Dot card number talks: Illustrating counting strategies with preservice elementary teachers

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ARTICLE

Abstract: A dot card number talk was implemented in a mathematics content course with preservice elementary teachers (PsETs) to highlight counting strategies that are commonly seen in elementary school mathematics. PsETs' sketches on the dot cards showcase many different strategies, such as counting-all, counting-on, matching, and subitizing. While their illustrations demonstrated these different strategies, their answers were ultimately the same. The dot card number talk sparked meaningful conversations and helped PsETs distinguish between the counting strategies.

Keywords: dot cards, number talks, counting strategies, subitizing

Number talks are brief routine practices (typically 10-15 minutes in length) where students solve computation problems and discuss their strategies (Humphreys & Parker, 2015). A number talk can be as simple as showing students a collection of objects and asking, "How many objects are there?" Students engage with the problem posed by the teacher and share their unique ways of thinking with their peers. Number talks give students opportunities to practice justifying their reasoning and expose them to ways of thinking that are different from their own.

Dot card number talks are number talks that use dot cards to promote students' sense-making of numerical relationships and counting strategies (Sun, Baldinger, & Humphreys, 2018). Typically, a set of dot cards will include different spatial arrangements with varying amounts of dots. During a dot card number talk, students are shown a series of dot cards and are asked questions about each collection, such as "How many dots are there?". After solving each dot card, students share their strategies for finding the total amount of dots with their peers.

A DOT CARD NUMBER TALK FOR PRESERVICE ELEMENTARY TEACHERS

While dot card number talks are typically employed with elementary school students, they can be effectively carried out in teacher preparation programs to highlight counting strategies that teachers may see students use in the classroom. I created a dot card number talk for a mathematics content course for preservice elementary teachers (PsETs). The dot card number talk consisted of five dot cards (Figure 1). The first three cards asked PsETs to find the total number of dots. The last two cards presented PsETs with two groups of dots (one blue and one red) and asked them to identify the group with more dots.

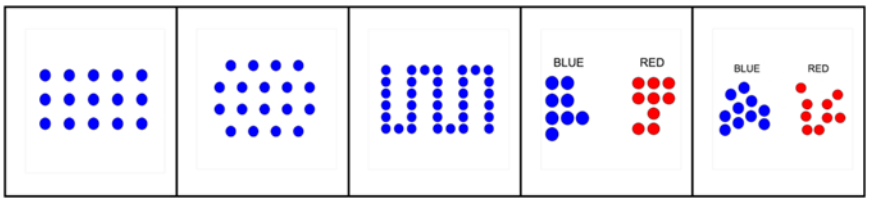

Figure 1. The set of five dot cards for the dot card number talk.

Before implementing the dot card number talk, I introduced PsETs to the quaternary number system. This base-4 number system uses the digits 0_4, 1_4, 2_4, and 3_4 to represent any real number. I used the base-4 system, as opposed to base-10, because I wanted PsETs to re-experience some of the more basic counting strategies that elementary students tend to use. I assumed that if I implemented the dot card number talk using our traditional base-10 number system, my PsETs might use more complex strategies to solve the problems.

Once PsETs were familiar with the quaternary number system, I implemented the dot card number talk. Within the Desmos Activity Builder software (https://teacher.desmos.com), I uploaded images of the five dot cards and created an interactive activity. PsETs moved through the five dot cards in the activity individually at their own pace, drawing directly on each dot card with the sketch tool feature to illustrate their thinking. The teacher dashboard feature allowed me to share their work on the overhead projector. PsETs took turns explaining their counting strategies to the rest of the class.

How Many Dots?

Figure 2 shows sketches from three PsETs on the second dot card. All three PsETs found the total to be 33_4 in different ways. The first PsET (left) employed a counting-all strategy. They started from the dot on the top left and counted dots individually by row. The second PsET (middle) noticed that the three rows each had the same number of dots. They found the total for the first row and used repeated addition to add $11_4+11_4+11_4$. The third PsET (right) grouped dots by 10_4s first, used

repeated addition to add $10_4+10_4+10_4$, and then they employed a counting-on strategy to account for the last three dots.

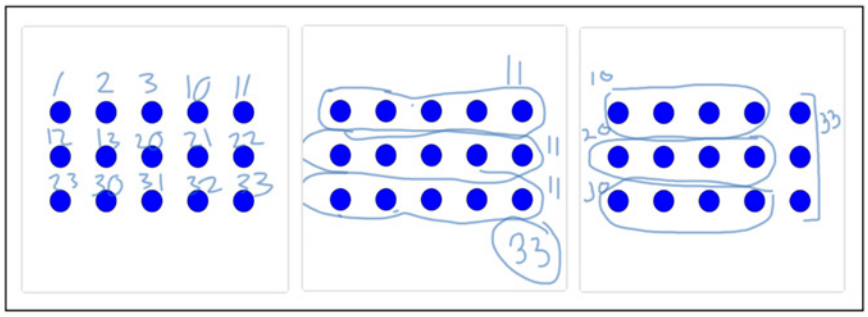

Figure 2. PsET work sketches from the second dot card.

PsETs' illustrations on these dot cards accentuated the difference between two counting strategies that are common in elementary school mathematics: *counting-all* and *counting-on* (Carpenter & Moser, 1984). While everyone agreed that counting-on is a more efficient strategy, many PsETs felt more comfortable using a counting-all strategy, especially in a different base system. On a written reflection assignment after the activity, one PsET said they used counting-all instead of counting-on simply to "make sure I wasn't missing or skipping any dots during the count."

Which Group has More?

Figure 3 shows sketches from two PsETs on the fourth dot card. Both PsETs determined that the red collection had more dots than the blue using different reasoning processes. The first PsET (left) grouped dots by 104s. They noticed that each collection had two groups of 104 dots, but the red collection had one dot left over. The second PsET (right) used a matching strategy involving the construction of a one-to-one correspondence between the two collections. After matching each blue dot with a red dot, they noticed that the red collection had one dot left over.

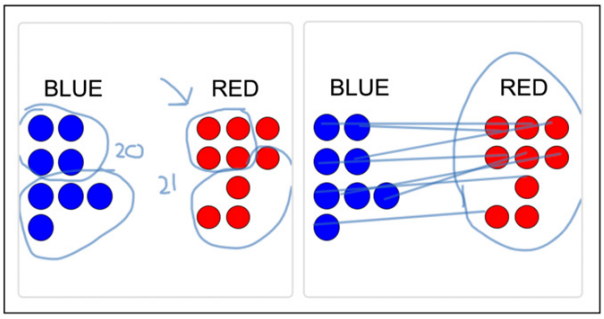

Figure 3. PsET work sketches from the second dot card.

The dot cards highlighted the value in using a matching strategy (Carpenter & Moser, 1984) involving one-to-one correspondence when

identifying differences between two sets of dots. During our class discussion about the fourth dot card, one student came up to the board and demonstrated one-to-one correspondence by using her left hand to cover a blue dot and her right hand to cover a red dot. She continued to match dots, covering pairs of dots, until it was evident that there would be one dot without a match.

Additionally, the illustrations on the dot cards sparked an important conversation about subitizing (Baroody, 1987). Subitizing is the ability to recognize a quantity without needing to count the individual objects. Several PsETs said that they started to recognize groups of 10_4 dots arranged in squares, columns, or rows without having to actually count the dots. They were able to subitize this quantity and use this recognized pattern to find future totals more efficiently.

CONCLUSION

The dot card number talk proved to be a valuable introductory activity for subsequent lessons on early additive reasoning. In the following weeks, PsETs practiced employing these counting strategies as we began solving more complex addition and subtraction problems in the quaternary number system. Their understanding and experience with counting-all, counting-on, matching, and subitizing will help them better support their future elementary students.

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