole-group versus small-group play settings. During whole-group instruction, Quentin was frequently characterized as disruptive—at times, even being excused from the carpet altogether—while in the play centers, he was seen as on-task and a good playmate. We came to view Quentin as an interesting case for exploring the potential affordances of play in mathematics classrooms. From these initial noticings, we began to conjecture about the role of each mathematical context in facilitating opportunities for Quentin to be recognized and taken up by others and, therefore, deliberately selected him as a case for further analysis (Flyvbjerg, 2011).

Data analysis

To begin our analysis, we first turned to the small-group data to review and transcribe Quentin's mathematical participation. As a student within the first cohort of the study, our data corpus included small-group videos of Quentin in both kindergarten (n = 10) and first grade (n = 10). We uploaded these 20 videos to a video annotation program and assigned two researchers to each video, who then tagged initial observations of Quentin's participation during the small-group play tasks. From these initial noticings, we determined that we would center our analysis on just one year, and therefore one classroom, so as to more acutely focus our attention on potential differences between small-group play settings versus whole-group instruction, rather than differing factors of his two classrooms. Therefore, during our next phase of analysis, we transcribed only the 10 kindergarten videos.

With these 10 transcripts, we again assigned two researchers to each episode for further analysis. Given our initial wondering around Quentin's proclivity for social interaction, we initially focused our transcript annotations on Quentin's "bid making," as well as any evidence of uptake from his peers. For the purposes of this early stage of analysis, our transcripts only included verbal utterances. After debriefing over these early annotations, we confirmed that "bid making" and "bid uptakes" seemed like an analytically salient next step, given the sheer quantity of Quentin's proposals for social engagement throughout the play episodes.

To select episodes for our more in-depth analysis, we turned to tasks that (a) did not feature adult intervention and (b) were generally more mathematically productive (Knowe et al., n.d.). These selection criteria allowed us to focus on the differing affordances of small-group play settings versus whole-group instruction, rather than potentially confounding factors, like adult presence or task design. This resulted in two play tasks, zoo and dot paint, which happened to be on the same day and during the same play unit: counting. In zoo, students counted out animals to match varying quantities within each enclosure. The enclosures were illustrated on a large posterboard that sat in the middle of each small-group table so that all students could work on the same zoo. For dot paint, students participated in pairs by creating different dot paint quantities and counting one another's creations. For both tasks, we constructed elaborated transcripts that included verbal activity, gesture, and movement. Next, following methods from conversation analysis (Goodwin & Heritage, 1990), we examined turns of talk to identify when an interaction was initiated, and how that initiation was taken up (accepted, modified, or rejected). We also tracked who initiated each interaction, and how it was initiated.

Finally, and given that these two episodes occurred on the same day, we analyzed the whole-group lesson video from this day. The three introductory whole-group activities were similarly watched with attunement to "bids" made during each activity and responses to those bids for engagement. Specific attention was given to Quentin's actions, gesture, talk, and movement as decipherable from the whole-group video. The first activity, "Sparkle," was transcribed to include verbal activity, gesture and movement. In the following sections, we organize our findings around these two differing contexts: whole-group versus small-group play centers. In doing so, we highlight the ways in which Quentin's activity was taken up differently across these two settings and end by discussing the potential affordances of play spaces for recognizing children's ways of being.

Findings

Quentin during mathematical play

The small group activities on this day involved Quentin and three other students, who moved together to different play stations during math time. All play stations were about counting, and invited students to count different objects in different ways. Across the stations that Quentin played at on this day, he was regularly the person who would make a bid for social connection. When reviewing the conversations amongst the four children, we found that Quentin made approximately 75% of the bids to connect to others in the group. In addition, every time another member of the group initiated a bid to connect, he accepted that bid. An example of this can be seen in the number of times Quentin invited King, a child sitting across from him, to play with him, regularly using the word "let's" as he launched an idea (see Table 1).

Table 1

Quentin and King During Zoo

	Transcribed talk and gesture	Initiation/response
1	Keira: *Pulls two animals from the bin and gazes at Quentin.* Look, these two are the exact same. Quentin: Yeah, I can fight them. *Picks up two animals.*	K Initiates; Q Accepts
2	Quentin: ROOOAAARRRR! *Pretend fights with animals near the 13-enclosure, right in front of King.* King: Stop. *Places animals one-by-one into 13-enclosure.*	Q Initiates; K Dismisses
3	Quentin: **Let's** make this a shoe store. *Places animals into the 13-enclosure, and knocks over an animal that King had placed down.* King: Hey. *Continues placing animals into 13-enclosure.*	Q Initiates; K Accepts
4	Quentin: *Reaches into the bin and gasps.* I found another one. **Let's** put them all together. I'm gonna put these together *puts two tigers next to one another* and these together *puts two cheetahs next to one another*. I got to get another giraffe. *Finds giraffe and places it in the 13-enclosure next to another giraffe. King continues to place animals, but not in pairs as Quentin is doing. Moves one of the animals that Quentin placed in a pair, disrupting the pair.* King: No, you, we can't put that together. *Removes one of the tigers from the pair that Quentin had placed.*	Q Initiates; K Dismisses

Figure 1
Quentin and King During Zoo

Quentin standing to move from his spot (left), behind King (center), and in-between King and Kiera (right)

In Exchange 1, Kiera initiated an interaction with Quentin, which he immediately accepted. In Exchange 2, he extended this bid through the position of his body, offering an opportunity for King to join in the game. King dismissed this invitation; however, Quentin immediately rallied, and in Exchange 3 proposed a different game—making a shoe store, a proposal which King tacitly accepted by continuing to place animals in the same enclosure that Quentin identified. This game was almost immediately modified by a discovery about the animals in the bin—that there were duplicates—prompting Quentin to propose yet another game that they could play together. As can be seen, many of Quentin's bids for social connection were dismissed by King (this pattern persists throughout the episode), but this dismissal did not seem to be a deterrent, further strengthening the claim that Quentin was consistently and personally oriented towards social interaction.

Quentin was also regularly in motion while playing, although this was not necessarily unique to Quentin. His movements tended to be large, and he often leaned, reached, or moved his body into other children's space. For example, Figure 1 (sequence a, b, and c) shows Quentin's move from his seat, to circle around the table, and work in between King and Kiera throughout the zoo episode. During this play episode, Quentin's movement was never commented on or shut down by other members of the group, nor did it interfere with his (or others') mathematical engagement. Rather, his movement and invitations to connect with others, at times, even enhanced others' mathematical engagement.

As an example of this mathematical enhancement, we turn to Quentin's activity during the dot stamping center (see Table 2). At this play center, Quentin collaborated with Kaleb on dot stamping—an activity that involved stamping a quantity, and then passing the paper to your partner to count and write down the correct numeral that matched the quantity of dots. Throughout the episode, it was Quentin who reinforced the turn taking of the activity (in contrast, the pair across the table were working individually to stamp dots and count them). These bids for social connection centered on the playful task at hand and connected directly to mathematics. Quentin's close attention to Kaleb kept the pair mutually focused on the act of counting. Quentin's bids for social connection can be seen perhaps most strongly, however, in Exchanges 3 and 4. Kaleb confessed that Quentin simply stamped too many dots to be counted, and even asked, with apparent suspicion: "Did you do one hundred?" This seemed to be a point of potential breakdown for the pair, as Kaleb felt the task was beyond him and indeed, that Quentin might have gone too far with his dotting to be reasonable. In that moment, Quentin worked to maintain the connection between the two, however, offering to do the counting himself, but staying in the rules of the task: "Pretend you gave it to me, okay?" Similarly, Quentin's body was in motion during this episode, crossing over into Kaleb's space, (Exchange 1), leaning into his space while he was working, and ultimately, taking the paper back from Kaleb (Exchange 4). These movements were connected to his mathematical and playful activity, however, and were not made problematic by Kaleb.

Table 2
Quentin and Kaleb During Dot Paint

	Transcribed talk and gesture	Initiation/response
1	Quentin: Here you go. *Passes paper with 43 dots to Kaleb and places it directly in front of him, reaching over his outstretched arm.* You gotta write the number and then you give it back. Write it, right here. *Points to an open space on the edge of the paper with no dots.*	Q Initiates; K Accepts

	Kaleb: *Puts two papers back into the bin in the middle of the table, then picks up pencil and looks down at the sheet in front of him. Places his pencil in the black space, pauses, and then turns to Quentin* What number is it?	
2	Quentin: You gotta count. You gotta pass it to each other and count Kaleb: *Touches dots on paper while counting* one, two, three, four, five, six, seven, /eight. Quentin: /You gotta count all of them, you know? *Looks back to the papers on table and pulls some closer to himself.* Kaleb: *quietly* //eleven, twelve. Quentin: //I'm goin—I'm goin *turns to look at Kaleb* *Kaleb:* ///thirteen, fourteen Quentin: ///It ain't twenty either	Q Initiates; K Accepts
3	Kaleb: eighteen, seventeen *leans forward, turns to Quentin.* I can't count all of those. *Turns back to face the paper, sits back in his chair, slumps down.* Quentin: *Looks at Kaleb, pauses two seconds.* How many DID you count? Kaleb: [says something very quietly while looking at his paper] *Turns to Quentin* Did you do one hundred?	K Initiates; Q Accepts
4	Quentin: Let's pretend—pretend, pretend you gave it to me, okay? *Takes paper from Kaleb.* And I gotta count, okay? Kaleb: *Looks at Quentin.* 'kay	Q Initiates; K Accepts

Quentin in the whole class

We turn next to the whole-group context on the same day, in which Quentin's propensity for movement and connection were still present, but enacted and recognized quite differently. Before the math stations began, Ms. Lane gathered students on the carpet for a whole-group introduction to the math lesson. Below we focus on one activity, the Sparkle game, which involved the teacher, Ms. Lane, pointing to each student consecutively as the class counted (for example, from 10 and 20). After the last number, students would all yell "Sparkle!" and the student who Ms. Lane landed on would sit down. This continued in rounds until only one student was left standing, who was declared the winner. As Ms. Lane introduced Sparkle to the class, she made clear her expectations for students' behavior and interaction. Although the whole-class activity was tightly orchestrated, Quentin's proclivity for making and staying connected to others was apparent. For example, he regularly made bids to connect with others by making himself more visible (for example, by laughing more loudly than anyone else in the group). Even during moments of compliance, he still found ways to connect with other students in the group—in this case, by making sure others were also following instructions:

1	Ms. Lane:	Alright everyone, stand and freeze.
2	Quentin:	*Along with other students, stands and looks at Ms. Lane.* Are we going to play Sparkle? *Bounces on the balls of his feet and wiggles his shoulders.*
3	Ms. Lane:	Alright so I'm trying to talk. So, make sure you do a body check. You're around the carpet standing on the line. Make sure you have very calm bodies.
4	Quentin:	*Looks down, finds the line that marks the edge of the carpet, puts his feet on it, and then directs his neighbor to do the same.*
5	Ms. Carlisle:	If your body isn't calm, then you'll be out, and the game hasn't even started yet.
6	Quentin:	*Jumps slightly and wiggles and falls off the line, but steps quickly back*

Throughout the rest of the opening activities, Quentin was similarly interactive and in motion, sometimes in ways that were consistent with the activity, and sometimes in ways that were at odds with the activity. As an example of the former, when asked for volunteers to participate or share, Quentin was often one of the first children to raise his hand, which he did with apparent excitement, for example by wiggling his fingers or raising his hand extra high. As an example of the latter, while Ms. Lane read the class a book called *How Many,* most of the students sat quietly and listened. However, Quentin's listening happened while his body was in motion, as seen in Figure 2. Images a, b, and c show Quentin wiggling off of his spot on the rug and attempting a seated headstand. Overall, and throughout the majority of the whole-group activities, both Ms. Lane and Ms. Carlisle

made clear that keeping bodies calm was crucial to being able to do, and not be removed from, mathematics, as indicated by the above and below exchanges:

Figure 2
Quentin During Whole-Group Instruction

1	Ms. Lane:	I really wanna play this game but if you doing all of this. *Wiggles body wildly while keeping feet in place.*
2	Quentin:	*Along with other students, laughs loudly.*
3	Ms. Lane:	You can hurt somebody. So, let's just bring it down. *Raises hands and lowers them slowly.* Take a deep breath. *Takes a deep breath.* It's really important that we are calm and we are counting, but guess what there's friends in this circle who want to know how to count and they have to be able to hear. They cannot hear if they are distracted. So, let's make sure we are staying calm and using our counting voices. We're moving right into math. Is this recess?
4	Quentin:	*Interlaces hands behind his back, leans back and forth, steps side to side, jumps up and down.*
5	Quentin:	[Along with other students] No!
6	Ms. Lane:	Starting with 10. Here we go.

Although Quentin was never called out for talking with peers or being wiggly on the carpet, behaviors, such as moving one's body or talking with peers, were seen as antithetical to doing mathematics. Therefore, we emphasize that it was not *Quentin* who changed between the small-group play centers versus whole-group instruction, but rather how his participation aligned, or not, with the given mathematical activity, as indicated by differences in how *others* took up his bids or reminded students of body-related expectations. As a result, and as illustrated in this analysis, Quentin's behavioral tendencies for connection and movement became more or less notable—more or less frequently commented on—depending on the context of the mathematical activity.

Discussion

The goal of this analysis was to explore how the same individual, Quentin, could be recognized in distinctive ways across two varying mathematical contexts. In both the whole-group and small-group play settings, Quentin sought opportunities to connect with other people in the classroom. Even when members of our research team entered the classroom, he was regularly one of the first children to greet us. This tendency towards connection was extended to virtually everyone in the classroom, as Quentin was often the person reaching out to other children, asking them questions, and inviting them to play. Similarly, Quentin's body was busy; he would reach out to touch things, move his legs and arms when sitting on the rug, sing and dance with his whole body, and was regularly one of the first to spring to his feet when the opportunity arose.

During whole-group work, Quentin was frequently in motion and attempted to connect with his neighbors, while also trying to follow Ms. Lane's directions. These tendencies came into conflict with the consistent reminders from Ms. Lane and Ms. Carlisle that doing mathematics, here, required calm bodies, sitting on bottoms, not talking to neighbors, and having controlled voices. Although these expectations are reasonable for these whole-group activities, they also meant that Quentin was less able to explore mathematics with his full self. Rather, he needed to work to control or suppress aspects of himself in order to do participate mathematically.

On the day that was the focus of this analysis, Quentin was not called out for problematic behavior during whole-group instruction, although this was not always the case. In our prior observations, we frequently noticed Quentin's dismissal from whole-group carpet time. In fact, prior to entering Ms. Lane's class, he had originally been placed in a different kindergarten classroom. Following his continued labeling as 'disruptive,' he was eventually moved to Ms. Lane's class in order to see if a differing context might 'support' his behaviors. However, even when his behavior was not labeled as transgressive, it was also not always seen as mathematical. For example, amidst his jumping, wiggling, and bouncing, were continual reminders of expected norms that were in tension with his propensity for movement, such as statements like, "Who is standing and frozen?" On the other hand, during the play times, Quentin's orientation to collaboration with his peers, as well as his tendency to be in motion, were not only *not* characterized as problematic, but were often accepted by his peers. Importantly, Quentin was not engaged in more or less mathematics across these two settings, but rather, his desire for social connection and movement were *a part of,* rather than *separate from*, his mathematical participation in the small-group play settings.

In line with humanizing perspectives of teaching and learning, which call educators to center the varying realities, identities, and sociocultural resources of their students (Salazar, 2013), the small-group play centers facilitated a space in which Quentin could engage his whole self in ways that were seen as legitimate by others. Far too often, mathematics instruction offers rigid, narrowly defined norms and expectations around mathematics participation. However, as Berry (2021) writes, "The field of mathematics education must engage in critical conversations about humanizing and rehumanizing mathematics to broaden the space of participation" (p. 45). Drawing from Freire, Frankenstein and Powell (1994) call for a liberatory orientation towards mathematics, in which varying conventions and inclinations for doing and learning mathematics are elevated, asserting, "[The] belief in the universality of mathematics can limit one from considering and recognizing that different modes of thought or culture may lead to different forms of mathematics, radically different ways of counting, ordering, sorting, measuring, inferring, classifying, and modeling" (p. 78). We highlight Quentin's story as just one example of how play may be able to facilitate more humanizing, liberatory orientations towards children and their mathematical engagement. In line with McDermott (2001), we see play as a potential "spotlight" on children's behaviors and modes of engagement. However, rather than spotlighting what children *cannot do*, as experienced by Adam, play may instead reveal how the activities that children *already do* are, in fact, mathematical.

References

Bergen, D. (2009). Play as the learning medium for future scientists, mathematicians, and engineers. *American Journal of Play*, *1*(4), 413–428.

Berry, R. (2021). Humanizing mathematics to broaden the space of participation. *Journal of Mathematics Education at Teachers College*, *12*(2), 45–46.

Bullock, E. C. (2019). Mathematics curriculum reform as racial remediation: A historical counter-story. In J. Davis & C. Jett (Eds.), *Critical race theory in mathematics education* (pp. 75–97). Routledge.

Clements, D. H., & Sarama, J. (2017). Play, mathematics, and false dichotomies. *DREME Development and Research in Early Math Education*.

Cobb, F., & Russell, N. M. (2015). Meritocracy or complexity: Problematizing racial disparities in mathematics assessment within the context of curricular structures, practices, and discourse. *Journal of Education Policy*, *30*(5), 631–649.

Danish, J. A., & Gresalfi, M. (2018). Cognitive and sociocultural perspectives on learning: Tensions and synergy in the learning sciences. In F. Fischer, C. E. Hmelo-Silver, S. R. Goldman, & P. Reimann (Eds.), *International handbook of the learning sciences* (pp. 34–43). Routledge.

Dunleavy, T. K. (2015). Delegating mathematical authority as a means to strive toward equity. *Journal of Urban Mathematics Education*, *8*(1), 62–82.

Flyvbjerg, B. (2011). Case study. In N.K. Denzin and Y.S. Lincoln (Eds.), *The sage handbook of qualitative research* (pp. 301-316). Sage.

Frankenstein, M., & Powell, A. B. (1994). Toward liberatory mathematics: Paulo Freire's epistemology and ethnomathematics. In P. McLaren & C. Lankshear (Eds.), *The Politics of Liberation* (pp. 74–99). Routledge.

Frankenstein, M., & Powell, A. B. (1994). Toward liberatory mathematics: Paulo Freire's epistemology and ethnomathematics. In P. McLaren & C. Lankshear (Eds.), *The Politics of Liberation* (pp. 74–99). Routledge.

Gee, J. P. (2001). Identity as an analytic lens for research in education. In W. G. Secada (Ed.), *Review of Research in Education* (Vol. 25, pp. 99-125). American Educational Research Association.

Ginsburg, H. P. (2006). Mathematical play and playful mathematics: A guide for early education. In D. Singer, R. M. Golinkoff, & K. Hirsh-Pasek (Eds.), *Play = learning: How play motivates and enhances children's cognitive and social-emotional growth* (pp. 145–165). Oxford University Press.

Goodwin, C., & Heritage, J. (1990). Conversation analysis. *Annual Review of Anthropology, 19,* 283-307.

Gresalfi, M., Martin, T., Hand, V., & Greeno, J. (2009). Constructing competence: An analysis of student participation in the activity systems of mathematics classrooms. *Educational Studies in Mathematics*, *70*(1), 49–70.

Hand, V. (2010). The co-construction of opposition within a low-track mathematics classroom. American Educational Research Journal, 47, 97-132.

hooks, bell. (1994). *Teaching to transgress: Education as the practice of freedom*. Routledge.

Jasien, L., & Gresalfi, M. (2021). The role of participatory identity in learners' hybridization of activity across contexts. *Journal of the Learning Sciences*, *30*(4–5), 676–706.

Joseph, N. M., Hailu, M. F., & Matthews, J. S. (2019). Normalizing Black girls' humanity in mathematics classrooms. *Harvard Educational Review*, *89*(1), 132–155.

Knowe, M., Gresalfi, M., Vescio, J., Park, A. & Lu, S. (under review). "Picking the right games for them to play": Designing for mathematical play in schools. *Journal for Research in Mathematics Education,*

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Land, T. J., Bartell, T. G., Drake, C., Foote, M. Q., Roth McDuffie, A., Turner, E. E., & Aguirre, J. M. (2019). Curriculum spaces for connecting to children's multiple mathematical knowledge bases. *Journal of Curriculum Studies*, *51*(4), 471–493.

Lifter, K., & Bloom, L. (1998). Intentionality and the role of play in the transition to language. In A. M. Wetherby, S. F. Warren, & J. Reichle (Eds.), *Transitions in prelinguistic communication* (pp. 161–196). P.H. Brookes Publishing Company.

McDermott, R. (2001). The acquisition of a child by a learning disability. *Understanding Learning: Influences and Outcomes*, *2*, 60-70.

Miller, E., & Almon, J. (2009). Crisis in the kindergarten: Why children need to play in school. *Alliance for childhood (NJ3a)*.

Nasir, N. S., & Hand, V. (2008). From the court to the classroom: Opportunities for engagement, learning and identity in basketball and classroom mathematics. *The Journal of the Learning Sciences*, *17*(2), 143–179.

Parks, A. N. (2015). The mathematical practices. In *Exploring mathematics through play in the early childhood classroom* (pp. 83–93). Teachers College Press.

Powell, A. B., & Frankenstein, M. (1997). Ethnomathematical knowledge. In A. B. Powell & M. Frankenstein (Eds.), *Ethnomathematics: Challenging eurocentrism in mathematics education* (pp. 5–11). SUNY.

Salazar, M. del C. (2013). A humanizing pedagogy: Reinventing the principles and practice of education as a journey toward liberation. *Review of Research in Education*, *37*(1), 121–148.

Shah, N., & Leonardo, Z. (2016). Learning discourses of race and mathematics in classroom interaction: A poststructural perspective. In I. Esmonde & A. N. Booker (Eds.), *Power and privilege in the learning sciences: Critical and sociocultural theories of learning* (pp. 50–69). Routledge.

Su, F. (2020). *Mathematics for human flourishing*. Yale University Press.

Tate, W. F. (2013). Race, retrenchment, and the reform of school mathematics. In E. (Rico) Gustein & B. Peterson (Eds.), *Rethinking mathematics: Teaching social justice by the numbers* (2nd ed., pp. 42–54). Rethinking Schools, Ltd.

Yeh, C., Martinez, R., Rezvi, S., & Shirude, S. (2021). Radical love as praxis: Ethnic studies and teaching mathematics for collective liberation. *Journal of Urban Mathematics Education*, *14*(1), 71–95.

Yeh, C., & Otis, B. (2019). Mathematics for whom: Reframing and humanizing mathematics. *Occasional Paper Series*, *2019*(41), 85–98.

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