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INNOVATIVE K-8 CURRICULUM FROM THE ARBOR SCHOOL OF ARTS & SCIENCES

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MUTUAL BENEFIT

One of our aims in the Arbor Center for Teaching is that our teacher training program provide mutual benefit to the apprentice teacher in training and to the mentor teacher. We want our apprentices to receive and engage in a rich and rigorous preparation in which theory and practice meet and inform each other. But we also cultivate conditions in which these beginning teachers can bring new perspectives, ideas and insights to the practice of their more experienced mentors.

This fall's "action research" project provided just such an opportunity. After a full year of collaboration, each apprentice/mentor teacher duo had designed thematic units, assessed student work, and prepared for parent conferences as a team. This meant each contributing insights, research, questions and alternative approaches for a study, a lesson, or support of a particular child. It also meant living a year of backing each other up—through recess duty, co-teaching in both successful and challenging lessons, and sharing feedback in the service of ongoing development of teaching practice.

By Year Two, apprentices have clear ideas about aspects of their practice that they would like to develop or areas of student learning they wish to investigate more deeply. These ideas and questions became the spur for their teacher research, including reflection, analysis, and adjustment in service of building students' understanding and honing teacher practice.

Of the five action research projects our apprentices launched this school year, two had particular impact on the practices of the mentors, introducing methods that intially seemed out of sync with their pedagogical philosophy but proved to be valuable tools for deepening student understanding and making children's learning processes visible to the teacher. One example comes from non-fiction research reading at our Junior level (second and third grade), the other from seventh-grade Math. We've opted to tell those stories in narrative form within these pages, but all our apprentices' full research papers are available for free download on our website:

www.arborcenterforteaching.org/articles

–Annmarie Chesebro
Director of Teacher Training
Arbor Center for Teaching

ARBOR SCHOOL
OF ARTS & SCIENCES

WHY ARE THEY TELLING ME THIS?
JUNIORS READ FOR UNDERSTANDING

action research by Elsie McIver

Apprentices' ideas for action research often spring from their special position within our school as full-time co-teachers, entirely immersed in our curriculum and practices but seeing it all for the first time. While they are learning all they can about child development and Arbor ways and finding their own stances as educators, they are perfectly poised to ask important questions about why we do things as we do.

Elsie McIver, teaching alongside Peter ffitch in one of our 2-3 classrooms, was helping students practice writing non-fiction "in their own words." We require this of even our youngest researchers when they are gathering facts, aiming to instill the habit of processing what you read by restating it in language that makes sense to you. But Elsie began to notice that students who could deftly rephrase facts to produce beautiful reports didn't necessarily retain the information or show the ability to think critically about it. She decided to take a step back, to look more thoughtfully at how we teach children to gather and synthesize information and how we can know what sense they're really making of what they read and report.

"My research interest started in non-fiction report writing. However, it soon became clear to me that quality writing is difficult to achieve if deep and intentional reading and comprehension habits are not in place first. I began to wonder how we can help even the youngest readers to pull meaning from texts and take ownership of this new information in a way that sticks. This led me to an even more perplexing question: how can we as teachers offer instruction and gain insight into what is happening in students' minds during this deeply internal process of reading and synthesizing non-fiction?"

When Elsie asked her students to explain passages they'd just read on Iroquois housing, while many could recite some relevant facts, some of the responses were troubling. One child replied, "Uh, I don't know." Even a highly advanced reader demurred, "I'm just bad at remembering things." A child asked to write down the main idea of a text went looking for a single sentence she could copy word for word. Asked to summarize a passage, another selected an inconsequential phrase.

Elsie had expected a range of ability amongst her broad spectrum of readers, some of whom are just leaving the decoding stage, but what she had discovered was that even children who are adept at processing text could leave their non-fiction reading with little new information or knowledge.

Reading for understanding is not easy; research shows that humans are wired to rely and act on memory rather than putting forth effort to think deeply about new information. Non-fiction projects in Arbor's classrooms frequently begin with opportunities to pose questions on a subject and are followed by treasure-hunting through a rich selection of literature to uncover answers and generate new questions. Listing things we know and things we wonder helps to guide students into a subject of study and gives them practice at discerning the difference between trivial questions that are easily answered and more complex questions that require deeper research and usually unfold into chains of new questions. Channeling children's natural curiosity into the beginnings of a research process, we hope to train them in the habit of asking questions and in the skillful seeking of answers. (See Cambium Vol. 1, No. 3, Writing to Learn: "The Art of the Question.")

When Elsie questioned this approach and proposed a more strictly prescribed encounter with non-fiction to improve comprehension, Peter hesitated. He was concerned that it might not be appropriate or effective to ask children this young to slow down and reread with such specific goals in mind. He worried about asking them to work in such a controlled way, losing the inspiring aspect of choice that comes from diving in and looking through lots of books. The moment when the spark happens might be lost. Peter's strong reaction prompted Elsie to devise ways to test whether reading comprehension was an aspect of their teaching that really needed probing.

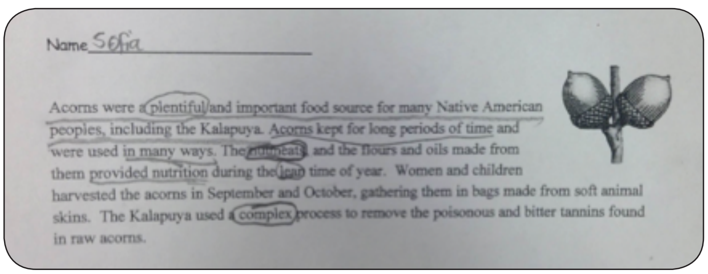
What Elsie wanted to teach was Close Reading. As the Juniors began to study the Kalapuya people who were the first inhabitants of this part of Oregon, Elsie introduced the process to see whether it could help her students make meaning from texts despite their current reading level.

Tenets of Close Reading:

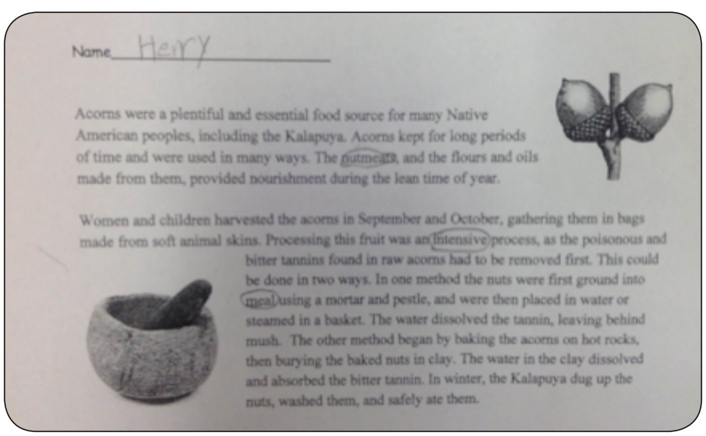
- provide text of adequate but not overwhelming complexity
- read and reread
- draw attention to central idea and key supporting details
- summarize
- identify unfamiliar words to build self-awareness of understanding
- ask questions

"In order for Close Reading to work with both the most emergent and the most advanced readers, I found that using differentiated texts was crucial. I began differentiating by simply reading aloud to the emergent readers, but they needed more time to process what they heard and to learn the necessary background information and vocabulary. Even when I read aloud to them, I changed the text to a shorter and simpler format. I also began to frontload important new vocabulary words."

Elsie recreated on paper what she was naturally doing aloud, rewriting the main ideas of the Kalapuya resources in short, simple paragraphs. Having multiple differentiated versions of the same text on hand allowed students to move up or down in text complexity as needed. But even the briefest versions were surprisingly dense in content. Elsie had her readers circle words they weren't sure about, which helped her understand which words were tricky for many students and also gave her a quick check on the veracity of their claims to have understood a passage — if terms that were critical to making sense of the text were circled, she knew their comprehension couldn't be sound.


Name Sofia

Acorns were a plentiful and important food source for many Native American peoples, including the Kalapuya. Acorns kept for long periods of time and were used in many ways. The nutmeats and the flours and oils made from them provided nutrition during the lean time of year. Women and children harvested the acorns in September and October, gathering them in bags made from soft animal skins. The Kalapuya used a complex process to remove the poisonous and bitter tannins found in raw acorns.


Name Henry

Acorns were a plentiful and essential food source for many Native American peoples, including the Kalapuya. Acorns kept for long periods of time and were used in many ways. The nutmeats, and the flours and oils made from them, provided nourishment during the lean time of year.

Women and children harvested the acorns in September and October, gathering them in bags made from soft animal skins. Processing this fruit was an intensive process, as the poisonous and bitter tannins found in raw acorns had to be removed first. This could be done in two ways. In one method the nuts were first ground into meal using a mortar and pestle, and were then placed in water or steamed in a basket. The water dissolved the tannin, leaving behind mush. The other method began by baking the acorns on hot rocks, then burying the baked nuts in clay. The water in the clay dissolved and absorbed the bitter tannin. In winter, the Kalapuya dug up the nuts, washed them, and safely ate them.

Examples of close reading texts differentiated for emergent and advanced readers. Both students have circled unfamiliar words; Sofia has underlined key ideas.

But she wanted to know more: what was unfolding in their minds as they were reading?

"I began experimenting with reader partnerships in order to make the reading and comprehension process visible and audible to me as a teacher, as well as to provide students with practice in pausing to consider their understanding. I paired advanced readers with emergent readers. The advanced reader was given the job of 'whisper reader,' quietly reading aloud while the other partner listened closely and summarized what the whisper reader had read after two or three sentences. The whisper reader was tasked with adding any information to the spoken summary that he believed his partner had missed. If the summarizer was not sure of what he had heard, the whisper reader would reread the text.

From our very first whisper-reading session, the classroom was an incredible place to be. A hushed, productive buzz filled the room, and I could either rotate through the room listening in on conversations or help a partnership of struggling readers. When I read aloud to a pair of emergent readers, the conversation they began to have was truly exciting. One girl who sometimes misses things during group discussions was making thoughtful inferences and connections as she repeated back what she understood. 'Well, it said that the door was small. That was probably to keep the cold out,' she mused as I described the Kalapuya winter dwellings. Not only was every student engaged and thinking throughout the period (as they each had a job), but they built comprehension that lasted through the weeks that followed."

The Kalapuya study offered opportunities for students to show what they understood in multiple ways. This unit typically contains a project to build a Kalapuya-style home for a clothespin person in the Arbor woods. After the whisper-reading partners read and summarized a complex text about Kalapuya building methods, all students drew the phases of the building process as they understood it. This required many of them to stop and seek a better understanding — although you could copy the term "upright forked stick" into a report and receive full marks for your detailed description, you cannot draw one if you don't understand the phrase.

A Kalapuya-style woods house for a clothespin person

"House-building in the woods showed great evidence of their understanding as students excavated before building, drove upright forked sticks into the ground, built frameworks using crosspieces, and insulated the walls with dirt," Elsie was glad to notice.

Even more impressively, after ten days had elapsed, students wrote about the construction process in their journals. Their entries showed that they had retained a remarkable level of detail:

"We went about collecting forked logs for framework," wrote second-grader Juliette. "When we had enough, we started driving them into the ground, then started getting crosspieces and grass. We layed the crosspieces don on the forks. Then we covered our crosspieces with super-long grass.... We covered the grass with mud for insolation."

Another Close Reading practice Elsie wanted to introduce was to require students to write down questions as they read. "In order to formulate a question, students need to pause and think enough about a concept to have a novel, independent thought. They need to synthesize what they have understood in the context of their background knowledge and wonder how this new information connects. Question-asking also helps me as a teacher know where confusions lie, and then address those confusions.

Finally, asking questions about a text is more engaging than memorizing and copying lines; it can make reading more fun."

Elsie gave three emergent readers some pages photocopied from a non-fiction book — not a simplified text she had rewritten — to see how they would do at question-posing. One boy came back with a question scrawled on every page, including "Why are they telling me this?" next to the very first paragraph.

"The text described a pickup truck racing down a dirt road next to a shepherd walking with his flock, to illustrate that both traditional and modern ways of life exist side by side among the Navajo. Once I learned that Ahti had not understood this main idea, we spent some time decomposing and understanding the text together and then shared it with the group. This example has become a landmark for our class in thinking about modern Native American life. Without Ahti's written question, a key piece of comprehension would have been lost, with neither of us the wiser and an opportunity for the whole class missed."

Peter was convinced by Elsie's results: strong readers and emergent readers alike were showing improved comprehension and retention using Close Reading techniques. He still believed in what he calls "the diving in," but recognized that he had been missing miscomprehension, particularly among students who were turning in beautiful work based more on deftness at copying and rephrasing than on having built lasting understanding. Elsie's more scaffolded methods were elevating everybody's learning. The kids might be writing less, but their sense of meaning was stronger and more durable. It was time to apply what they had learned to a report cycle, one of the biggest research efforts of the year.

Junior Design teacher Patricia Ballarché devised a concurrent small-group project to construct scale models of houses from different cultures. Students did careful research, wanting to get the details right.

"All of the activities leading up to our Native American research projects demonstrated to me that Close Reading is a complex and slow process. This made me want to slightly change the research cycle to sustain our focus on careful, thoughtful reading. To me, this meant that students might read and write fewer pages and study fewer topics compared to previous research experiences. It also meant that I would be very careful about letting them loose with a bunch of non-fiction books, where we would likely lose many of our Close Reading practices and fall back into copying information directly into reports. To make things feasible for this age group, we would apply our best reading habits to just a few texts and gather additional information from read-alouds, videos, images, stories, and music.

We would also spend less time on other report-writing skills, such as locating information in books, note-taking, or the general writing process. This is not to say that these skills are less important, just that I believe reading and understanding what you read is so foundational that we should first spend a significant amount of instruction bolstering this part of the research cycle. Once the class has good habits of non-fiction reading, future research cycles can focus on other important parts of the process. The more I work with young researchers, the more I see how complex each stage of the research cycle is, each warranting its own in-depth focus."

Elsie chose to divide her Pueblo and Navajo researchers into "expert pairs," each taking ownership of a different subtopic and then teaching the larger group what they had learned. The pairs used whisper reading to tackle the differentiated texts she gave them, practicing the habits of finding the main idea, summarizing, circling unfamiliar words, and asking questions. Elsie added a checklist at the top of every text so that her students could monitor their own attention to each habit.

Because this class of Juniors was so enthusiastic about building, a complementary project took shape in Design. Each research group would collaborate on a larger model of their culture's traditional housing. The desire to incorporate realistic details fueled students to delve into complex texts and work hard to understand them. Asking questions to better comprehend the readings became an essential and fun part of the process.

A Pueblo-style adobe dwelling made of individual bricks. The students working at the far end have begun to add the outer layer of mud.

"During a read-aloud, I modeled our four habits. Then I asked everyone to think of at least one question while I re-read the passage. Eyes began to squint in concentration, and slowly a sea of hands emerged. Camden was curious about the Pueblo spiritual practice of outlining a house foundation with cornmeal. 'Why would they want to waste food?" he wondered. He was making a connection to a conversation from the day before about how the Pueblo paid their workers with food and therefore employed the fewest people possible. 'Why was it so hard to grow food?' we had wondered in response. Now Camden's question led us into a discussion about how important their spirituality must have been if they were willing to use such a spare resource in this way. Question after question followed: 'Who was raiding the pueblo?' 'Why did the woman own the house?' 'If women owned the homes, where did the men go?' Soon our board was full of wonderings. It was an animated, engaged gathering."

This experience led Elsie to an important realization. In previous research projects that had begun with question-asking, the class would work diligently to answer the "What I Want to Know" column of guiding questions. Sometimes additional questions would be added, but those initial questions generally remained the same. And they would be largely topical: *What did they eat? What were their weapons?* Now Elsie could see how background knowledge gained in the Close Reading exercises sparked deeper curiosity and more complicated questions: *Why would they waste food? How did they know which foods were poisonous?* The more students learn, the better their questions become. “However, getting to this point took careful, thoughtful, guided information gathering. It took access to quality, leveled texts; good reading habits; and a little outside structure, where continued question-asking was a required part of each student’s research,” Elsie points out.

The role of student curiosity in driving research also came under Elsie’s scrutiny during this project. While she had planned for her whole group to study the Pueblo, several boys were fascinated by a tangential mention of the Navajo as “raiders.” They lobbied to learn more and Elsie, wanting to honor their enthusiasm, hesitantly allowed a second research group to form. It was challenging to have two groups going at once, and the collection of resources about the Navajo was not as strong. Our books did not divulge much more information about Navajo raids, and as the Pueblo research group was able to go deeper, the Navajo researchers began to return to the fold, enticed by the details of Pueblo life that were emerging. The instigator of the Navajo research ended up writing his report on both cultures. “Is it possible that understanding leads to interest more than interest leads to understanding?” Elsie wrote.

Close Reading has earned an enduring place in the Junior Down classroom. While Elsie was away for her teaching placement at a public elementary school, Peter led the next research effort on his own. He incorporated some of Elsie’s practices, but left other aspects of the process alone and taught the unit as he’d done before. And he wasn’t satisfied. In the absence of careful guidance through differentiated texts, he could see how quickly students fell back into the habit of copying lines — rephrasing them, perhaps, but not putting in the extra thought to truly comprehend the underlying ideas. The higher-order questions that had proved to him the worthiness of Close Reading structures weren’t bubbling up as universally. Peter wished he’d introduced the material the way Elsie would have.

That Peter and Elsie could work together through this experience, trusting and respecting each other’s stances while thoroughly probing the whys of the ways of their joint classroom, is due to the solid foundation they have had time to build as co-teachers. Elsie and Peter had already shared a year’s worth of debates, discussions, and pondering over kids. And Peter brings to bear the wisdom of long experience coupled with an open, humble, and reflective mindset. Arbor aims to be an environment in which teaching practices can evolve. “We create that environment by never saying to apprentices, ‘and that’s the way we do it here,’” Peter explains. “It’s always, ‘here’s what we’ve done, but let’s see if we can make it better.’”

MAKING SENSE OF MATH
FLEXIBLE THINKING & CULTURE CHANGE THROUGH NUMBER TALKS

action research by Cecca Wrobel

Cecca Wrobel, our Senior-level apprentice, undertook action research last fall that probed a question much like Elsie's: *How can we better understand students' processes for making sense of math problems?* Cecca had been mulling over that thought since encountering the Common Core Standards for Mathematical Practice in the early days of her apprenticeship. The very first standard requires that students "make sense of problems and persevere in solving them." "Though I'd long known that even very intelligent people can be confused by math, that anyone would *not* try to make sense of a problem was wholly new to me," Cecca wrote. "For any trouble that I might have had keeping straight the details of calculus, I always expected it to make sense."

In talking to her students, Cecca found that faith in the integrity of math is not universal. "Some students arrive expecting math to make sense, and will put great thought into a confusing concept until it does. Others may concentrate their efforts in memorization, holding on with a sort of blind faith. There are also non-believers, disinterested in the subject and frustrated by the long list of rules handed down from on high." She wanted to find a way to help all of them develop their number sense, strengthening their understanding of the reliable ways quantities relate.

Doreen Ho is Cecca's classroom mentor. Doreen's goal for their seventh-grade class, particularly, was to prompt some culture change that would encourage quiet students to raise their voices and contribute to whole-group knowledge. She felt there was a great divide between kids who wanted to demonstrate their knowledge and those who didn't. Doreen decided to try introducing Number Talks, a routine of computation practice that uses a method developed by a group of teachers in the 1990s to help students "take back the authority of their own reasoning." Doreen and Cecca might quickly show the class an array of 25 dots and tell them, "There are 25 dots. How are you going to count them?" The pressure to give a correct answer was gone, and a premium on finding multiple useful strategies was established. Kids who hadn't been talking began to talk.

Number Talk Protocol:

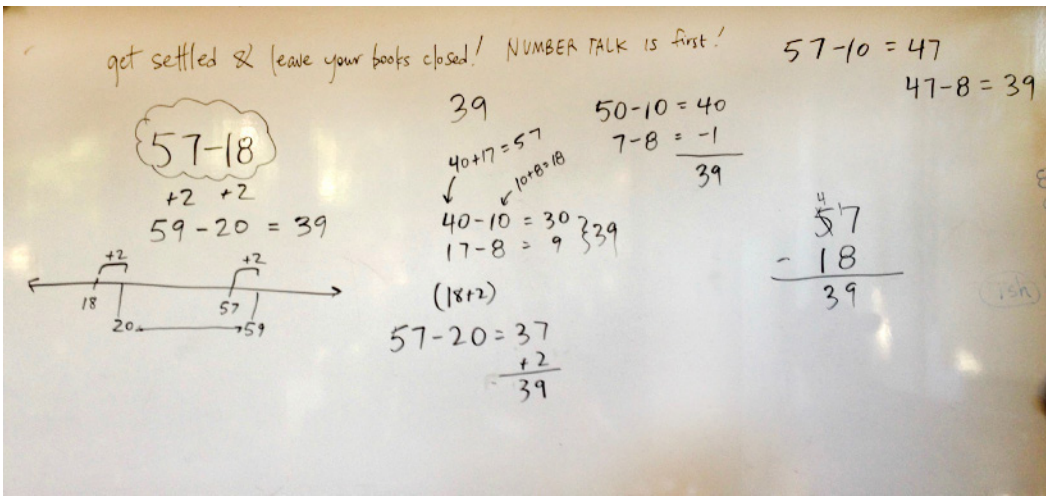
- students display their readiness with a closed fist at the chest; teacher writes a problem on the board
- students solve the problem mentally, raising a thumb when they have an answer; teacher allows wait time
- students share possible answers; teacher creates a list on the board
- students share strategies step by step; teacher charts thinking on the board

Cecca was intrigued by the chance Number Talks offered to push for more flexibility in thinking, less reliance on familiar algorithms. At first, the students were taken aback. "What do you mean, 'different ways' [to solve a problem]?" they'd ask. "Many were adept enough to offer some alternative problem-solving approaches, but few of these were models of efficiency," Cecca noticed. "It's important to know that multiplication can be thought of as repeated addition, but is adding up 18 individual 5s going to be as useful as multiplying ten 5s and then adding that to another eight?"

"When faced with a double-digit multiplication problem, the old reliable algorithm had been my own go-to, even for working mental calculations. Though I was always a believer in the availability of alternate routes through the landscape, I still kept to the well-trod path, leaving roads less traveled to become overgrown. Even a shortcut can seem laborious when untended! While we do want students using algorithms in their written computations, as they are effective and efficient in most situations, over-reliance without deep understanding can be problematic. Too often a mechanical error within the tightly packed machine of the algorithm will lead to a very wrong answer." What's critical at this point is that the student be able to apply her number sense —

what another ACT apprentice once dubbed her "reasonableness detector" — to notice that the answer is fishy. Learning ways to approach double-digit computation without using the algorithms gives students deeper and more durable understanding of why the algorithms work.

Cecca began last fall with Number Talks involving straightforward multiplication and subtraction — problems that could invite multiple strategies. She asked her seventh graders to consider 57 – 18. "Even in a simple subtraction problem, some students found elegant strategies not considered by the majority of their classmates," she was excited to find. The final student she called on offered a strategy the Number Talks literature calls "same difference:" Round the minuend (the number being subtracted) to a more "friendly" number — 18 becomes 20 — and then adjust the subtrahend (57) by the same amount. 59 – 20 is a much simpler problem to calculate in your head to arrive at the same answer: 39. "Several other students in the class reacted audibly to this demonstration, to the effect of, 'Wow, that was really easy!'"



But old habits die hard. When Cecca gave them a problem with fractions in the hope that someone would try the "same difference" approach, no one took the bait. After several days, she reluctantly moved on from subtraction so that the problems wouldn't begin to feel predictable.

At Arbor, Senior math begins with a unit on reasoning that asks students to think about how they know what they know. This isn't a new idea for them, either; as fourth and fifth graders they've been accustomed to writing summative encapsulations of their understanding of science concepts called HIKWIKs: How I Know What I Know. But it was clear to Cecca that more confidence in the strength of their own logic would still benefit many of her seventh graders. "Uncertainty may not be a bad starting point if students can come to depend on math through their own explorations," she reasoned. "Unfamiliar problem contexts — ones for which there are no handy algorithms — best lend themselves to this work." She worried about overwhelming her students with complicated tasks, but with encouragement from Annmarie, she began to select more complex problems for her class. And these quickly yielded very interesting discussions.

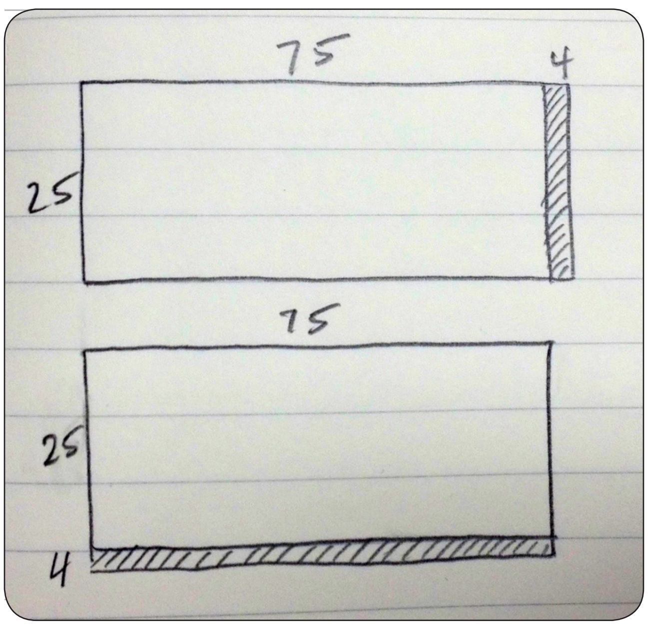
Intermediate teacher Charles Brod wrote about HIKWIKs in Cambium Vol. 3 No. 2, Evidence In Action: "Refuting Aristotle."

One such Number Talk began with an invitation to reasoning that needn't necessarily involve any calculations. "I asked the seventh graders, 'Which is greater, 79 x 25 or 29 x 75?' The freedom to estimate brought out a new kind of discussion. Some less-frequent contributors articulated their rounding strategies, each of which produced a slightly different estimate but pointed to the same pair of factors having the greater product." Then Cecca called on Cole, who'd been waiting with his answer throughout the discussion.

"I'm not really sure how to describe it," he began, a statement Cecca found exciting already. Though quiet and not often vocal during Number Talks, Cole is known to his peers as a strong mathematician, which made his admission of uncertainty doubly significant. "He went on to say that he saw the difference between the two expressions, 79 x 25 and 29 x 75, as nearly the same but 'with an extra 4: one in the 79 and one in the 29.' What he admitted trouble articulating was what made the 29 'worth more,' so I took the extra step of breaking those two factors into addends: 25(75 + 4) and 75(25 + 4). From here, it was a little easier to prove that distributing the 4 produced extra 25s in the first case and extra 75s in the second."

Sammy spoke up next. He had total faith in his reasoning, but couldn't explain why. "I just know that when you multiply two pairs of numbers that add up to the same thing, the pair that are closer together will have a larger product." Cecca and the class mulled over this surprising claim. "I asked if anyone else had noticed this pattern before, but the room was silent. I suggested that we could all — outside our limited Number Talk time — test its plausibility by checking different number pairs until we were convinced, but then it occurred to me to draw arrays. Rectangles of the dimensions 25 x 79 and 75 x 29 will have the same perimeter, corresponding to Sammy's claim about sums. As we could more quickly test with smaller numbers, the area of a rectangle with a given perimeter is optimized when it is a square: 8 x 4 and 7 x 5 yield lesser areas than does 6 x 6." Through careful communication and a teacher's nimble thinking about visually displaying ideas, what each student believed by faith in his own strong number sense could be proved — to the enlightenment of the whole class.

Cecca realized after the fact that Cole's solution could also have been easily mapped with an array, as shown below. This visual representation clearly shows how the extra 4 is "worth more" when added to the 25.



Doreen had been impressed from the beginning how hard it actually is to lead a Number Talk. The teacher has to be listening hard while translating what she's understanding to map the student's process on the board. She admires Cecca's ability to pick up on what a child is driving at and create a visual representation for the class. It takes a lot of practice to keep those skills sharp — as the Senior Math team has worked through cycles of running frequent Number Talks and then slackening off for awhile, they have had the sense of needing to train themselves up again to lead another round. "Part of the challenge is to resist going after teachable moments, when it would be easy to tell a student, '*This* is what you're trying to say,'" Doreen says. "The point is to let them explain themselves; you're just the recorder. If there's a misstep, the kid will often notice it as you're writing it down and make the correction himself."

Besides honing her natural gifts for intuition and clear communication, Number Talks helped Cecca learn to manage her time as she was beginning to take on more responsibility for the classroom — knowing and practicing what you can accomplish in ten minutes is a good intermediate step before stretching to plan a whole period. Because our mathematics curriculum is largely self-paced, teaching Number Talks also gave Cecca a chance to develop whole-group pedagogical skills that was otherwise difficult to work into the class routine.

Greg Neps, rejoining the Math team in Cecca's second year after having been on loan to the Science program, was initially skeptical about giving up 10 minutes of the class period multiple times each week to work on problems that every student should already be able to solve. "And it's hard to keep Number Talks to that narrow ten-minute window," he noticed. "It can expand so easily. You always want to hear one more answer and you're always hoping that if you linger a bit longer you'll draw out that student you're wanting to hear from." But he sat back and trusted Cecca's instincts about the benefits this method could offer to their class. "The more I watched, the more I saw the value in Number Talks — the discussion the kids were having, the insight I was gaining into how kids think as I listened to them describe their procedures in depth. It took me awhile to get comfortable with spending class time this way, but for a couple of my students in particular, Number Talks helped me understand so much better how they process numbers. I can see why they're making certain types of mistakes. A kid may be a really clever problem-solver, and describing his reasoning to the class reveals that innovative cognition in ways that written work can't." Greg recruited Sammy to the Arbor MathCounts team on the strength of his participation in Number Talks, where he showed truly insightful ways of thinking and an amazing knack for simplifying a problem.

Although Number Talks at Arbor have persisted more as a tool for occasional use than as a daily practice, Doreen feels they truly have helped change the classroom culture. For shy kids, she likes the safety of the private gesture of holding up your thumb against your chest when you have an answer rather than raising your hand for attention. For constant contributors and highly competitive types, the restraint this method requires is beneficial exercise. For kids who are quick mental mathematicians, there's the challenge of finding multiple strategies rather than producing a single accurate answer. And as Greg saw, Number Talks can allow children to shine as mathematicians in a new light.

"Nearly every day in Number Talk, a few familiar thumbs are the first up," Cecca has noticed. "They don't belong to the most 'advanced' students in the class as measured by progress through the curriculum; two of my most reliable and creative Number Talkers are behind most of the class in our algebra textbooks. But while they're not always as focused and self-driven as some of their peers, these students have shown themselves to have incredibly flexible thinking in the math landscape — solid number sense. For these students, Number Talks have been both an outlet for their ideas and an alternative form of assessment for us teachers." At Arbor, where thorough and elastic understanding of concepts is valued above rapid progress through the curriculum, this opportunity to spotlight creative thinking was a chance to make our values plainly visible to the students.

Cecca realized early on that Number Talks need careful leadership to avoid succumbing to the same imbalance in participation that Doreen had first set out to combat. While different voices were leading the conversation, there were still more male "regulars" than female. Cecca began to tally instances of participation against a class list and to covertly bring a list of the least vocal students to the board in order to prioritize her selection of sharers. "This has helped to ensure that I call on less-frequent contributors when they do volunteer, though they may stand out to me less than the three quiet girls I'll never forget to look for. In this way, I have been successful at turning some quieter but more confident students into frequent volunteers." She has also experimented with asking all students to write down their strategies after the usual wait time for mental calculation rather than sharing aloud.

Although our seventh graders will have the benefit of Cecca's thoughtful teaching for only a few more months before she graduates from her ACT apprenticeship, all our Seniors will have the opportunity to stretch their flexibility and bolster their number sense as the practice of Number Talks endures in our classrooms.

ARBOR SCHOOL
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Cambium

INNOVATIVE K-8 CURRICULUM FROM THE ARBOR SCHOOL OF ARTS & SCIENCES

THE ARBOR CENTER FOR TEACHING AT
ARBOR SCHOOL OF ARTS & SCIENCES

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Cambium: (n) the cellular growth tissue of trees and other woody plants, from medieval Latin "change; exchange."

What content would you like to see offered in Cambium? Do you have ideas about how we can improve it? Send us an email: cambium@arborschool.org

Masthead by Jake Grant, after an 1890 botanical illustration.

The Arbor School of Arts & Sciences *is a non-profit, independent elementary school serving grades K-8 on a 20-acre campus near Portland, OR. Low student-teacher ratios and mixed-age class groupings that keep children with the same teacher for two years support each child as an individual and foster a sense of belonging and community. An Arbor education means active engagement in learning, concrete experiences, and interdisciplinary work.*
For more information on the Arbor philosophy, please visit www.arborschool.org.

The Arbor Center for Teaching *is a non-profit organization created to train teachers in the Arbor educational philosophy through a two-year apprenticeship while they earn MAT degrees and licenses, and to offer guidance to leaders of other independent schools. In 2007 its mission expanded to include the publication of material underpinning the Arbor School curriculum.*

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