Sense-making Notebooks: A Learning Tool for Students and Teachers

(Editor’s note: This article is third in a series on science and mathematics notebooks. In our second article, we discussed the role of the teacher in helping students construct sense-making notebooks by addressing various types of student entries that scaffold thinking. The important thing to recognize when selecting an entry type is that each notebook entry requires students to gather and integrate information in different ways.

In this article, we focus on using sense-making notebooks as a tool for teachers and students to promote learning.)

Sense-making Notebooks are all About Student Thinking

Perhaps the most important (and no doubt difficult) task of teaching is to discover what your students know and don’t know. The “Engage” of the 5E learning cycle is one way to work toward accessing student’s prior knowledge which reveals what students already know about a particular topic, including their misconceptions.

Teachers also build into their 5E lesson plans Decision Point Assessments which allow them to gauge students’ understanding in real time.

Finally, the “Ask, Don’t Tell” K-12 Alliance policy helps teachers remember to ask students questions – a student’s line of thinking emerges as teachers ask follow-on questions. This begs the question: Why do we need to use sense-making notebooks?

Dave Hart, a fifth grade teacher in the Palm Springs Math Opens Doors Project, shares his take on why you use notebooks:

Why do you use notebooks?

The big idea here is uncovering student thinking, which leads to effective instruction and a rich learning experience. What did you hope to accomplish by using the notebooks?

Learning to talk about math is one way to uncover student thinking. But, sometimes it is hard to capture and analyze. When a student writes, you still read about the process thinking. Consequently, writing in notebooks reflects deeper, higher level thinking. That’s my motivation for student notebook writing. However, students should reflect (individually or with partners) before they write because it gives them time to process their thinking.

What does the analysis of student work tell you about student understanding?

My learning goals are the fifth grade math standards. Quantitative assessments give you some good information. But, the picture is not complete without the qualitative. Student writing is the qualitative piece. The writing uncovers what the student knows, what the student does not know, and the misconceptions. After I read the writing, I do two things: first, I give the student feedback (by having a brief whole-class discussion) and second, I adjust my instruction.

Dave reminds teachers that writing is a complex form of communication that not only reveals students’ thought processes, but also captures their understanding that can be evaluated, thus providing teachers opportunities to re-evaluate the direction of their instruction.

Using Sense-making Notebooks as a Learning Tool in Mathematics

Jasmina Ivanov is an eighth grade algebra teacher at Toro Canyons Middle School in Coachella Valley whose own schooling in Bulgaria influences her instructional decisions.

One reason she has always required her students to keep a notebook is because in Bulgaria every teacher and professor required it of her. As a student, Jasmina found that a notebook was sufficient to keep her notes, information and essentials. Furthermore, she found her notebooks indispensable during finals weeks and before exams.

In addition to having students use notebooks in her classroom today, Jasmina organizes her students to work in groups of four and has high expectations of them. “I will definitely continue to demand a lot from them because my students are certainly capable enough to learn and succeed,” she says. “I do not believe there are other options.”

A recent visit to Jasmina’s eighth grade algebra class reveals the way students actively use notebooks as a learning tool.

In the classroom, as part of a daily challenge question, students were asked to figure out a way to represent two coordinates on a graph. Students had to recognize the coordinates represented two different pieces of information and could not be placed on a single number line. In addition, the two number lines had to be perpendicular to each other.

Eventually, students realized the information given to them could be represented in the form of a graph. In order for them to successfully complete the challenge question, the students needed to synthesize their prior knowledge about number lines, data placement and coordinate planes.

During the challenge questions, groups of students discussed various possibilities of how to display the data. Within seconds of starting the activity, several student groups reached for their math notebooks. They scoured through the many pages that contained notes, sample problems and their own writing with a sense of urgency.

The algebra students were convinced the pages of their notebooks contained valuable information that could help them with the challenge question.

When asked why they were looking in their notebooks, they replied: “I know I have done something like this before. I am trying to find it” and “There might be clues in my notebook that will help us figure this out.”

Clearly, these eighth grade algebra students rely on their notebooks as a source of information to help them remember what they already know, connect old information with new information, and, most importantly, provide a point of reference for thinking through math problems.

This observation exemplifies how students use notebooks as a learning tool, but what about the teacher? How does Jasmina use notebooks as a learning tool to guide her instruction? Here’s what she shared:

What did you hope to accomplish by using the notebooks?

My students can write vocabulary words, and their definitions, math formulas and examples (with details and step-by-step solutions) that they can always depend on when going back through its pages during study time. It is easier to find the information for them this way. Besides, each rule is accompanied with an example. Therefore, it is a great source of information and visuals.

What does the analysis of student work tell you about students?

Thinking in the “right direction” is difficult, especially if the students are not trained and not accustomed to the idea of using logic. Ironic enough, if students are left with no other choices, but to arrive at their own answers, regardless of the length of time (in the beginning), they just do the thinking, especially when you tell them that you will come back to them with the same question.

If given a certain amount of time to think, students certainly do the thinking. Furthermore, thinking in the right direction comes with prior knowledge in the subject area and experience in this approach of teaching/guiding students.

The use of sense-making notebooks allows all teachers, like Jasmina, to consider students’ thinking as part of the total equation to promote student learning. A notebook on one hand can be a go to source of information, but it can also reveal where students stumble in their learning. In this case, Jasmina learned from her students that they have difficulty using logic, a big idea that no doubt will influence her instruction.

Using Sense-making Notebooks as a Learning Tool in Science

Jenny Lopez Ngigi teaches at Chavez School in Coachella Valley Unified School District. For the last two years, Jenny has directed an after school science program and has incorporated the use of student notebooks for primary level students who are also part of a Spanish-English Dual Language Immersion Program.

Jenny explains that her biggest surprise this year has been the writing samples produced by her second grade students, the same students who began the program last year.

Jenny tired something new this year – she taught students more about the mechanics of writing and used protocols to help them put words on paper. Jenny attributes the students’ enthusiasm for writing to these changes in her instruction, and to the students’ motivation to share what they understand about science. In many cases, students added sentences without being prompted — and in more than one language! (See sample 1.)

Jenny also realized that by having students expose more of their thinking through their writing, she was able to get a clearer idea about what they understood. Jenny’s
The Matrix: What is Your Reality?

BY KATHY DI RANNA

The triangle: an important element in love, in mathematics and in teaching and learning. We know of its impact in relationships, we can identify it as isosceles, equilateral or scalene math, but we have no clue as to the triangle in symbology in teaching and learning. Simply put, the cornerstone (tops, vertices-stone) of education is the relationship among content, teacher and student. Our job in professional development is to make the triangle as strong as possible by linking good content with good teaching and good learning. A key to the strength of the triangle are the teachers; how deeply they know their content, how well they know their students and how they can provide meaningful learning experiences.

We all know some teachers are very effective with nearly all of their students, while others fail. Gary Waddell, a curriculum services administrator in San Mateo County noted. “The best teachers engage students academically with empathy; connect with them emotionally in ways that create profound differences in both experiences and results.”

From his administrative experiences, Gary created a teacher efficacy matrix as a way to identify and support master teachers. He presented his matrix in the Journal of Staff Development (Summer, 2009) in an article, Who’s That Teacher? His matrix has implications for us who want to improve our craft!

In the matrix, one axis is “knowing your stuff” which includes teachers having a solid mastery of content and clear understanding of the standards. This axis also includes teachers who are adept with instructional strategies and facilitate their uses. These teachers know how to probe for student understanding, monitor and adjust instruction based on student responses.

At their best, these teachers are master teachers, skilled educators with whom nearly any student will achieve. At their worst, these teachers are technicians who make students learn something, but not necessarily like it!

The other axis of the matrix is “knowing your students” which measures how well the teacher “knows and values their students as individuals as well as in the context of their family, racial and cultural groups.”

Skilled teachers on this axis understand what motivates students and how to connect with them. These teachers guide students not only academically, but socially and emotionally. Teachers high on this axis are caretakers who motivate and inspire; those low on this axis often alienate their students.

These axes result in four distinct quadrants:

- **Struggler**: Weak in content, weak in pedagogy and student focus, often resulting in student poor academic achievement and behavior problems.
- **Technician**: Known for academic rigor, but who lacks the skill or will to meaningfully engage all learners.
- **Master Teacher**: Has the ability to connect with and motivate all students in the context of rigorous academic requirements.
- **Caretaker**: Kind and supportive but lacks a handle on content and strategies to raise student achievement.

**NOTEBOOKS... CONTINUED FROM PAGE 1**

Interpretation of the student sample work above in Spanish is that this student understands the difference between the sounds, “c” and “s” and high and low, but he does not use the word pitch.

Jenny also thins the second sentence seems to indicate that the student recognizes a relationship between the length of the tube and sound (pitch). Looking at the third sentence, however, she starts to question what the student really understands when he writes, “La mas alto hace peqamno the highest makes small.”

When Jenny looks at the English translation, she thins the writing seems to parallel the Spanish response as long as she interprets the student’s words “bigger” for higher and “smaller” for lower.

Analysis of this student work triggers three possible interventions for Jenny: how to get the student to try to propagate academic vocabulary both in Spanish and English, how to improve the student’s syntax, and how to strengthen the student’s understanding of the relationship of length to pitch.

“When we did writing unconnected to science experiences, many of my students would only write a sentence or two,” says Jenny. “Now doing the science experiments first and giving students a process for writing, I see my students excited and wanting to explain what they know. Being able to read my student’s thoughts helps me be more reflective of what I need to do next in my teaching.”

Jenny’s response’re to our questions follow. As you read, Jenny’s thoughts may be similar to yours.

**Jenny**

Why do you use notebooks?

“I was encouraged to do notebooks for two reasons: one, because of the research behind it, and two, because I see that it is through note taking and reflecting upon what is being done or learned that the student rises his or her level from knowledge to comprehension.

What did you hope to accomplish with the notebooks?

“My goal is that through the use of questioning, leading them to see the conceptual flow of the subject presented to them, and note taking (a record of their thoughts and understanding), my students will reach a level of evaluating their own learning. What does the analysis of student work tell you about student understanding?

It allows me to see where students are in the ladder of learning a concept.

What do you change in instruction based on the level of student work in the notebooks?

Based on the information I get from the students’ notebook, I know whether the child is ready for the next concept, or if I need to provide that child the opportunity to do a hands-on activity or that child only needs some questioning that will allow him or her to meet the lesson’s objective.”

In our next article, we will present a rubric designed to foster student’s thinking by using the various types of notebook entry types.
Diving In and Making Waves
BY JUDI WILSON

"Y"ou recruited teachers for California Science Implementation Network (CSIN) and now you need to be the Staff Developer, said the voice on the phone. That was 20 years ago. Little did I know that I would soon be taking an unexpected path in my career and being exposed to ground-up walnut shells for stream tables, making ice cream in a Ziploc® bag and the infamous sock sex.

Key to our efforts in CSIN was leadership training. My assigned task for one of the first Summer Institutes was to "do something on leadership," so I bought the then-current book Swimming with the Sharks by Hanney MacKay to give me some ideas about how we could all suddenly be leaders.

And swim we (somewhat) did! We certainly gathered enthusiasm, had a lot of fun, tolerated the cold; but I about how we could all suddenly be leaders.

Several years: I bought the then-current book Swimming with the Sharks by Hanney MacKay to give me some ideas about how we could all suddenly be leaders. Because of such a limited amount of fresh water, conservation needs to be a number one concern for everyone. Throughout the lesson, I discovered first-hand how much water is wasted everyday, but they also believed ways they could save water. We started working on the Water Cycle and the students spent a few days creating the Rock Salt so they could use it as an aid for their writing activities. Because I learned the 5 Es along with the Conceptual Flow with the K-12 Alliance, I took the opportunity to dive deep into content material and student engagement. It’s like finding a path to the pot of gold – which is student learning. With these tools, I am learning student engagement and student satisfaction, as well.

On the day our special guests came to visit, my students were looking at their Water Cycle charts and notes. I had just put a Step-Up-To-Writing outline on the board for students to list three key ideas for their writing activity. I made a persuasive writing prompt for water conservation. Students were asked to take a stand pro or con and support their stance. While all of this was going on, our principal and visitors arrived.

1. **Dive IN.** Leadership is action, not position. I have worked with hundreds of teacher leaders and have learned that each teacher leader has unique skills for developing, designing or running a program, project or event, and they each play an important part. When they become empowered, teacher leaders are willing to take on more responsibility. Current research on teacher leaders shows that these leaders can be very important part of school improvement and they are especially critical in science education because of the few curriculum personnel in science.

2. **Come UP for Air.** Believe in making a difference. Get support. When teachers associate with other leaders and become educated and empowered, they grow in confidence and expertise. Once teachers develop an “I Can Do It” efficacy and build relationships with other involved teachers, leadership activities are a natural byproduct.

3. **Make Waves.** Even a small amount of movement makes waves. Each year, we sponsor an event called "Catch the Working, Action, Vision and Education (WAVES) in Science" to celebrate leadership in science. Be an “asset builder.” AFFIRM what you want to happen. Banish all comments such as: ‘Science isn’t happening in our school.” or “No one wants to do science,” and make an attempt to never dwell on what might drag you down. BE what you want to happen – heart, body and mind.

4. **Go the Distance.** Leadership involves collaboration and often takes time and many steps to accomplish something important. Forget the credit and focus on the addressing the task or challenge. Make sure your goal has a clear vision of what needs to be accomplished and what the ultimate purpose is all about. Be tenacious and don’t give up!

LEADERSHIP

TEACHING & LEARNING

Classroom Rewards
BY JAMES FENNEY

(This is my second year being involved with the K-12 Alliance, and I have directly seen my classroom grow dramatically in science and Language Arts because of the K-12 Alliance! Let me tell you what really happened to me and my students.)

One day, our principal Dr. Susan Yalick said Superintendent Dr. Carol Leighly and new board member, Dr. Rutz-Robinson, where coming to visit. I always love sharing how hard our kids are working, but I also get worried that my lesson or activity might not be as impressive as I want it to be.

Having recently finished training and lesson teaching days with the K-12 Alliance a few weeks earlier, I decided to bold the lesson I learned with the Alliance into my own classroom.

With the K-12 Alliance, I learned that only three percent of all of our teachers are true leaders and followed the mantra “Leadership is responsibility, they grow in confidence and expertise. Once I learned the 5 Es along with the Conceptual Flow with the K-12 Alliance, I took the opportunity to dive deep into content material and student engagement. It’s like finding a path to the pot of gold – which is student learning. With these tools, I am learning student engagement well as student satisfaction, as well.

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STUDENT WORK – Teacher James Fenney is proud of the work his students have done recently on the water cycle.

Dr. Leighly and Dr. Rutz-Robinson were amazed by the students’ Water Cycle flow charts. They were also excited to see science being used to promote Language Arts. At the students’ desks, they talked with the kids and looked over their work. Naturally, I was nervous, but I was excited and proud of my students.

Later that day, I received one of the most rewarding e-mails I have ever received during my entire time teaching. I have always imagined my leaders coming into my classroom and being speeches – but that’s what exactly happened that day! The e-mail said our visitors were extremely impressed that we were integrating Language Arts in our science programs. I knew our class had been singled out.

This could have only happened because of my involvement with the K-12 Alliance and its outstanding educators who truly live and model the practices they teach us.

This year my teaching is still going through the roof, and it’s hard to contain my enthusiasm! Thank you K-12 Alliance for giving teachers the tools we need to make our classrooms a model on “How It Should Be Done!”

TEACHING & LEARNING, CONTINUED ON PAGE 4

COLLABORATION

Seeking Science in the Community
BY JAMES KISIEL

Science learning happens all the time—in museums and aquariums, in parks, on the Internet and in our homes. Given the amount of time we spend out of school, these places provide resources that are important pieces of everyone’s science learning landscapes.

Science centers, natural history museums and zoos are community institutions that foster informal science learning. Unlike the traditional classroom, these places allow learners to choose when and what to learn, as well as with whom they will learn.

Although these locations are often seen as family destinations, most make significant efforts to support science learning in formal or classroom settings through outreach programs, professional development and family workshops, and of course, the traditional field trip.

Unfortunately, studies indicate that many informal science institutions struggle to connect with teachers, and that teachers are typically unaware of the resources these community institutions offer to schools and teachers. How can this connection improve?

As part of a three-year CPEC project, the K-12 Alliance and California State University Long Beach faculty are involving informal science institutions in professional development efforts at Bell Gardens Elementary School in Southern California.

In addition to reinforcing teachers’ science content knowledge and instructional approaches through Teaching Learning Collaborative (TLC), project leaders are engaging teachers in a variety of activities to help expose them to resources that these informal science institutions offer.

Last year, teachers met at the Discovery Science Center (DSC) in Santa Ana and were given guided investigations and observations to carry out within the Center. Different groups were given different activities, depending on their grade-level science content training, such as: “rocks and minerals, atmosphere and weather, space, etc.”

These were not the typical ‘scavenger hunts’ often seen in museum spaces, but rather open-ended prompts that required participants’ active observation and manipulation of exhibits, and ask questions related to their experiences. These experiences served as jumping-off points for more in-depth content discussions back at their school.

For the second week of the training, DSC took the role of PD provider, engaging teachers in sessions adapted from their free monthly teacher workshops. These two-hour workshops featured several related science concepts (e.g. the rock cycle or force and motion) and their connections across elementary grade-level standards, with particular emphasis on common misconceptions.

These teachers participated in DSC-led hands-on Earth science sessions (last year’s content focus). Following these workshops, a brief seminar introduced teachers to the idea of community institutions as sources of science teaching support.

As the multi-year project continues, additional local informal science institutions will be tapped to further support these teachers’ professional development.

Project leaders are hopeful that experiences with institutions like DSC, a rich learning environment for both teachers and students, may begin to help educators understand how these locations provide learning opportunities beyond the traditional fieldtrip.

James Kiesiel is an Associate Professor in the Science Education Department at California State University, Long Beach.

January 2010

James Fenney is a fifth grade teacher at Temecula Elementary.
Environmental Education: EEI Updates

BY ANDREA LEWIS

For the past six years, the California Environmental Education Network (CEEN) and the California Integrated Waste Management Board (CIWMB) have been leading the charge to bring education about the environment into California’s public schools. En- tering the year 2005, with the Environmental Education Initiative (EEI), this unprecedented work brings environmental education into California’s classrooms resulting from AB 1721 (Pavley, Chapter 581, Statutes of 2005) and the Integrated Waste Management Board (CIWMB). The sessions were eye-opening for pre-service educators; Sue Bratcher, Madhusudan Katti and Steve Blumenhagen. This was also the month of the first Teaching and Learning Collaborative (TLC) for Kings Canyon and Sanger school districts.

Pleasant Valley, the first to participate, was also the first to experience their first TLC at the Sanger school districts. Rita presented, staff developers – Jennifer Weber, Brad Schleder, Josie Fierro, Heidi Betancourt, Terena Mitchell, Tammy Abbott, Emily Rowell and Terry Sayre – began facilitating the beginning of the TLC process. Teachers’ presentation, special notes were posted and reposted on the teachers’ conceptual flow charts. Flows developed throughout the day and were accompanied by thoughtful conversations regarding how to achieve the flows’ Big Idea. Density, static electricity, properties of metals, and ecosystems were just a few examples of the content of the various TLC lessons. Lessons from Fresno State University faculty served as content experts. Sue Bratcher, Madhusudan Katti and Steve Blumenhagen, assisted the groups by answering questions and clarifying certain scientific concepts. Teachers’ presentations and discussions were filled with colorful charts, aided their presentations when discussing content and alignment with standards, must be rated as fully met in order for the instructional material to be adopted. Categories two through five can be rated as partially met and the material can still qualify for adoption. These categories include: program organization, inclusion of assessment strategies, universal access and instructional planning and support. Seventy-one of the EEI units passed this review and are scheduled to be presented before the State Board of Education for approval in January 2010, the remaining 9 are in early 2011. Tricia Radovic, a K-12 Alliance middle school science teacher from Temecula Unified School District, served on the panel that reviewed the materials. The amount of effort and dedication to this process was remarkable, she says. “The dedication of the panelists in completing the exhaustive and detailed work is to be commended, as it is the commitment of the CIWMB and Cal EPA. Significant resources were devoted to producing materials that are engaging to students and their choice to submit the product to the rigorous state review is impressive. In days when our education system is often under fire, it is a pleasure to see so many committed to providing our students with good instructional materials.”

Curriculum approval is the first step in EEI implementation in California’s schools, and facilitators are now exploring how best to offer professional development opportunities and identify where to begin school district implementation. Even with the EEI curriculum available on the internet, the California Environmental Education Network (CEEN) and the California Integrated Waste Management Board (CIWMB) have been leading the charge to bring education about the environment into California’s public schools. En- tering the year 2005, with the Environmental Education Initiative (EEI), this unprecedented work brings environmental education into California’s classrooms resulting from AB 1721 (Pavley, Chapter 581, Statutes of 2005) and the Integrated Waste Management Board (CIWMB). The sessions were eye-opening for pre-service educators; Sue Bratcher, Madhusudan Katti and Steve Blumenhagen. This was also the month of the first Teaching and Learning Collaborative (TLC) for Kings Canyon and Sanger school districts. Rita presented, staff developers – Jennifer Weber, Brad Schleder, Josie Fierro, Heidi Betancourt, Terena Mitchell, Tammy Abbott, Emily Rowell and Terry Sayre – began facilitating the beginning of the TLC process. Teachers’ presentation, special notes were posted and reposted on the teachers’ conceptual flow charts. Flows developed throughout the day and were accompanied by thoughtful conversations regarding how to achieve the flows’ Big Idea. Density, static electricity, properties of metals, and ecosystems were just a few examples of the content of the various TLC lessons. Lessons from Fresno State University faculty served as content experts. Sue Bratcher, Madhusudan Katti and Steve Blumenhagen, assisted the groups by answering questions and clarifying certain scientific concepts. Teachers’ presentations and discussions were filled with colorful charts, aided their presentations when discussing content and alignment with standards, must be rated as fully met in order for the instructional material to be adopted.

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