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PROFESSIONAL DEVELOPMENT

Ruof

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David Green teaches Ruof *to his third graders every year. His students always love to play the game whenever they have a few spare moments in class. The game provides the opportunity to explore math in a variety of ways. The game exercises students' problem-solving skills as they seek ways to accurately predict the winner, testing out, discarding, or keeping hypotheses based on the information gleaned from actual game play. The game also helps students think about numbers and requires them to look for, discover, and explain myriad patterns that occur in the game.*

Finding ourselves with some extra time before going to lunch, I decided to introduce a new game to my third graders that had been a favorite of previous years' classes. *Ruof,* I explained, was a game of elimination. Counting around the room in order, each student would say the next number in the following sequence: "One, two, three, ruof, one two, three, ruof, one, two..." Any student who said "ruof" was eliminated and had to sit down. The pattern would then repeat over and over, with every student unlucky enough to say "ruof" sitting down until only one student remained.

I wrote the word *Ruof* on the board and asked the students if they could figure out why the game was called *Ruof.* A number of hands shot up right away, and others slowly followed as the class realized that *ruof* was *four* spelled backward, hence the elimination of every fourth person in the game.

Rather than gathering in a large circle, we played the game while standing at our desks, which were grouped into four "tables" of four desks each and one "table" of five desks. This required us to count around the room in a wiggly loop from table to table. After a few times around the room, the class learned the order in which we counted around the room. We randomly selected a starting point for our first game.

"Before we begin, and while we are playing, look around the room and try to predict who you think will win the game or which of the five tables the winner will come from," I told the class. "As the number of people standing gets lower, you can change your predictions if you want to."

We started the game, counting, "One, two, three, ruof..." with every fourth student sitting down. Initially, I pointed to the students on their turn and reminded them what number to say if they lost track. Students who were eliminated sat down with disappointed smiles while the remaining students grew more excited the longer they survived. Some in the class watched whoever happened to be saying the next number, following the counting as it happened, while others appeared to be silently counting ahead, trying to figure out if and when they would be eliminated.

The number of players dwindled until only Annie and Gus stood, facing each other across the room from their respective desks. "One," said Annie on her turn. Gus smiled as he said, "Two," since he knew what was coming. "Three," Annie said. Gus sat down as he said, "Ruof." Annie had won.

"We started the game with Annie," Charlie noticed out loud. "She went first and she was the winner."

"That's an interesting observation," I said. "Let's play again. If we start with Sharon this time, who do you think will be the winner?" A number of students said Sharon would win while others thought someone else would be the winner, although they did not pick a specific person. "Some people think since Annie went first and was the winner in our first game, then if Sharon goes first this time, she will be the winner. But some of you don't think that will be the case. Let's find out."

We started the next game. Sharon went first. The numbers dwindled. To the surprise of some (including me), with two players left, Sharon sat down. Zoe had won. "That's interesting," I said. "The first person in the loop didn't win this time. Take a look where Zoe, the winner, is sitting in relation to Sharon." Many students pointed out that Zoe was sitting at a desk next to Sharon.

"So now we seem to have two different *hypotheses,"* I said, explaining that hypothesis was a fancy word for *prediction."* The winner will be the person who starts the game — the first person in our loop — *or* the winner will be somebody sitting next to that person. Why do you think we ended up with two different possibilities?"

"Maybe they both work," offered one student.

"Maybe we made a mistake during one of the games," offered another.

"Maybe it makes a difference if we start at a table with four people or a table with five people," said a third student.

"Yeah," added another, "if Max's table only had four people instead of five, then when we play, the fourth person at every table would sit down. But at Max's table, two kids sit down because they have five people at their table."

"I wonder if changing the number of players in the game will affect who wins," I reiterated, picking up on the previous comment. "Keep that in mind for later exploration. For now, let's stick with twenty-one players until we are able to figure out how to predict the winner for sure. We have lots of different predictions and hypotheses to test out. Let's play again with Rebecca going first."

Kids made predictions as to who would win. Some stuck with the first hypothesis that Rebecca would win. Others chose a person sitting next to Rebecca, although some chose the second person in the loop while others chose the last person in the loop. Still, others were unsure or unwilling to commit by predicting a winner.

We played again. Rebecca sat down second to last, leaving John, who was sitting across from Rebecca, as the winner. I asked the students what they now thought.

"The first person isn't the winner because Rebecca and Sharon didn't win," said one. "We probably made a mistake the first time we played."

"If that's the case," I said, "which person in the loop will be the winner? John won this time. Where in the loop does he fit?"

"Everyone else said a number before me," said John. "I was the last one to say a number when we went around the room."

"Is that what happened to Zoe in the second game?" I asked. Students looked over at Zoe's table. "When Sharon went first," I added, "did Zoe say the next number after Sharon or was she the last one in the loop to say a number?" It turned out Zoe was the last person in the loop in the second game. We seemed closer to pinpointing the winning position in our loop.

"Kristin, if we played again with you going first, who do you predict the winner will be?"

Kristin looked across her desk at Peter. "Peter would win," she said, "because he would be the last one in the circle."

I asked the rest of the class to silently agree or disagree with Kristin's prediction: thumbs up if they agreed that Peter would win, thumbs down if they disagreed, or a sideways waggling thumb for those unwilling to commit to a prediction. While a number of students, based on the knowledge gleaned from the first three rounds, agreed with Kristin, others in the class disagreed or remained noncommittal. Glancing at the clock, I realized we had to leave for lunch.

"We need to stop now, but we will play again later," I said. "Please remember your ideas and predictions so we can test them out later."

The next time we had a chance to play, half the class was out of the classroom, so we played with just ten people. I reminded the group of the general rule we were considering — that the last person in the loop would win. Given we had a different number of people playing, I asked if that prediction would still hold true. A thumb vote before we started produced a variety of responses. The last person did not win, and we spent some time discussing who won, how we would describe that person's location in the loop, and what general rule we might come up with to test out by playing some more. I ended our playing time by leaving the students with the question "Does changing the setup of the game affect who the winner will be?"

The next time we played with the entire class, we were short on time, so I announced that instead of playing *Ruof,* we would play *Eerht.*

"Listen to the name of this version of the game — *Eerht,"* I said. "Who can tell me what the counting pattern will be?" I could tell the students' brains were working from their expressions as they tried to visualize the word *eerht* in their heads in order to flip it around or tried to say the word backward to themselves.

"Two?" one student said tentatively.

"The number does start with a t but it's not two," I responded.

"Three," a group chorused.

"Yes," I said. "In the game *Eerht,* we count one, two, eerht, with every third person sitting down. If we start with Adam, who do you think will win?"

I was curious to see who would rely upon the rule we had derived from playing *Ruof* — choosing the last person in the loop next to Adam — and who would realize that changing the game parameters would change the elimination pattern. Again, predictions were mixed between the two options while others still remained unsure or noncommittal. Playing *Eerht* opened up a whole new avenue of discussion and considerations.

"Given that we had less time than usual to play our game," I asked the class, "why do you think I decided to play *Eerht* instead of *Ruof?"* We lined up and filed out the door with the question hanging in the air to be considered later.

While our math discussions about these games were casual, they certainly could have been formalized in a math class, with students playing a series of games and writing down their predictions as they moved toward writing down statements about who the winner would be for a given version of the game. Using pencil and paper, students could also draw pictures or a list of numbers and play the game themselves on paper, crossing out pictures or numbers from the list in order to determine a winner. Students could do trial runs of games, changing the number of players in the game or changing the elimination sequence to see how the location of the winner would be affected. Doing so creates a wonderful opportunity to explore and discuss any number patterns that might emerge.