

Alarcón, J. D., Chauvot, J. B., Cutler, C. S., & Gronseth, S. L. (2021). An interdisciplinary approach to collaborative professional development for teacher educators: Number talks as culturally responsive online teaching. In *Online Learning in Mathematics Teacher Education*. Springer. (<https://www.springer.com/series/13030>)

Chapter Appendix

Number Talks Lesson Plans/Descriptions

Part 1 Cutler’s Elementary Mathematics Methods taught synchronously and asynchronously

Materials:

Video examples of number talks with kindergarten and second grade

Engage

PSTs work individually.

PSTs watch a video of a kindergarten class number talk with dot cards and ten frames. Kindergarten children use subitizing and counting to say the number of dots on cards shown by the teacher. The dots are arranged randomly and in ten frames.

PSTs use a t-chart to organize things they Notice and Wonder during the video.

Facilitation Questions	Potential Responses
What do you notice about the physical setting during the number talk? Why is this arrangement unique?	When children are seated on the carpet rather than at their desks, the experience feels different from regular math work. Students do not have paper and pencils or other materials that prompt algorithms but must use mental math strategies instead. The teacher is seated near the students.
What do you notice about how children signal they are ready to share a response? Why do you think this strategy supports equity in mathematics?	Students place a thumbs up against their chests directly below their chins. A thumb signals the student has an answer, another finger signals he/she has a strategy for finding that answer. Additional fingers signal additional strategies. All students have time to think before showing they have a strategy.
How do you think the teacher decides when to begin the group discussion?	The teacher begins the discussion when almost all (or all) of the students have at least one finger raised.

Explore

PSTs work in virtual breakout groups of 4-5 students.

PSTs discuss what they Noticed and Wondered during the Engage portion of the lesson with their breakout groups. A recorder for each group makes a list of the group's Noticing and Wondering. Groups are tasked with creating a definition of a number talk.

The instructor joins each breakout group to ask facilitations questions that promote understanding of the purpose and structure of number talks.

Facilitation Questions	Potential Responses
What is a number talk?	A number talk is a short (5-15 minutes), ongoing daily routine that provides students with meaningful ongoing practice with computation. Number talks are a powerful tool for developing computations fluency because the expectation is that students will use number relationships and the structures of numbers to add, subtract, multiply, and divide.
How do number talks support children's mathematical thinking?	Number talks allow students to practice reasoning, to find relationships between numbers (number composition and decomposition) and between operations. Students learn to communicate mathematically as they express and clarify their thinking.
How long did the video last? Why do think it is only five minutes long?	The video was five minutes. A number talk provides brief, frequent experiences with mental math and computational fluency. Number talks are meant to compliment, not replace, a full mathematics curriculum.

Explain

PSTs join for a whole-group discussion.

After 5-7 minutes, the breakout groups share their observations with the whole class. The instructor helps the class agree on a definition of a number talk. As the groups share, the instructor asks the facilitation questions and clarifies understanding about the purpose and implementation of number talks.

Facilitation Questions	Potential Responses
What number concepts lend themselves to exploration through number talks?	Numbers are composed of smaller numbers.

	<p>Numbers can be taken apart and combined with other numbers to make new numbers. What we know about one number can help us figure out other numbers.</p> <p>What we know about parts of smaller numbers can help us with parts of larger numbers.</p> <p>Numbers are organized into groups of ones, tens, hundreds, and so on.</p> <p>What we know about numbers to 10 helps us with numbers to 100 and beyond.</p>
What computation strategies for older children can be explored through number talks?	Number talks encourage students to rely less on rote procedures and algorithms and more on mental math computation strategies such as mental number lines, bridging to a 10, rounding, and using compensation and compatible numbers.
What do we mean by computational fluency?	The ability to compute accurately using flexible, efficient strategies that are appropriate to the problem.
Why is mental math a worthwhile mathematical skill to develop?	Thinking flexibly about numbers builds students' computational fluency, mathematical confidence, and positive attitude toward mathematics.
What are some other benefits of number talks?	<p>Number talks provide an opportunity for children to communicate mathematically, accept others' approaches, justify their thinking, and question peers. All strategies are given equal consideration as the teacher writes them on the board, supporting equity.</p> <p>The problems have multiple entry points that can be solved multiple ways.</p> <p>Students are given opportunities to think first and then check, promoting math-positive attitudes.</p> <p>Students are oriented to others' ideas and ways of making sense of mathematics.</p>

Elaborate

PSTs work in five breakout groups of 5-6 students.

Breakout groups jigsaw the article “Number Talks Build Numerical Reasoning” (Parrish, 2011).

The following prompts guide the five groups' discussions:

1. Accuracy, flexibility, & efficiency in computation
2. Classroom environment, discussions

3. Teacher’s role, role of mental math
4. Purposeful computation problems
5. Small steps to get started

Breakout groups review the article to find information related to their prompt. They discuss the information as a group and prepare a Google slide to present big ideas.

After the breakout groups share, the instructor uses the facilitations questions to clarify number talk planning and prepare PSTs to begin thinking about enacting a number talk in their field placement.

Facilitation Question	Potential Response
<p>What are the steps to implementing a number talk?</p>	<ol style="list-style-type: none"> 1. Teacher creates a problem or string of problems. <ul style="list-style-type: none"> • The problems should be related so that children develop reasoning and look for relationships between numbers. • Number string example: $6 + 7, 7 + 8 =, 8 + 9 =$ • Be realistic about time and children’s attention spans. Keep it short. • If you have a target strategy in mind, don’t give it away. It is more powerful for students to “discover” an effective strategy on their own. 2. Teacher presents the problem. <ul style="list-style-type: none"> • Problems are presented in many formats: <ul style="list-style-type: none"> ○ as dot cards, ○ ten frames, ○ sticks of cubes, ○ number line, ○ Rekenreks, ○ a word problem or ○ a number sentence. 3. Students are given time to figure out the answer. <ul style="list-style-type: none"> • To make sure students have the time they need, the teacher asks them not to call out but to place a “thumbs-up” close to their chest when they have an answer. • The thumbs up signal is unobtrusive—a message to the teacher, not the other students. This allows others to continue thinking without feeling rushed. • When they have a second strategy for figuring out their answer, they put up a second finger. • The teacher waits until almost all (if not all) of the class has at least one finger up. 4. Students share their answers.

	<ul style="list-style-type: none"> • Four or five students volunteer to share their answers. • The teacher records them on the board, regardless of whether they are right or wrong. <p>5. Students share their thinking.</p> <ul style="list-style-type: none"> • Three or four students volunteer to share how they got their answers. • Occasionally, students are asked to share with the person sitting next to them. • The teacher records the student's thinking as clearly as possible on the board. This takes practice! The teacher may want to sketch out anticipated responses in advance. <p>6. If time allows, the teacher writes the next problem in the number string (a new but related problem) on the board and the sequence is repeated. Or the teacher may choose to highlight one of the student's strategies and asks how it could be used with other problems.</p>
<p>How is the classroom environment structured to facilitate successful number talks?</p>	<p>Children are seated comfortably on the carpet. Children sometimes use tools but generally rely on mental math (at increasing levels of abstraction). The number talk concepts have multiple entry points and problems that can be solved multiple ways. Students are given opportunities to think first and then check.</p>
<p>What is the teacher's role during number talks?</p>	<p>Elicits responses from a variety of students. Honors all responses by recording them on the board. Adopts a mask of neutrality to promote deeper thinking and support students' self-correction. Uses growth mindset phrases such as, "I can tell you thought hard about that." "When you make a mistake, your brain grows." "Your effort is paying off." "Stretching your brain helps it grow." Focuses less on speed and more on how students formulated their answers. Provides adequate wait time. Shifts the focus from, "See what I see," to "What do YOU (the student) see?" Records, clarifies, and restates students' responses. Selects problems that intentionally highlight mathematical concepts and mental computational strategies.</p>
<p>What questions can a teacher use to facilitate discussion and elicit student thinking?</p>	<p>Who would like to share their thinking? Who did it another way? How many people solved it the same way as Knox? Does anyone have any questions for Knox? Knox, can you tell us where you got that 5?</p>

	Who can tell us in their own words what Knox just said? How did you figure that out? What was the first thing your eyes saw or your brain did? I think what you are saying is _____. Is that right? What if we changed the number to _____. Would that strategy still work?
--	---

Evaluate

PSTs will work individually to prepare and conduct a number talk in their field placement classroom.

The following Number Talk Assignment Guidelines are provided in the course syllabus.

Number Talk Assignment Guidelines

In class we will learn about orchestrating number talks as an approach to developing numerical fluency. Number talks can be implemented in any grade level. For this assignment, you will develop a number talk and implement it with a small group or whole class in your field placement. Steps you will take to complete this assignment:

1. Agree on a date and a learning focus (must focus on computation or number composition) with your cooperating teacher. You can implement it with the whole class, but if your students are not experienced with number talks, I recommend that you work with a group of 6-10 students. Including fewer than six students seems to limit the richness of the conversation.
2. Develop the number talk using the following guidelines:
 - a. Use a string of related problems (or numbers). For example, a first grade number talk string may include $6 + 7$, $7 + 8$, $8 + 9$. These are related problems, and the number talk supports certain mental math strategies for Doubles Plus One without explicitly teaching this strategy. For younger students, you might create at least three dot cards or ten frame cards, etc. as a subitizing task. For older students, you might ask, "Tell me everything you know about the number 5,750" to encourage students to think about place value and number composition.
 - b. Fill out the Number Talk Planning Template found in the course materials on Blackboard. This can be hand-written. Make sure you plan ahead how you will record possible student responses and write these in the middle column of the template. If you teach preschool or kindergarten, use number bonds to record students' responses to dot cards or ten frame cards.
3. Implement your number talk in your field placement.
4. Turn in:
 - a. Your Number Talk Template filled out and signed by your mentor teacher.
 - b. Written Reflection and Summary that includes the following sections (at least 3-4 sentences to answer each prompt):
 - Why did you choose the problems you chose? How do they go together?
 - What strategy are you trying to help students discover or develop?
 - What went well?

- What would you change?
- Did your students learn? How do you know?
- What did you learn?

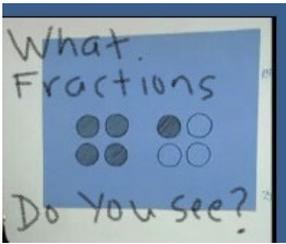
Facilitation Questions:	Potential Response
What obstacles can you work to overcome in planning and conducting your number talk?	Your class meets virtually? Use a virtual whiteboard or a traditional whiteboard or document camera to record student responses. Limited time given by cooperating teacher? Do the number talk with a small group of 6-8 students rather than the whole class. Students' lack of familiarity with number talks or group discussions in math? Prepare many questions to elicit student thinking.
How does thinking ahead to anticipate student thinking help you implement an effective number talk?	Recording students' oral explanations in writing can be tricky in the moment. Planning ahead how you will write down anticipated responses helps the number talk go smoothly. It also helps you think about mathematical connections students may make to the ideas.
What questions can be used to elicit student thinking? Should these questions be general or specific to the number talk?	Use a mix of general (How did you think find your answer?) and specific (How did changing the 21 to a 20 help you solve the problem more easily?) questions to elicit thinking and guide students to mental math strategies.
Where can you look for examples of number talks?	<ul style="list-style-type: none"> • <i>Number Talks</i> by Sherry Parrish (2014, Math Solutions) • Facebook page: Mathematical Number Talks • Meaningful Flash Cards • Dot cards and Ten Frames • Open Number Lines • Number Strings Video Example: http://www.nctm.org/Conferences-and-Professional-Development/Principles-to-Actions-Toolkit/The-Case-of-Jennifer-DiBrienza-and-the-Addition-Strings-Task/

Part 2 Chauvot’s Grades 4-8 Mathematics Methods Course taught synchronously and asynchronously

Earlier in the semester: Assigned reading of Kalinec-Craig & Robles (2020) with corresponding synchronous class discussion about *Rights of the Learner (RotL)*. The four rights are that learners have the right to be confused; to claim a mistake; to speak, listen, and be heard; and to write, do, and represent what makes sense to them.

Synchronous session, prior to the number talk activity: Assigned reading of Herbel-Eisenmann & Shah (2019). Prior to the number talk activity, there was a Nearpod Matching Pairs activity that focused on matching descriptions of the six focal teacher discourse moves to the terms 1) waiting, 2) inviting student participation, 3) revoicing, 4) asking students to revoice, 5) probing a student’s thinking, and 6) creating opportunities to engage with another’s reasoning.

Enactment of number talk activity:

The Task		Note: PSTs had seen and explored the task in a previous course with Author 2.
Number talk Feature	Description	
Wait Time and Private Signal to Instructor	Preservice teachers (PSTs) took a Nearpod poll to indicate readiness. Instructor used “Show student names” feature.	
Sharing of Answers	PSTs contributed to a Collaborate Board in Nearpod. All saw “sticky notes” of answers with student names.	
Supports for Equitable Participation	Instructor monitored PSTs’ contributions to the Poll and Collaborate Board.	
Recording Student Thinking	PSTs used Google Jamboard to explain and display their thinking. Instructor called for volunteers for as long as time permitted.	
Orienting Students to One Another	Instructor modeled discourse moves by calling on volunteers to revoice or comment on a classmate’s solution.	

Debrief (homework for the next synchronous session): Jigsaw model. For homework, each group had a separate reading/viewing assignment, as shown below. During the subsequent synchronous session, groups collaboratively prepared a presentation that attended to the following prompts:

1. What are the important features of number talks?
2. Provide examples from the reading/video.

3. What connections do you make to other course readings or experiences within the teacher preparation program?
4. What argument would you make to someone who claims that number talks are only for the elementary school?

- **Group 1:** Read Gerstenschlager & Strayer (2019).
- **Group 2:** Read Sun, Baldinger, & Humphreys (2018).
- **Group 3:** Read “Number Talk” handout (<https://www.youcubed.org/wp-content/uploads/2018/09/3-Number-Talks-Final.pdf>) and watch “Cathy Humphreys Teaching a Number Talk” video (<https://www.youcubed.org/resources/cathy-humphreys-teaching-number-talk/>)
- **Group 4:** Read “Number Talk” handout (<https://www.youcubed.org/wp-content/uploads/2018/09/3-Number-Talks-Final.pdf>) and watch “A Student Makes a Mistake During Number Talk” video (<https://vimeo.com/265666922/23377db40d>)

References

- Gerstenschlager, N. E. & Strayer, J. F. (2019). Number talks for statistics and probability, *Mathematics Teaching in the Middle School*, 24(6), 362- 367.
- Herbel-Eisenmann, B. & Shah, N. (2019). Detecting and reducing bias in questioning patterns. *Mathematics Teaching in the Middle School*, 24(5), 282-289.
- Kalinec-Craig, C. & Robles, R. A. (2020). Classroom rules reimagined as the Rights of the Learner, *Mathematics Teacher: Learning & Teaching PK-12*, 113(6), 468-473.
- Parrish, S. (2011). Number talks build numerical reasoning. *Teaching Children Mathematics* 18, 198-206.
- Parrish, S. (2014). *Number talks: Whole number computation grades K-5*. Math Solutions.
- Sun, K. L., Baldinger, E. E. & Humphreys, C. (2018). Number talks: Gateway to sense making, *Mathematics Teacher*, 112(1), 48-54. <https://www.jstor.org/stable/10.5951/mathteacher.112.1.0048>