

Nuggets of Knowledge

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Department of Curriculum, Instruction, & Accountability

Algebra in Elementary School

Dr. Tom Carpenter, well-known mathematics researcher from the University of Wisconsin-Madison and the director of the National Center for Improving Student Learning and Achievement in Mathematics and Science, has worked along with colleagues to assist teachers in developing algebraic thinking in students. He discusses the traditional disconnect between arithmetic and algebra in our classrooms. This separation is especially problematic in California schools, given that many 8th graders (and potentially many more in the future) are currently enrolled in a traditional Algebra 1 curriculum.

Rather than moving high school coursework into lower grade levels, and simply promoting the memorization of and fluency with procedures, teachers would be wise to promote the development of algebraic thinking in our young students, according to Dr. Carpenter. One of the important strategies espoused by Carpenter is to have students construct generalizations about numbers and operations. With limited classroom instruction time, teachers often resort to giving students information, in the belief that it is an efficient way to deliver curriculum. Dr. Carpenter recommends that teachers try an alternate method of encouraging students to **verbalize** their mathematical thinking, while analyzing number properties or operations. In one example, a teacher asked children whether it is true that $0 + 5,869 = 5,869$. Discussion ensued, with students trying to find counter examples. Some generalizations were offered that were not completely accurate, so by trial and error, the group decided that "*zero added with another number equals that number.*" Subsequent discussions led to related generalizations about subtraction and multiplication.

In similar studies completed at Tufts University, researchers also concluded that children can think about arithmetic in ways that are more algebraic in nature than they are currently practicing.

Consider this computational problem: $7 + 6 = ?$
How does the problem differ if we pose it this way: Is $7 + 6 = 8 + 5$ true or false?

Framing arithmetic questions in this manner develops a student's sense of relationships and equivalence instead of merely doing an operation to get an answer. This problem also lends itself to more advanced thinking when students are eventually asked how to fill in the blank for $7 + 6 = _ + 5$.

An Oregon elementary school is seeing progress by using similar methods. Instead of asking for an answer, and proclaiming it right or wrong, the teachers ask students to explain their thinking and have them set up their own problems and equations. In addition to developing algebraic reasoning, the students are "playing with numbers" and enjoying their math classes!

For more information on Dr. Carpenter's article, go to <http://www.wcer.wisc.edu/NCISLA/>. For more information on the Oregon classroom visit: http://www.oregonlive.com/news/index.ssf/2008/12/math_education.html. For many related articles, visit the NCTM (National Council of Teachers of Mathematics) website at <http://www.nctm.org>.

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Common Formative Assessments

There is strong and rigorous evidence that improving formative assessment can raise standards of pupils' performance.
(Black & William, 2004. *Phi Delta Kappan*, 86 (1).

Common formative assessments are collaboratively created and used by a grade-level or content-area team of teachers before teaching a unit. Members of the team agree on the essential knowledge and skills (standards) that students must master and the level at which students will be deemed proficient. Prior to instruction, the members of the team discuss research-based instructional strategies that have been proven to help students understand what they must learn and different ways in which the teachers will check for understanding. William and Thompson (2007) provide several reasons to support their contention that common formative assessments offer the largest gains in student learning:

1. Teachers working together are more likely to possess a higher level of subject matter expertise than teachers working in isolation.
2. Teachers are more motivated to investigate alternative instructional strategies when presented with compelling evidence of higher student achievement, when this evidence is presented by their colleagues.
3. Commitments of teachers made to teammates keep them moving forward with implementation of new strategies.
4. When teams of teachers develop common formative assessments, they are engaged in learning that is job embedded and is the most powerful form of professional development.
5. Common formative assessments help educators make the transition from a focus on teaching to a **focus on learning**.

In *Revisiting Professional Learning Communities at Work* (2008), Richard DuFour states that three things **must** happen to make an assessment formative:

1. The assessment is used to identify students who are experiencing difficulty with their learning.
2. A system of intervention is in place to ensure students experiencing difficulty devote additional time to and receive additional support for their learning.
3. Those students are provided with another opportunity to demonstrate their learning and are not penalized for their earlier difficulty.

Since the goal of formative assessment is to gain an understanding of what students know (and don't know) in order to make responsive changes in teaching and learning, it is important for teachers to use a variety of formative assessment strategies. Questioning and classroom discussion are useful tools as long as teachers make sure to ask thoughtful, reflective questions that involve the entire class. Black and William (1998b) suggest:

- *Invite students to discuss their thinking in pairs or small groups, and then ask a representative to share (think/pair/share).*
- *Present several possible answers to a question, then ask students to vote on them.*
- *Ask all students to write down an answer, and then read a selected few out loud.*

Other ways to assess students' understanding are:

- *Ask students to summarize the main ideas from a lecture, discussion, or reading.*
- *Exit questions: "your ticket out the door."*
- *Graphic organizers.*
- *Daily warm-up review questions.*
- *Journaling.*

Black and William (1998b) also make the following recommendations in regard to assessments:

- *Frequent short tests are better than infrequent long ones.*
- *New learning should be tested within about a week of the first exposure.*
- *Be mindful of the quality of test items and work with other teachers and outside sources to collect (or create) good quality test items.*

Resources

- ◆ Black, P. and William, D. (1998a). Assessment and classroom learning. *Assessment in Education*, 5 (1): 7-74.
- ◆ Black, P. and William, D. (1998b). Inside the black box: Raising standards through classroom assessment. *Phi Delta Kappan*, 80 (2): 139-148.
- ◆ Black, P., Harrison, C., Lee, C., Marshall, B., and William, D. (2003) *Assessment for Learning: Putting it into practice*. Open University Press.
- ◆ Sadler, D.R. (1998) Formative assessment: revisiting the territory. *Assessment in Education*, 5 (1), 77-84.

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Deconstructing Language for English Learners

from *Aiming High*, A SCOE Publication, March, 2007

By Vanessa Girard and Pam Spycher

Building a home is a useful metaphor for understanding how to approach instruction for students who are learning English. When designing a structure, architects begin by looking at the location, evaluating the site for strengths, and determining what modifications will be needed to successfully build the home.

Educators of English Learners also start by considering the unique qualities of "the location"-that is, what the students bring to the learning situation. What are their academic strengths? How much English do they already understand? Only with knowledge about what each student brings to the task of learning English can teachers determine what needs to be done to bring them to parity with their English-speaking peers.

Girard and Spycher contend that English Learners must learn how the English language is constructed. Furthermore, students must be able to use language that is authoritatively presented, informationally dense, and highly structured. If students don't know the academic language that affords them access to content, we do them a disservice. They simply cannot learn the content.

The authors recommend the following strategies:

- **Word-smithing**- changing words to improve the precision and specificity of a sentence. For example:
 In a third-grade classroom, the teacher notices that students are overusing the word *mad*. Using a piece of student writing, the teacher highlights the word *mad*. She states, "I think the word *frustrated* might be a better word here. People are frustrated when they've tried repeatedly, but haven't been successful. Let's use it instead." The teacher then revises the sentence using the word *frustrated* instead of *mad*.
- **Nominalization**-transforming the verbs novice speakers use to nouns that are more often found in academic dialogue and classroom texts.
 Original: Scientists *developed* plants that responded to fertilizer and farmers were able to *produce* more.
 Revised: The *development* of plants responsive to fertilizer led to increased *production*.
- **Providing sentence frames**: this technique is useful for teaching students to understand and use a particular type of sentence construction. To demonstrate understanding of cause and effect students use the following frames:
 If _____ is _____, then _____.
 Because _____ is _____, the result will be _____.
 One possible outcome of _____ might be _____.

When using frames, it is essential teachers explicitly tell students what is important about the frame so that students can generalize those aspects of language to other academic tasks they engage in.

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