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Play as a Site for Children's Construction of Internally Persuasive Mathematical Discourses

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Abstract: This study explores the relationship between play and authoritative discourses (Bakhtin, 1981) in a kindergarten mathematics classroom. Drawing on interpretive methodological traditions, the research team video recorded and took field notes on a week of geometry lessons following a professional development session in which teachers co-designed playful geometry lessons with the researchers. Our findings demonstrated that engaging in play allowed children to construct their own internally persuasive discourses about mathematics.

Introduction

When children experience mathematics as a set of rules to memorize, they come to see mathematics as something they do not have the authority to question or create, such as when children execute procedures like "borrowing and carrying" without conceptual understanding of place value (Laupa, 2000). In contrast, mathematical play can allow children to engage in mathematics in ways that allow them to explore, reason, and rely on their own authority (Wager & Parks, 2014). In this study, we were interested in identifying qualities of mathematical play in a kindergarten classroom that made it possible for children to challenge authoritative discourses about mathematics. For example, rather than seeing mathematics as primarily requiring the memorization and recitation of correct answers, we hypothesized that certain kinds of mathematical play might allow children to raise mathematical questions of their own, form and test mathematical conjectures, and engage other children and even teachers in mathematical arguments. In defining play, we drew on definitions that emphasized play as providing opportunities for pleasure, chosen repetition, creativity, social engagement, and use of attractive materials, whether or not individual children took up these opportunities (Burghardt, 2011). To guide our study, we asked the following research question: What qualities of play-based tasks support children's meaningful sense-making about mathematics and to engage with mathematics as more than an authoritative discourse circulated by the teacher?

Theoretical frame

In exploring the potential of play in a kindergarten classroom during mathematics, we adopted a discursive perspective on authority, heavily informed by the work of Bakhtin (1981). Bakhtin (1981) differentiated between authoritative and internally persuasive discourses. He called authoritative discourses "acknowledged truths," and "the word of a father, of adults and of teachers" (Bakhtin, 1981, p. 342), while he defined internally persuasive discourses as those we believe to be true even though they are "backed up by no authority at all" (Bakhtin, 1981, pp. 342-344). In mathematics classrooms, authoritative discourses circulate around appropriate behavior—for example, sit criss-cross applesauce, raise hands before speaking, obey the teacher—and around mathematics—use proper vocabulary, perform procedures correctly, memorize rules. An authoritative discourse "demands that we acknowledge it, that we make it our own; it binds us, quite independent of any power it might have to persuade us internally" (Bakhtin, 1981, p. 343). In contrast, we hypothesized that play could provide a site for children to develop their own internally persuasive discourses about mathematics.

Methods

This study, which is part of a larger project, draws on interpretive ethnographic traditions (Erickson, 2004). The site of the study was a school serving a racially and socio-economically diverse population. Kindergarten teachers at the school participated in a week of professional development (PD) on mathematical play during the summer as well as four daylong sessions focused on adapting lessons from the mandated mathematics curriculum throughout the school year. This smaller study focuses on one kindergarten classroom with two co-teachers and 26 students during the week of geometry lessons planned during PD. Data collection included video of the week's lessons with four video cameras. In addition, at least one member of the research team observed each lesson. In the weeks before the play-based lessons, a member of the research team observed typical mathematics lessons one or two times each week and took written fieldnotes. For this analysis, the research team viewed video from four recorded lessons in one classroom to identify moments of mathematical play. Additional viewing of the

videos focused on identifying authoritative mathematical discourses and moments when children challenged these discourses. These moments were then analyzed to identify differences in children's and teachers' participation in playful mathematics activities as well as to differences in the quality of play and the content of the mathematics (e.g., social engagement, creativity, open and closed problems, etc.) across the playful activities implemented during the week.

Findings

In the weeks leading up to the play-based geometry lessons, children's engagement in mathematics was largely directed by Ms. Lane, who provided explicit instruction and typically assigned independent tasks to children. For example, after first introducing an activity to students in which they counted objects on cards and recorded their counts on a number line, referred to as a "game board," Ms. Lane and her students had the following exchange:

01	Ms. Lane:	Is it time to play?
02	Students:	(*loudly and in unison)* No!
03	Ms. Lane:	Is it time to work?
04	Students:	Yes!
05	Ms. Lane:	"Is it time to learn?
06	Students:	Yes!
07	Ms. Lane:	Is it time to talk to your neighbor?
08	Students:	No!

In typical lessons like this one, Ms. Lane reinforced authoritative discourses about mathematics by focusing on the production of correct answers, acting as the authority in determining correctness, and giving explicit directions about tasks. During these lessons, children typically worked independently after the whole-group introduction. During the week of play-based instruction, Ms. Lane added in group activities co-developed during the PD by the research team and the kindergarten teachers, such as pattern block puzzles, shape sorts, and making shapes on geoboards. During the exploration, children rotated through centers chosen by Ms. Lane.

Authoritative task, authoritative discourse

On the first day of the geometry unit, in addition to using the play-based tasks developed in the PD, Ms. Lane provided the children with a a game that they had played during the previous unit. This game challenged children to unlock a toy by correctly matching a picture with a numeral. The task of the game was relatively closed, supporting only one kind of play with not many opportunities for improvisation. When Ms. Lane engaged with children at this center, she focused their attention on the production of correct answers, as in the episode below:

01	Layla:	*(Counts to 14).* Fourteen! Where's fourteen? (*Picks up a key and smiles at Ms.*
02		*Lane*).
03	Ms. Lane:	Is that fourteen on the key?... I can't see the number.
04		*(Layla shows Ms. Lane the number 15 key she is holding. Ms. Lane smiles.)*
05	Ms. Lane:	FOURRRteeeen, is that FOUUURRRRteeeen? Find FOURRRteeen
06		*(Layla shows key number 13.)*
07	Ms. Lane:	FOURteen? Is that FOURteen?
08	Layla:	(*searching for the correct key)* Four....teen

Even though this moment was playful for both Ms. Lane and Layla—they both smiled, Ms. Lane's voice was teasing, and Layla seemed to find pleasure in handling the locking toys—Ms. Lane focused her questions on getting Layla to repeat that the numeral was fourteen and not fifteen rather than exploring Layla's thinking.

Opportunities for improvisation and internal persuasiveness

A center where children used stencils to draw polygons and then mark vertices with dot paints seemed to provide more opportunities for children develop internally persuasive discourses about mathematics. Children could make choices about which shapes to draw and how to mark the vertices, and the blank paper used for the activity supported children in going beyond the authoritative directions for the task. For example, Will and Nicholas wrote numerals inside of a circle they traced, making a connection between the number and geometry. In addition, Ms. Lane's interactions in this center also seemed less focused on reinforcing the authoritative mathematical discourse. For example, when Ms. Lane saw the children writing numerals, Ms. Lane asked the children to explain:

01	Ms. Lane:	What are y'all doing? What's that? *(Points at Will's paper.)*
02		*(Will and Nicholas look at Ms. Lane silently.)*
03	Ms. Lane:	Why are you putting those numbers in the circle?
04		*(Will and Nicholas look down at papers, look at each-other, and then smile at*
05		*Ms. Lane, still silently.)*
06	Tiana:	(*Interjecting.)* I didn't put numbers in the circle, but I put a smiley face.
07	Ms. Lane:	No, I am talking to these two. What is that? What are you making?
08	Will:	I'm making a clock.
09	Ms. Lane:	You're making a clock?
10	Nicholas:	Yeah.
11	Will:	Out of the circle.
12	Nicholas:	We are making a clock.

In this episode, the two boys played with the rules of the activity by not just identifying vertices, but also creating pictures out of the shapes. This improvisation allowed them not only to connect shapes and numerals but also to make a connection to a mathematical tool in their ordinary lives. The more open task and the playful social context, which allowed the children to talk freely and build off each other's ideas, supported the children to engage with mathematics as something they had the power to manipulate. In addition, Ms. Lane seemed to adopt a slightly more playful stance in this interaction than in the matching lock interaction, perhaps because the drawing of the clocks inside a shape was both not incorrect and was mathematically relevant.

Authoritative discourse, internally persuasive discourse

Beyond the importance of open activities (e.g., those that supported choice, exploration, and multiple answers), spaces where children could interact outside of the watchful eye of the teacher provided important opportunities for children to develop internally persuasive discourses about mathematics.

One morning before centers, Ms. Lane led a whole group discussion about the orientation of triangles, asking the children to decide if triangles of various shapes and orientations were still triangles. Some children said no, and she talked about how orientation did not determine if shapes were triangles. She prompted children to count all the sides and vertices to determine if a shape was a triangle.

Following this discussion, Will, Nicholas, and Tiana were assigned to a geoboard activity during centers. Each child had a geoboard, stack of shape cards, and some rubber bands. Ms. Lane had asked children to choose a card that had a shape on it and to recreate that shape with rubber bands on their geoboards. As Will, Nicholas, and Tiana begin the geoboard activity, Ms. Lane joined the group to continue the conversation about orientation. She presented the group with a square shape card turned so the square stood on a vertex. Will and Nicholas both claimed that the shape was a diamond while Tiana was insistent that the shape remained square, regardless of its orientation:

01	Ms. Lane:	*(Addressing Nicholas.)* What is it this way?
02		*(Ms. Lane turns the card three different ways and repeats her question. Nicholas*
03		*continues to call the shape a square only when a side was parallel to the table;*
04		*otherwise, he calls it a diamond.)*
05	Ms. Lane:	*(Addressing Nicholas and Will.)* How does it change from a square to a
06		diamond? It's still the same shape.

In this exchange, Ms. Lane maintained her commitment to reinforcing the authoritative discourse about shapes—orientation does not matter—even though Nicholas disagreed. Ms. Lane continued to press her point by grabbing a board eraser and turning it in multiple directions, asking what it was at each turn. The children agreed it was always an eraser, but when Ms. Lane returned to the square example, both Nicholas and Will still insisted it was a diamond. Throughout this interaction, even in the play-based context, Ms. Lane maintained a commitment to guiding children toward authoritatively correct answers. However, the playful context of the center and Ms. Lane's own smiles seemed to have made Will feel comfortable in reiterating his own position— the square is a diamond—even though it was backed up by "no authority at all." Ms. Lane left the group before she convinced Will and Nicholas to adopt her position. Not long after Ms. Lane left, Will, looking at a square, exclaimed, "It's a diamond! I know it is!" Then, after about a minute of individual work, Tiana reintroduced the orientation conversation:

01	Tiana:	(*showing the square card to the group)* What is this everyone?

02	Both boys:	(w*ithout really looking)* A square.
03	Tiana:	*(changing the orientation of the card)* If I flip it over like this, what it is? *(looking*
04		*frustrated)* How does this change, but... what if you had a triangle? When you
05		flip it over it still looks like a triangle because all of the sides are the same.
06		(s*hows Will a triangle card)*
07		(*Will repeatedly affirms the shape is a triangle as Tiana turns it*.)
08	Tiana:	(s*hows two different square cards turning them to be different and then matching*
09		*orientations)* Then how does this one change? They are both the same thing!
10	Tiana:	*(attempting to build a hexagon on her geoboard by making two trapezoids)* I'm
11		making the same shape you teached me.
12	Will:	*(making a square on his geoboard)* I got a diamond. Did you know, if it's a
13		square sideways or diagonal then it's a diamond. Do you see the difference?
14		Nicholas, do you see the difference? *(Taking a breath and pointing to his square*
15		*turned on a vertex)* This is actually a square! Look! It's just facing diagonally.
16	Tiana:	That's what I just told you.

In this independent interaction Tiana advanced an idea she seemed to find internally persuasive—that the orientation of the shape did not change how it was identified. No doubt, hearing this argument from both Tiana and Ms. Lane helped Will reach a similar conclusion. However, it was his own play with the geoboard that brought his own internally persuasive discourse about shapes in line with the authoritative discourse. The atmosphere of play, where children were able to make shapes on their own, to talk as they worked, to argue and disagree with the teacher supported their exploration of mathematical ideas.

Discussion

As with previous research, introducing playful spaces into the kindergarten provided opportunities for children to construct their own internally persuasive discourses about mathematics; however, some characteristics of play seemed more important to children's sense-making than others. While children found the matching numeral and quantity locking game pleasurable and talked with each other and the teacher while playing with it, the play did not allow them to do their own sense-making, but rather pushed them toward accepting authoritative discourse. In contrast, the tracing shapes and geoboard activities allowed children to alter the tasks in ways that let them explore questions of interest to them and to develop their own understandings. This suggests that closed playful tasks—even if they are pleasurable, social, and low-stress—may not provide the kind of support necessary for children to do their own sense-making around mathematics.

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