Number Talk

Purpose: flexibility, accuracy and efficiency in mathematical thinking through the articulation of and sharing of mental math strategies

GENERAL DESCRIPTION:
A **Number Talk** is a 10 to 15 minute whole group *mental math* activity where students find the answer to a math problem in their heads, then share aloud the strategies they used to find that answer. This strategy helps to develop quality student discourse in a whole class setting as students are encouraged to explain their thinking, justify their reasoning, and make sense of each other's strategies. During a Number Talk, the teacher steps away from his/her role of authority, and into the role of facilitator by asking students questions, recording student responses on the board, and encouraging students to make meaning out of the mathematics through verbal exchange. A Number Talk can be used to address gaps in student skills or understanding, to confront anticipated misconceptions, to surface multiple strategies, and/or as a formative assessment when introducing new concepts. Number Talks also build flexibility, accuracy and efficiency with numbers for all students. In lower elementary, students might experience a Number Talk where they have to look at a pattern of dots for 3 seconds, and share strategies for how they knew the total number of dots. In upper elementary, students may be asked to multiply 25×8 and may use different decomposition strategies or their knowledge of money to calculate. In middle school, students may be asked to mentally find 35% of 160. In high school, they may share multiple strategies for solving $125^{2/3} \bullet 2$. Number Talks may be used to make sense of grade-level content, but can also build from concepts from previous classes by starting with a dot talk or a simple arithmetic problem at any grade, based on where the students' needs are.

WHEN AND WHY IS THIS USEFUL?	WHAT CAN STUDENTS LEARN FROM THIS EXPERIENCE?
A Number Talk is useful: • To help students move from a reliance on memorization to truly understanding numbers and their relationships to each other. • To help students recognize structure, and use that structure to understand more complex mathematics. • As a regular routine where the problems in a series of Number Talks build on each other. • To launch a task by activating students' prior knowledge. • To provide students the opportunity to practice explaining their thinking and asking each other questions. • To develop a stronger sense of mathematical identity and self-confidence in students, since mistakes are treated as learning opportunities, and everyone's opinion contributes to group knowledge.	• Flexibility, accuracy and efficiency with mathematical thinking • Ways to make sense of the mathematics and talk about the strategies used to solve a problem. • Ease with composing and decomposing numbers • Conceptual understanding of the relationships between numbers • Computation strategies • Mathematical reasoning skills • Precision in explanations of mathematical thinking • Multiple strategies and multiple representations for finding an answer • Learning from the ideas of peers • Confidence and motivation, contributing to a positive mathematical identity • Empowerment through validation of each person's mathematical thinking process • The value of both successes and errors in deepening understanding

Number Talk: Step-by-Step

Ready to try a Number Talk? Here are step-by-step instructions for structuring a Number Talk in a lesson.

1. Start by identifying the mathematics students will need to be successful in a curricular unit. Are there basic mathematical structures or patterns that, if recognized and understood by students, will lead to understanding of more complex mathematics? Would familiarity and flexibility with particular understandings about numbers, or kinds of computations, support students to make connections between the new material and things they have learned previously? Are there basic skills students may lack that might hinder their progress with new material? From this list, write a problem that students can tackle mentally and to which they might apply several different solving strategies. (See "Choosing a Problem," below.)

2. Anticipate the different strategies that students might apply to finding an answer to the question. Consider how to record each of these strategies so that the symbols or diagrams accurately reflect the strategy. This can be one of the most challenging parts of facilitating a Number Talk, but is critical. Scribing in a way that accurately represents students' thinking allows students to see the structure of their thinking and to compare different strategies.

3. Before posing the question to the class, remind students that this is a mental math exercise, and that everyone will have time to arrive at an answer silently before the discussion begins. If they arrive at an answer before the silent time is up, they should try to think of a different strategy for finding the answer. Demonstrate any silent signals you want students to use to indicate when they are ready – such as putting a fist to their chest when they have an answer, and raising a finger for each additional strategy they think of.

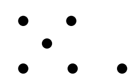
4. Surface the different answers students reached. Poll the class to determine if most students got a specific answer. Then, call on students to share strategies and record their solving processes. As much as possible, based on the complexity of the problem and the strategy, listen through a student's full explanation before scribing, so that the strategy can be accurately represented and you can avoid assuming or prompting a next step by how initial numbers are recorded.

5. Wrap up the number talk. Closure can be achieved, through a discussion, such as identifying similarities and differences between strategies, or by connecting the number talk to the material of the unit, or by asking students to apply a strategy different from their own to a new problem.

Choosing a Problem

A Number Talk may stand alone in a unit as a way to activate specific prior knowledge or introduce new content, or Number Talks may be organized in a series over several lessons in order to point to particular structures in numbers and expressions.

The problem that a Number Talk is organized around may take different forms. Examples include:

Solve or evaluate an expression:	$53+37=?$ "Simplify $\frac{50000}{150}$"
Compare two values:	"Determine which is greater: $\frac{2}{3}$ or $\frac{10}{18}$"
Consider a string of computations to identify patterns:	$2\times 30=60$ $3\times 30=90$ $4\times 30=120$ $5\times 30=150$ $6\times 30=?$
How many dots are there? How did you see the dots?	

When crafting a problem as the focus of a number talk, consider:

- Does the problem lend itself to mental math? Numbers should be friendly enough to manipulate without pencil and paper. If multiple steps are required, the numbers should be easy to retain as students process through the math.
- Are there multiple strategies for solving the problem? Some problems may be able to be visualized in multiple ways (geometrically, on a number line, on a graph, with an expression, using friendly numbers). Numbers may be able to be composed or decomposed in different ways to achieve an answer. If you cannot readily find two or three different ways to arrive at an answer, the problem may not stimulate multiple strategies or discussion from students.
- If the Number Talk falls in a series, does it allow students to build on the strategies used in the previous Number Talk? Do multiple strategies translate to the new problem? Are all of the strategies applicable in the new context, and is there a value to reasoning about why or why not?

Number Talk — Defining Features

The chart below outlines some of the core features of a Number Talk that distinguish it from any other mathematical discussion about a problem.

Facilitation Feature	Student Experience
Problems are written and read publicly, but students solve mentally (no pencil and paper or white boards)	• Students develop efficiency, accuracy and fluency with mathematical thinking using mental math. • Students move away from a reliance on standard algorithms and strict memorization, and move into sense-making and sharing their reasoning around the mathematics.
Wait time	• All students have time to reflect upon and struggle with mental math and/or come up with multiple ways of solving
Silent signals as mode of response ("I have an answer" "I have 2 strategies"…) Silent validation of who got the same answer / who agrees or disagrees with an answer	• Students are not distracted by hands in the air, or by others who have found an answer quickly and want to share immediately. • Students are motivated to come up with more than one way of solving. Emphasis is placed on the thinking process more than the answer itself. • Students interact with each other, not just with the teacher
Surface all answers up front, including mistakes	• Mistakes are treated as learning opportunities • Students agree with and/or critique the reasoning of others
Turn and Talk (optional)	• Every student has an opportunity to share her/his way of thinking about and solving the problem • Students articulate ideas with a partner before engaging in large group academic discussion
Teacher begins scribing /representing student's strategy *after* student has finished explaining and without steering student in a particular direction. Teacher confirms with the presenter that his/her thinking is properly represented.	• Multiple strategies are made public • Students see different ways to record a mental process • Scribing reflects student's actual process, and not a specific, anticipated solution path • Students feel ownership of their own strategies
Engagement /participation /comprehension questions after strategies are shared. • *Who did it exactly the same way as ___? ("raise your hand if…")* • *Can you do that? Is that legal?* • *Did everyone understand ____'s way?* • *Can someone explain ___'s strategy in your own words?* • *Who has another way of solving it?*	• Students make sense of each other's strategies • Students see multiple ways of mentally solving problems, make connections between different ways of solving problems • Students talk about their own and each other's thinking

Number Talk Planning Tools

The following pages include two different blank templates for planning a Number Talk as part of a math lesson. The blank templates are followed by examples of completed templates for two different Number Talks, one for a primary class and one for a secondary class.

The lesson planning templates are intended to guide a teacher's thinking as s/he prepares to facilitate a Number Talk, including anticipating student responses, considering possible ways to scribe different strategies, and identifying questions that will elicit student thinking and prompt students to make sense of each others' ideas. Thinking through each of these steps is important as teachers build familiarity with the strategy.

Anticipating student responses is a particularly crucial step in preparing to facilitate a Number Talk. Because they are developing both their understanding of the mathematics and their ability to articulate their thinking, students will often share strategies that are difficult to understand, either because the reasoning is complicated or because their language is not precise, or both. This can be particularly true for younger students. Anticipating student responses before presenting the problem to the class, and giving thought to the kinds of strategies students might apply to the problem, helps to ensure that the teacher will be able to find the mathematical logic in any student's contribution. Asking questions that encourage students to elaborate, or having other students paraphrase, can also help to reveal more of a student's intention and support the student in articulating his/her thoughts.

Once Number Talks become a routine part of classroom practice with a group of students, the procedures for how students signal that they have an answer in mind, how the Number Talk is framed, and how answers are shared before strategies are discussed may become habits for both teacher and students and will require less formal planning. At that point, teacher planning can focus more narrowly on anticipating responses and identifying connections a teacher hopes students will recognize or specific strategies that a teacher hopes will surface through the discussion.

Number Talk Lesson Planning Template 1: Narrative

Grade Level: ____________ **Unit:** ____________________

Core Math Idea:

Number Talk Problem:

Anticipated student methods and how to represent them:

<u>During the Lesson</u>

Frame for the activity: We are using a Number Talk to share different strategies for how we mentally approach a problem. Each person's role is to work on explaining their own thinking clearly, and to listen to other's explanations as well.

Maximum length of quiet time: _________

Silent signal when students are ready: ____

Process for sharing out:

-
-
-

Questions to orchestrate the class conversation about strategies:

Wrapping Up:

Number Talk Lesson Planning Template 2: Chart

Grade Level: **Unit:**
Core Math Idea:

Number Talk Problem	Possible Strategies & Method of Recording	Questions to Students
Follow up Problems (series)		**Wrap Up**
Academic Language		

Number Talk Lesson Plan 1: Elementary Sample

Grade Level: 3-5 **Unit:** Multiplication and Division

Core Math Idea: **Students may be hindered in this unit because they are not yet fluent with basic addition and subtraction facts. So in this Number Talk, I will focus on adding and subtracting single and double digit numbers mentally, and specifically on the idea of doubles plus/minus one.**

Number Talk Problem(s): 15 + 16 (First in a series, to be followed by 15 +14; 20 + 21; 22 + 23; 22 + 21

Anticipated student methods and how to represent them:

Standard algorithm (stack them in your head)	15 +16
Count on fingers:	15, 16, 17,... **31** (use open number line to represent single jumps)
Add 10 then add six	$15+10=25$ $25+6=31$
Double 15, then add one more:	$15+15=30$ $30+1=31$
Add 10 and 10, then add 5, then add 6	$10+10=20$ $20+5=25$ $25+6=31$

<u>During the Lesson</u>

Frame for the activity: We are using a Number Talk to share different strategies for how we mentally approach a problem. Each person should be ready to explain their process, and to listen to understand someone else's.

Maximum length of quiet time: 2 min

Silent signal when students are ready: **Thumb up in front of your chest when you have an answer. Raise another finger for each different strategy you think of.**

Process for sharing out:

- Talk to your partner about your strategy.
- Volunteers, what number did you get for your solution? (Record all responses)
- After sharing, poll the class – raise hand if you got this value

Questions to orchestrate the class conversation about strategies

- **Who would like to share how they got their answer?**
- **I heard you say ______, did I hear correctly?**
- **Did anyone use a different method?**
- **Can someone explain _____'s strategy in their own words?**
- **Please raise your hand if you understand what _____ just shared.**

Wrapping Up: Questions I might ask:

- Can you find two strategies that are similar? How are they the same?

  Look at all of these strategies. Which new strategy would you want to try to use tomorrow

Number Talk Lesson Plan 2: Elementary Sample

Grade Level: 3-5 **Unit:** Multiplication and Division

Core Math Idea: Adding and subtracting single and double digit numbers mentally, and specifically the idea of ***doubles plus/minus one***.

<table>
<tr><th>Number Talk Problem</th><th>Possible Strategies & Method of Recording</th><th>Questions to Students</th></tr>
<tr><td>15 + 16</td><td rowspan="5">Standard algorithm (stack in your head):
15
+16

Count on fingers:
15, 16, 17,… 31
(use open number line to represent single jumps)

Add 10 then add six:
15 + 10 = 25
25 + 5 = 31

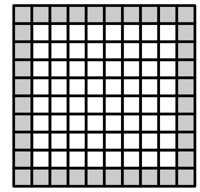
Double 15, then add one more:
15 + 15 = 30
30 + 1 = 31

Add 10 and 10, then add 5, then add 6
10 + 10 = 20
20 + 5 = 25
25 + 6 = 31</td><td>• Who would like to share how they got their answer?
• I heard you say ______, did I hear correctly?
• Did anyone use a different method?
• Can someone explain _____’s strategy in their own words?
• Please raise your hand if you understand what ____ just shared.</td></tr>
<tr><th>Follow up Problems (series)</th><th>Wrap Up</th></tr>
<tr><td>15 + 14
20 + 21
22 + 23
22 + 21</td><td rowspan="3">Can you find two strategies that are similar? How are they the same?

Look at all of these strategies. Which strategy would you want to try to use tomorrow?</td></tr>
<tr><th>Academic Language</th></tr>
<tr><td>addend, sum, total, doubles, doubles plus one, doubles minus one</td></tr>
</table>

Number Talk Lesson Plan 1: Secondary Sample

Grade Level: *5th through 11th* **Unit:** *Equations and Expressions*
Core Math Idea: *Modeling real world situations with expressions, equivalent expressions*



Number Talk Problem:

Given a 10 x 10 grid, what is the area of the border?
(Show students the diagram)

Anticipated Methods and how to represent them:

Saw four strips of 10 around the perimeter but realized that corners were counted twice.	$10+10+10+10-10-1-1-1$ **or** $4(10)-4(1)$
Saw 4 center strips of 8 and added in the corners *How did you know there were 8 in a strip	$4(8)+4(1)$ $4(10-1-1)+4(1)$
Saw two strips of 10, one at the top, one at the bottom, and that left two strips of 8 on the right and left side. **How did you know there were 8 on the right and left?*	$2(10)+2(8)$ $2(10)+2(10-2)$
Saw the strips of 10 on the right and left sides.	$2(10-2)+2(10)$

<u>During the Lesson</u>

Frame for the activity: **"**We are using a Number Talk to share different strategies for how we mentally approach a problem. Each person's role is to work on explaining their own thinking clearly, and to listen to other's explanations as well."

Maximum length of quiet time: *3 minutes*

Silent signal when students are ready: *Fist to chest when you have an answer. Show on your fingers how many methods you can think of.*

Process for sharing out:

- Turn and Talk about your strategy
- Popcorn out, what number did you get for the area of the border? (Record all responses on board)
- Raise your hand if you got this value.

(continued on next page)

Questions to orchestrate the class conversation about strategies: (10 minutes)

- Who would like to share how they got their solution? (LISTEN, consider how to scribe expression.)
- I heard you say _______, is that correct? (Get affirmation, then SCRIBE.)
- Please raise your hand if you understand what ____ just shared.
- Did anyone use a different method?
- Can someone explain ____'s strategy in their own words? (LISTEN, consider how to scribe expression.)
- _____, did _____ explain your method correctly? (Get affirmation, then SCRIBE.)
- Does someone have another strategy? (LISTEN, consider how to scribe expression. Student may need to approach the diagram to motion through their thinking)
- Can someone please repeat for me what _____ just described so that I can write it down?
- Might there be another method out there? (LISTEN, consider how to scribe expression. Student may need to approach the diagram to motion through their thinking)

Wrapping Up:
Questions I can ask:

- What do you notice about the expressions on the board? (Record full sentence statements)
  Are the expressions equivalent? How do we know? How can we check?
- *If a student has this expression [10 – 1 + 10 – 1 + 10 – 1 + 10 – 1)], what might that tell me about their strategy? What might a student who writes 4(10 – 1) have seen in the problem?
- *Will all of these strategies find the border for any square arrangement?