

Building Number Sense Through Number Talks— AIM4S³ Style

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Promising practices...

What are Number Talks?

Number Talks are classroom conversations built around purposefully crafted computation problems that students solve mentally. The teacher presents the problems and encourages students to solve them accurately, efficiently, and flexibly. A typical classroom Number Talk takes between 5 to 15 minutes. Using Number Talks in the classroom is a transformative instructional routine that supports students and teachers in building number sense, mental math, and computation strategies. It is a collaborative forum for student mathematicians to invent and clarify strategies. Mathematicians of all ages have the opportunity to justify, validate, and generalize their personal strategies. With number sense and fluency as the foci, students will “... develop a strong sense of the meaning of quantities and operations while gaining proficiency with mathematical practices” (Parker & Humphries, 2015, p.1).

Why Number Talks?

In the foreword of *Number Talks Matter* (Parker & Humphries, 2015), Jo Boaler writes, “When students fail algebra, it is not because algebra is a really hard subject; it is because they do not have a foundation of number sense.” Dr. Keith Devlin, mathematics professor at Stanford University, claims the most important mathematical concept in 21st century K-12 education is number sense (2017). Marilyn Burns, renowned math educator, describes students with strong number sense as “[They] can think and reason flexibly with numbers, use numbers to solve problems, spot unreasonable answers, understand how numbers can be taken apart and put together in different ways, see connections among operations, figure mentally, and make reasonable estimates” (2015, p. 51). It is crucial that students have the opportunity to build number sense from a very young age, and Number Talks are a powerful instructional routine to support mathematicians of all ages.

AIM4S³

Teachers and students at Bookcliff Middle School started implementing Number Talks 3 years ago. Staff designed a pre- and post-test based on the Marilyn Burns *Math Reasoning Inventory* oral and written components (offered free online at Math Solutions). The impact of implementation has been significant—in year 2 of implementation, 69% of Bookcliff mathematicians showed growth on a post-test. This year’s (year 3) results show 73% of students growing, with our dual immersion math classes coming in at 90%.



Students use a silent signal to indicate they have one or more solutions.

We attribute this growth in part to our work with Achievement Inspired Mathematics for Scaffolding Student Success (AIM4S³). After attending an AIM4S³ Level I Training in New

Mexico, teachers started incorporating elements of the Key Instructional Principles from the AIM4S³ Framework into the Number Talks routine, especially in the dual language classrooms. Teachers enhanced the instructional routine by introducing additional silent hand signals. They were more intentional with sentence stems and questioning (Talk Moves) to elevate the level of conversation. They also utilized planning tools to deepen understanding of strategies and misconceptions, introduced protocols to increase student output and engagement, and considered new ideas for the Compendium/anchor chart.

Focus and Motivation/Student Output

Middle school students frequently share their distaste for “cold-calling” or “hands-down” to elicit their responses. Teachers are now utilizing the strategy Numbered Heads from Spencer Kagan to increase student engagement and output without randomly calling on students. In groups of four, students each decide on their number, 1 to 4. Once students have time to think individually, each group member shares answers and strategies to ensure every group member is confident to present to the class. Next, a group is chosen, and a number is randomly selected.

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The student with that number will share their answer and strategy. If that student is stuck, he or she is encouraged to ask for help from the group. This protocol has increased participation and engagement.

A vital component of Number Talks is the use of “silent signals” that students use to indicate they are ready with an answer, the number of strategies they have to solve the mental math problem, and whether they agree or disagree with other students’ explanations. The hand signals allow processing time for all students, increase participation, encourage active listening, and provide formative assessment data for teachers without interrupting the flow of other students’ thinking. These are adapted from the work of Ruth Parker (2015) and Sherry Parish (2010). The teacher introduces the “silent signal” the first time she facilitates a Number Talk with a group and will review as necessary. It is critical that students understand the rationale behind the signals, and that the teacher explains why blurting out an answer or raising hands can easily distract the thinking of other students in the room. Students do not all think at the same speed and some students may have a tendency to stop thinking if they notice that someone else has already arrived at a solution. Since some students will arrive at an answer more quickly than others, they are encouraged to put up another finger for each additional strategy they derive during the wait time. Students now use the sliding “Y” sign signal for “I agree with you”. This allows the teacher to scan the room for students who are sharing the same thinking or strategy. Students are also encouraged to put their hand over their heart if they are stuck or if they feel like they are overwhelmed with the problem. This motivates students to engage and try instead of sitting idly, thus providing them with an opportunity for productive struggle. Students can at least dig far enough into the problem to realize that they do not have a mental strategy for solving it.

Classroom Culture

The “Student Participation Norms” publicly acknowledge that we value and honor the thinking of everyone. This includes errors and mistakes. Teachers strive to build a culture around the validity and value of mistakes. Jo Boaler (2014) offers a variety of resources that explain brain research and the benefits of mistakes. Positive classroom environment is an important component of the success of Number Talks.

Student participation norms are a cornerstone of the Number Talk routine. Each time the teacher introduces Number Talks to a new group or class, she displays a poster that starts with the same seven items. These seven norms are adaptations from Jo Boaler’s online class “How to Learn Math” (<https://lagunita.stanford.edu/courses/Education/EDUC115-S/Spring2014/about>). Teachers and students may contribute to these at any time. The teacher should revisit these norms each time she facilitates a Number Talk. Posting the norms can lead to some great conversations and teachable moments when the need arises. Adherence to norms enables all participants (students and teachers) to develop a positive classroom community that challenges and supports learners.

Teacher Mechanics and Delivery

When facilitating a Number Talk, moment-to-moment decision-making happens all the time. It is imperative that teachers prepare for Number Talks with a well-planned sequence, know multiple strategies, and anticipate misconceptions. The picture below shows a tool that we use to plan our Number Talks. The planning tool includes space to plan the problem or sequence, anticipated strategies and methods of recording, academic language, questions to students, Talk Moves, a conclusion or wrap-up, and a place to forecast misconceptions or errors. This allows for quick thinking with a variety of student responses and issues that may and probably will arise. Understanding common misconceptions helps teachers respectfully address errors in a way that propels learning forward for all students instead of pointing fingers at a mistake.

Number Talk Lesson Planning Template			
Grade Level: 6		Core Math Idea: Subtraction Strategies	
Number Talk Problem(s)	Anticipated Strategies and Method of Recording	Questions to Students	# Talks Matters
42-19 (*) 63-28 (pg. 38) 71-29 (*) 43-17 (*) 23-21 (**) (B) (34-27) ← warm up	1. Round the subtrahend & adjust 63-28 = 33 63-30 = 33 + 2 = 35 pg. 38 2. Same difference pg. 40 43-17 - 2 17 45-17 = 28 45-30 = 15	misconceptions... Will subtract 2 in addition - compensate means (63+28) - 2 17 Kid's may confuse	
Follow up Problems * My Favorite "No" 63-28 = 45 } bring attention to place value 71-29 = 42 }	3. Break Apart by Place pg. 41 63 40-20 = 40 - 29 3-2 = -5 40-5 = 35 4. Decompose the Subtrahend (removal) pg. 38 63-20 = 43 - 8 35 5. Add up: 28+2 = 30 + 3 = 33 28 30 33 = 35 63		Wrap Up • use # line to show strategies
Academic Language minuend subtrahend difference round compensate # line			

Planning Tool

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Sheltering and Scaffolding

With Number Talks, teachers push for student-centered conversations. It is rewarding when teachers can observe students share, explain, and defend their thinking, and ask about the thinking of others without prompts from an adult facilitator. Teachers activate students' prior knowledge at the beginning of Number Talks and highlight links between previous problems and strategies.

Dual language teachers understand the importance of sentence stems and Talk Moves in the development of academic language for all students, but especially for second language learners. Teachers post sentence stems for Number Talks in both English and Spanish in dual language classrooms. The sentence stems used during Number Talks include, “Me gustaría defender ___ porque ___” (I would like to defend ___ because ___) and “La estrategia que usé para conseguir mi respuesta es ___” (The strategy that I used to get my answer is ___) In addition to sentence stems, the dual language teacher started implementing the use of question stems after the AIM4S³ training. Question stems model proper questioning, help students get the academic conversation started, and keep them engaged during group talk. Question stems used during Number Talks include, “¿Cuál estrategia usaste para resolver este problema?” (What strategy did you use to solve the problem?) and “¿Me podrías explicar tu razonamiento?” (Could you explain your reasoning to me?).

Anchor Charts: Capturing Students' Strategies

The Number Talks strategy uses focused anchor charts to summarize student strategies. The charts are recorded in a single session or compiled after a series of Number Talks with several classes. The latter typically works well for middle school teachers with several sections of a math class. Anchor charts provide a variety of strategies to solve a problem and illuminate misconceptions. Teachers use the “my favorite no” strategy (a response that is incorrect but well-reasoned) to celebrate misconceptions and highlight the importance of taking risks and learning from mistakes. Anchor charts are posted in the room as long as they are relevant, and give students resources that they can rely on when they embrace the challenge of learning math. Students also collect strategies in their math folder or journal.

Conclusion

The work students do with number sense and fluency translates to all facets of their mathematics education.

Building number sense is critical to future mathematical success. Students have the ability and the right to access a deep understanding and realize their strengths with flexibility, fluency, and accuracy with numbers. Number

Talks is a powerful instructional routine to empower students and teachers of all ages. Bookcliff Middle School teachers are driven and inspired to continue this work not only because of the results we've seen in the data, but also the confidence and positive attitude students are showing in their math classes. We hope you are inspired to introduce this instructional routine to your students.



Anchor Chart

References

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