



DOT CARD NUMBER TALK

"There are things known and there are things unknown, and in between are the doors of perception."

—Aldous Huxley

OVERVIEW

Students view a card with dots on it for one second, then share the visual representations they used to come up with the number of dots they think they saw—illustrating that there are many different ways people see math.

PLANNING FOR IT

WHEN YOU MIGHT USE THIS PRACTICE

- At the start of a new year, to establish the value of the many ways we see mathematics
- Throughout the school year, with different dot cards, to create a productive climate of equitable group work and build a growth mindset culture for students around mathematics class

TIME REQUIRED

- ≤ 30 minutes

LEVEL

- Upper Elementary
- Middle School
- High School
- College

MATERIALS

- Projector
- Teacher guide ([PDF](#)), which includes sample dot cards
- Chalkboard or whiteboard

LEARNING OBJECTIVE

Students will:

- Focus on a visual pattern with no paper or pencil for written calculation
- Value the many different ways classmates see mathematics
- Develop a growth mindset toward mathematics

ADDITIONAL SUPPORTS

- [Making Practices Culturally Responsive](#)
- [Adapting Practices for Students with Special Needs](#)
- [Making Classrooms and Schools Trauma-Informed and Healing-Centered](#)

SEL COMPETENCIES

- Self-Awareness
- Social Awareness
- Relationship Skills

HOW TO DO IT

REFLECTION BEFORE THE PRACTICE

- Watch the video "[Jo Teaching a Visual Dot Card Number Talk](#)," engaging in the video as a participant.
- How open is your mind to the variety of ways in which students might approach math?

INSTRUCTIONS

Note: Practice 2 of 5 in youcubed [Mathematical Mindset](#) practice collection.

TO THE TEACHER

Dot card number talks are a really nice way to start a new class and value the many ways we see mathematics. A dot card focuses students on a visual pattern with no paper or pencil for written calculation. The pattern is shown only for a brief time so students cannot count the individual dots. As various visualizations are shared, students will be amazed at how differently their peers see the pattern. We encourage you to use different dot card number talks throughout the school year.

INTRODUCTION

A dot card number talk is a fantastic number sense activity for people of all ages to engage with and enjoy. It is a short but powerful learning activity that shows students:

- Creativity in math
- The visual nature of math
- That there are many different ways people see math

It also helps to develop an important part of the brain called the [Approximate Number System](#) (ANS).

LAUNCH (5 MINUTES)

- Start the activity explaining to students that you are going to show them a collection of dots for a short period of time. The time is short because you do not want them to count the individual dots.
- Next, let the students know that you will be asking them to explain the number of dots and how they visualized the dots to know how many were in the image.
- Show the dot card for about one second on the screen and then remove it.
- Ask students, "*How many dots did you see?*" and record their numerical answers on the board.
 - For now, you are only asking for the number of dots, not the ways of visualizing the pattern.
 - If students get different answers, write all of them on the board without identifying whether any answer is right or wrong. Often students will get different answers, which is great because it makes space for more conversation about numbers and visual representations. Different answers also provide a great time for you to discuss mistakes and explain their importance and that it means they are learning.

DISCUSS (15 MINUTES)

- Put the dot card back on the screen so that students can refer to the picture to describe their thinking. Invite students to share by saying something like, "*Who would like to tell us how they saw the dots?*"
- Ask students to share their visual representations. (Note: This is not the time to ask students to come to the board.) Carefully draw what each student describes and label their picture with their name. Including the student's name is important because it gives them ownership over their mathematical thinking.
 - Make sure you ask each student to explain their thinking and ask them clarifying questions to ensure that you are accurately representing their strategy. This process helps students focus on communicating clearly.
 - At times it is challenging to illustrate what a student is describing. These moments are great because they allow students to see you, the teacher, struggle to understand. (See the [PDF](#) for examples of recorded student strategies for a dot pattern.)
- To make sure you are accurately representing students' thinking with your representations, continually check with the student and ask them questions like:
 - *Is it like this?* (Referring to a part of your representation)
 - *Is this what you saw?*
 - *Is it a little bit like this other one? What was different about it?*
 - *What did you do after that?*
 - *Maybe we could draw this one out because that would be helpful. Does this look like what you did?*
 - *Do you feel like this represents your thinking?*
- Look-Fors:
 - **How are students engaging with mistakes?** Multiple answers in dot card number talks are an opportunity to honor and discuss mistakes.

- **How are students organizing dots when counting?** Dot card number talks are all about visualizing and having an appreciation for different ways of seeing. Take notice of the different strategies students are using and think about their connection to other mathematical ideas like reflection, grouping, subitizing, etc.
- **Which students are sharing their ways of seeing?** Encourage many different students to share their ways of seeing. Dot card number talks are a great opportunity to highlight the work of a variety of students.
- **How many different ways of seeing are shared?** This activity is visual and generally you can expect about 10 or more different ways. When you ask students to share take note of how many hands go up. Are there students who share strategies who did not have their hand up at the start?

REFLECT (5 MINUTES)

- Tell students why dot card number talks are important by saying something like, *"The reason I wanted you to see this is because math is an open and visual subject. There are so many different ways that people saw just this collection of dots. Some people think that math is all about the same method or procedure, but even a collection of dots can be seen many different ways. In this class we will be sharing all our different ways of seeing math."*
- Ask students to reflect on their experience with the class with a prompt like, *"What did you learn from this dot card number talk?"*

REFLECTION AFTER THE PRACTICE

- Did this exercise result in a more relaxed attitude towards math, with students experiencing that there is no "one right way" to see the pattern of dots shown?
- Did any of the students' representations surprise you? Do you feel any change in your own openness towards different ways of approaching math problems?
- How can you leverage this concept, accepting multiple approaches to math problems and promoting number sense as you teach math?

THE RESEARCH BEHIND THE PRACTICE

EVIDENCE THAT IT WORKS

[Research](#) has shown that students who learned about [growth mindset](#) with regards to mathematics reported more positive beliefs about math, were more engaged in math class, and did better on standardized math achievement tests. Mindset interventions in math benefit all students, but have demonstrated [even more power](#) for groups that may be more affected by myths about math learning, including girls, English language learners, and economically disadvantaged students.

In addition, a four-year study of high school students in different types of math classes showed that the students who learned math in mixed-ability classrooms that emphasized [cooperative](#) group work, open problem-solving, and the use of multiple strategies--compared to those in traditional math classrooms, which were often ability-

grouped and focused on teacher lectures and individual work--demonstrated greater gains in [math achievement](#) and greater reductions in achievement gaps, enjoyed math more, and treated each other with more [respect, support, and equity](#).

WHY DOES IT MATTER?

A substantial body of research has indicated that students who have a growth mindset about intelligence--who believe that, with effort, intelligence can be changed over time--are more likely to [do well academically](#).

Importantly, evidence shows that growth mindset [can be learned](#): in a nationally representative study, students who were taught about a growth mindset of intelligence went on to earn better grades (especially if they started out lower-achieving) and select more challenging classes. Grades improved even more in schools with more supportive learning climates, in which peer norms supported the growth mindset message.

Though much of the research on growth mindset has to do with beliefs about intelligence, other research suggests that social and emotional growth mindsets (e.g., believing that personality, emotions, etc., can grow and change) can [reduce bias](#) and promote [well-being](#), [social competence](#), and [prosocial behavior](#).

SOURCE

This is a practice developed by prominent practitioners including Sherry Parrish, Ruth Parker, and Cathy Humphreys. It is recommended by Jo Boaler and featured on the website of [youcubed](#), a center at Stanford University that she leads. In addition to classroom ideas and videos, youcubed offers a variety of resources for mathematics educators, including research summaries and professional development.