Learning By the Book

(Editor’s note: This is the fifth installment in an ongoing series on understanding students’ misconceptions – a.k.a. naive conceptions, alternate conceptions, pre-conceptions.)

In the four previous issues, we examined the importance of being aware of students’ misconceptions and how important it is to focus instructional planning around those misconceptions. Here we discuss how you can evaluate instructional materials for their educative nature in helping teachers improve their practice in regards to addressing student understanding and misconceptions.

A sk a teacher to describe his or her science instruction, and the response is very likely to include references to a specific textbook or curriculum series. Textbooks serve not only as resources for a teacher’s instructional decisions, but also as one of the tangible representations of that instruction.

Throughout educational reform, new textbooks have been central to the visions of change. In fact, several attempts have been made to ensure the visibility by making “teacher proof” textbooks. Yet we know -- thank goodness! -- this does not work. Textbooks alone cannot bring about change since change is a complex human endeavor. Changes in teaching and learning involve understanding the intersection of the two goals and the interplay of students, teachers and instructional materials.

Using textbooks is often met with mixed reactions: many effective teachers use them, new teachers use them as the “bible.” Some teachers never use them because their students can’t read and others use them as doorstops. But texts -- also known as instructional materials -- continue to serve as a teacher’s primary instructional resources for classroom instruction. As a focal point for instruction, texts raise concerns about the impact of “intended” curriculum versus the “implemented” curriculum. Quality science education curriculum calls for students to build their own understanding of science concepts at a deep and rigorous level. What is “implemented” or taught often misses the mark. Many times the gap in curriculum is not what was intended and is due to the teacher’s inadequate level of expertise in content and pedagogical content knowledge.

Teaching the Teacher

We know from research that teacher quality is the most important factor to help students achieve their educational goals. Teachers must have content background and pedagogical content knowledge. In other words, teachers need to know how to help students gain access to -- and build understanding of -- science concepts.

In order to have high quality in both content and pedagogy, teachers need support. Researchers at the University of Michigan (Schneider, R.M., Krajcik, J., & Marx, R. 2006) have found a way to help teachers improve their practice by using instructional materials that are educative for teachers as well as students.

Teacher educative materials are those instructional materials that help develop teacher knowledge, beliefs and abilities so that they can teach effectively for student achievement. Materials that are educative help teachers:

1. identify challenging learning goals and address student prior knowledge;
2. earn how to anticipate and interpret what learners may think about or do in response to instructional activities;
3. identify trends in student conceptual thinking, common naive, or alternative conceptions;
4. address strategies to help teachers adapt to the needs of diverse classes of students; and
5. address teacher background, both in content and in pedagogy.

Educative curriculum materials make visible the developers’ pedagogical judgments. The materials “speak to” teachers about ideas underlying tasks rather than merely guiding their actions.

Sound too good to be true? Yes, but in fact, there are materials that provide this type of support. Unfortunately, when California adopts K-8 science instructional materials in 2007, this level of teacher support is not part of the criteria. However, this does not prevent district committees, from looking carefully at materials for these characteristics in their adoption of K-8 materials. Likewise, when selecting high school instructional materials, committees can also review materials for this criteria in the same way they review high school materials.

Evaluating Instruction Materials

How do we evaluate and adopt instructional materials that are educative not only for students but also for teachers? One way to do this is to use heuristics (rubrics) that have been designed for this purpose.

“Sweeping our heuristics around important parts of a teacher’s knowledge base: subject matter knowledge, instructional approaches, rationales for using the approaches, and recommendations for their effective use.” (Davis & Krajcik).

Three heuristics focus on the importance of understanding student thinking as we have discussed in this series of lead articles on student misconceptions.

We have included these heuristics in (Fig. 1, page 4) so you can evaluate your own instructional materials for its educative value.

Read the teacher manual/material (not student text), apply the criteria, total the marks and then think seriously about adopting those with the highest rank!

Finding time

BY KATHY DIRANNA

Our newly remodeled kitchen is stunning. Radiant. Sleek. Now everything else has to go.

Of course that means moving the “stuff” one more time as we contemplate which wall to knock out next, which bathroom fixture to buy. I am amazed at the amount of stuff that can get stacked in a corner including a pile of professional journals that I just know I will get to someday.

As luck would have, today was just that day. Sorting journals by date was too overwhelming. Sort by topic? Hmmm...most of the paper clips that had carefully noted an article had slipped. Articles in journals by date had to be flipped over one by one. Articles about shared interests. Articles pointing out several clever ways how to rearrange my newly remodeled kitchen is stunning. Radiant. Sleek.

Sigh. It seemed easier to grab the big black bag and make a major contribution to the landfill, which I finally ended up doing.

Thinking I was finished with the task, I re-read another piece of furniture and found yet one more journal. It was the National Staff Development Council’s “The Time Dilemma in School Restructuring” by Gary Watts and Shari Cassel. I remembered reading this and thinking it might be informative for this column. So I re-read and found the information timely!

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“A poem for two voices is meant to be read aloud by two people, each reciting their lines, but joining in together with the common lines.

Poetic Inspiration

(For further information, contact)

This poem – written by Nikki DiRanna’s biology class at Centennial High School in Compton – describes both the beauty and science involving the hierarchy of living things.

A cell

A cell

a basic unit of life

a basic unit of life

of breath

of breath

of energy

of being

And blood

And blood

Flowing through veins

Flowing through veins

and arteries and the heart

and arteries and the heart

An organ

An organ

Now part of an organ system

Now part of an organ system

Thinking

Thinking

a man’s basic instinct

a man’s basic instinct

blended with learned behavior

blended with learned behavior

Making an organism

Making an organism

For balance

For balance

and equilibrium

and equilibrium

Joining breath and sex

Joining breath and sex

Now part of an organ system

Now part of an organ system

made of many parts

made of many parts

That has part in the world

That has part in the world

An organism

An organism

Who has part in the world

Who has part in the world

not just one, but many joined

not just one, but many joined

for balance

for balance

yet alike

yet alike

yet alike

yet alike

A hierarchy of Life

A hierarchy of Life

A Poem for Two Voices

A Poem for Two Voices

A hierarchy of life

A hierarchy of life

The basic unit of life

The basic unit of life

of breath

of breath

of energy

of energy

of being

of being

A tissue

A tissue

nerve and bone

nerve and bone

And blood

And blood

and arteries and the heart

and arteries and the heart

An organ

An organ

Now part of an organ system

Now part of an organ system

Thinking

Thinking

a basic unit of life

a basic unit of life

of being

of being

of a tissue

of a tissue

nerve and bone

nerve and bone

And blood

And blood

Making an organism

Making an organism

For balance

For balance

and equilibrium

and equilibrium

Contributing to the ecosystem

Contributing to the ecosystem

as a system

as a system

mixture of living and non living

mixture of living and non living

in a dance

in a dance

so different, so diverse

so different, so diverse

Yet alike

Yet alike

Based on the cell

Based on the cell

And infinity

And infinity
Dee Pierce, they designed science lessons that also met standards in science. Teachers are trying new strategies to engage students in meaningful activities that meet standards.

Knowing teachers have is a limited time to teach science – in addition to the language arts – the team decided to combine thinking processes. All data, analytical thinking happens in language arts as well as science. There’s predicting, inferring, observing.

Once again, TLCs provided opportunities for leadership and learning.

In fact, during a recent TLC, instead of quiet responses as students, children in Laura’s class were saying, “Oh, now I get it!” “Wow, the electricity travels in two complete pathways!” and “This makes sense!”

The TLC team of lead teachers, a pre-service teacher, scientist and facilitator presented a lesson about series and parallel circuits on the basketball gym which dramatized the flow of electrons through complete circuits.

When the teachers planned and then taught the lesson, students could illustrate and explain the pathway of electricity in both series and parallel circuits. Teachers were amazed at the quality of student work and students’ ability to explain their understanding both in drawings and writing.

Seeing such success in Laura’s class encourages other teachers to try different strategies in teaching. As the Lead Educational Agency for a CalMSP Grant in coordination with the K-12 Alliance, Tulare City Schools has shown outstanding support for teacher participation. Teachers are trying new strategies to engage students in meaningful activities that meet standards in science.

Tulare teachers who are participating in the TLCs are anxious to share what they have learned with their colleagues. Laura is an example of this leadership. Both Superintendent John Beck and Director of Curriculum Sue Ann Hillman are very involved in the results of this collaboration.

This CalMSP Grant is part of Cohort 2, which includes Tulare City, Pixley, Tipton, Buena Vista, Oak Valley, Palo Verde, Sundale and St. Aloysius. CSU Fresno and Fresno City College provide faculty and pre-service students as part of the collaborative team.

Together, we can make a difference!

Terry Sayre is the CalMSP Project Director. Tulare City Elementary School District.
### 'LEARNING BY THE BOOK' CONTINUED FROM PAGE 1

#### Heuristics Rubric

<table>
<thead>
<tr>
<th>Category</th>
<th>1 Little or None</th>
<th>3 Some</th>
<th>5 Comprehensive and Thorough</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supporting Teachers in Anticipating, Understanding and Dealing with Students’ Ideas About Science</strong></td>
<td></td>
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<tr>
<td>Curriculum materials should help teachers recognize the importance of students’ ideas and help teachers identify likely student ideas within a topic.</td>
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<tr>
<td>Curriculum materials should help teachers gain insight into how they might be able to deal with the ideas in their teaching, e.g. giving suggestions of thought experiments likely to promote the development of more scientific ideas.</td>
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<tr>
<td><strong>Supporting Teachers in Engaging Students in Questions</strong></td>
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<tr>
<td>Curriculum materials should provide driving questions for teachers to use to frame a unit and should help teachers identify questions that they can use with their students, including focus questions for guiding a class discussion.</td>
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<tr>
<td>Curriculum materials should help teachers understand why these are scientifically and pedagogically productive questions.</td>
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<tr>
<td>Curriculum materials should help teachers engage their students in asking and answering their own scientific questions, by providing suggestions of productive questions and ideas about how to guide students toward those or other productive questions.</td>
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<tr>
<td><strong>Supporting Teachers in Engaging Students in Making Explanations Based on Evidence</strong></td>
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<tr>
<td>Curriculum materials should provide clear recommendations for how teachers can support students in making sense of data and generating explanations based on evidence that the students have collected and justified by scientific principles that they have learned.</td>
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<tr>
<td>The supports should include rationales for why engaging students in explanation is important in scientific inquiry and why these particular approaches for doing so are scientifically and pedagogically appropriate.</td>
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**Fig. 1**


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### ‘TALK THAT MEANS SOMETHING’ CONTINUED FROM PAGE 3

“…She has small groups present a snippet of a discussion in a ‘fishbowl’ format, where the rest of the class observes and then they de-brief what happened during the conversation. She sometimes leaves a tape recorder on one group’s table so she can ‘catch them’ using accountable talk — the mere presence of the tape record tends to raise the level of discussion for that group.

She says that she’s seen students progress in their ability to discuss what they read with each other or what they’ve done in some investigations. It’s time that I try this!”

Resource: http://www.math.utep.edu/Faculty/dusek/class/random/ifl.html

**Accountable Talk Primer**

What can teachers do to create an environment that supports Accountable Talk in their classroom?

- Establish clear conceptions of academic goals for the lesson, so key concepts are understandable.
- Pick instructional tasks that provide multiple entry points for students with a high cognitive demand.
- Choose an instructional format (for example, small group, whole group, partner work) that best supports academic goals.
- Become comfortable when facilitating Accountable Talk within small groups. Ask a question and then walk away, let students work out the answer among themselves.
- During large group Accountable Talk, ensure that all students are participating in the discussion. What does Accountable Talk look like in a classroom?
- Students are asked to explain how their evidence supports their statement, to explain their thinking.
- Students link their talk to what others say. Students indicate that they have something to say that expands on another student’s statement, showing that they listened, understood, and can build on knowledge.
- Students listen to each other attentively and respectfully.
- Students refer regularly to the labs, tests, notes and activities in addition to providing evidence for their opinions and theories and/or ask questions to clarify ideas.

**Accountable Talk Stems**

Accountable talk stems can assist teachers and students with focusing the conversation around key ideas related to the task or activity. Consider making a poster or “Conversation Cards” of the stems, which can become a regular classroom tool for students and teacher.

- I disagree with that because…
- What evidence do you have to support that?
- I agree with _____ because…
- (state further evidence)
- I still have questions about _____
- I want to add to what _____ said…
- Based on my evidence, I think…
- I don’t understand what you mean by that, can you clarify it?
- Where did you find that evidence?
- Is the evidence really supporting _____?
- I disagree with the use of that evidence because…
- I wonder if…
- I observed _____ and my data shows ______.