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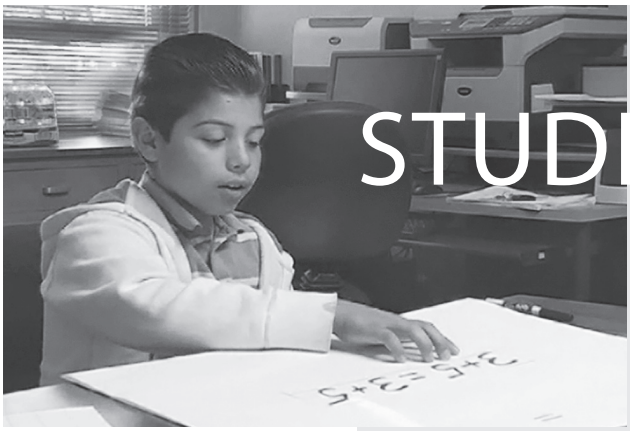

STUDENT INTERVIEWS

TEACHER CONVERSATIONS WITH STUDENTS REVEAL THE EDGE OF UNDERSTANDING IN MATHEMATICS

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Interviews can challenge educator assumptions about the knowledge students have and lead teachers to adjust instruction

See a sampling of student interviews online at www.scoe.org/publications

For the past eight years, teachers throughout Sonoma County have been utilizing a collaborative professional development process known as lesson study to examine and improve mathematics instruction. As part of this work, they have been interviewing students to ascertain what they know, what they've learned, and how they go about applying mathematical processes. These conversations have emerged as an essential element of the teachers' efforts to improve classroom practices, providing them with valuable information in support of effective lesson planning.

This issue of the SCOE Bulletin explores the impact of these teacher-student conversations about mathematics. We begin with a brief introduction to the how and why of student interviews, then share the results of interviews that were conducted in Sonoma County for various purposes. In each instance, the teachers have used the information gathered from the interviews to inform instructional practice and enhance student understanding.

INTERVIEWS: HOW AND WHY

Lesson study teachers have come to value the depth of information they get from student interviews. As teachers question students, they listen for evidence of mathematical reasoning and for the language needed to problem-solve. They identify gaps in learning, assess fluency of computation, and gain insight into the thinking strategies students apply when solving problems. Because interviews allow for a variety of modes of communication (gestures, expressions, words, representations), they provide a clear picture of the range of knowledge students bring to the classroom.

INTERVIEWS: WHAT RESEARCHERS SAY

The better interpreter you become of how children see the problems, the better you will be at making on-the-spot decisions in the classroom.

Ed Labinowicz, *Assessing for Learning: The Interview Method*

The teachers neither evaluated the merit of the strategy nor focused on what the child did not know or had not been taught. Instead, they tried to understand how the child was thinking and reasoning so that their instruction could be informed by children's perspectives.

Victoria Jacobs, et al., *Supporting Teacher Learning: Using Teacher-Produced Videotapes of Student Interviews as Discussion Catalysts*

Student interviews … influenced instruction in all classrooms. All teachers reported that after the interviews, they increased their focus on meeting the needs of individual students.

Larry Buschman, *Using Student Interviews to Guide Classroom Instruction*

Language development can increase as students learn mathematical concepts in situations in which they are expected to explain and express their mathematical understanding through the use of multiple representations.

Robert B. Davis and Carolyn A. Maher, *How Students Think: The Role of Representations, Mathematical Reasoning: Analogies, Metaphors, and Images*

In Sonoma County's lesson study groups, teachers generally interview three to five students who represent a range of knowledge and ability. They select students who are struggling with a particular mathematics topic, yet are confident enough to share their thinking with an adult. Careful selection of interviewees ensures that common learning issues will emerge.

Before students are interviewed, the teachers determine their focus and formulate the questions they'll ask. Questions are written on chart paper for easy reference and any materials that students might need to explain their thinking are prepared. Interviewers strive to uncover as much information as possible, but not to instruct. This can be challenging when a misconception emerges, but it's critical to the purpose of the interviews, which is to *inform the teachers*.

Student interviews can take place in the classroom during centers, during recess, after school, or when there is release time. Video-taping students is extremely helpful as it allows for teacher re-viewing and analysis. (Permission slips are signed by families before filming students.) Depending on its purpose, a student interview may take place in preparation of a lesson or after instruction has been delivered.

UNCOVERING THE KNOWLEDGE THAT STUDENTS BRING TO A LESSON

Interviews can challenge educator assumptions about the knowledge students have and lead teachers to adjust instruction based on the reality of student understandings. For example, when Sonoma County teachers began conducting student interviews as part of the lesson study process, they discovered they had over-generalized assumptions about what students did and did not know. As a result, their lessons were not targeting students' real learning needs. Through the interview process, the teachers found they had to pay special attention to statements beginning with the words, "All our students know …," and determine if *all* students really do possess that knowledge.

Recently, the student interview process confirmed a countywide gap in mathematics instruction that was revealed in the findings of education researchers. *Children's Mathematics: Cognitively Guided Instruction,* based on over 20 years of research, reports that students view the equal sign as a signal to write an answer, thereby missing the concept of equivalent relationships that is critical to success in algebra.

The first interviews exploring student knowledge about equivalency were conducted at three Sonoma County schools, with students from kindergarten through fifth-grade participating. The students were asked if a series of different equations were "true" or "not true," and to explain why or why not. For example, is **3 + 5 = 3 + 5** a true mathematical statement? No, one student replies. Why not? Because **3 + 5** is **8** and the equal sign should be at the end of the number sentence (not in the middle).

A video featuring a selection of these fascinating interviews is posted on the SCOE website, *www.scoe.org/publications*. The teachers conducting the interviews were initially surprised by what was revealed and decided to gather a wider range of evidence by interviewing students in four more districts. Interestingly enough, the group found that the misunderstanding persisted across districts and grade levels. This knowledge heightened their awareness of the need to extend student understanding of the concept of equality in mathematics—and the teachers adjusted their instruction accordingly.

IDENTIFYING THE LANGUAGE DEMANDS OF A LESSON

Student interviews can also be conducted to identify the language demands of a lesson. When interviewing for this purpose, teachers have discovered instances where students grasp a mathematical concept, but stumble over the vocabulary used, leading them to incorrect solutions or limited understanding of the questions asked.

For example, in one textbook problem, students were to estimate the size of a box that could hold 100 key chains. During an interview at Meadow View School, the teacher discovered that the student didn't know what a key chain was and was visualizing a more familiar bicycle chain. As a result, he estimated the box size based on his knowledge of bicycle chains, but missed the anticipated textbook solution. For this student, the lesson needed to define "key chain" or provide a visual example.

DISCOVERING HOW TOOLS HELP (OR HINDER) UNDERSTANDING

A team of fifth-grade teachers invested a significant amount of time teaching the concept of volume, but their students were still struggling. During the lesson, each student had a box they were asked to measure, then compute its volume: height x length x width. The class agreed that height was the dimension that went up-and-down, length was the dimension in front, and width was the distance from front to back.

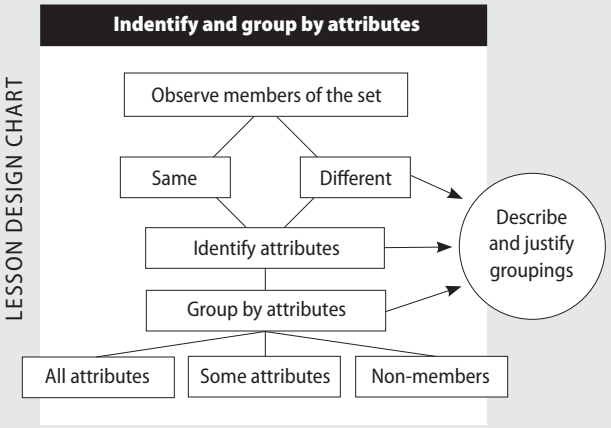
After the lesson, selected students were interviewed and asked to explain what they were thinking when they computed the volume of the box. Here, the teachers learned that the students became confused as they rotated their box to take its measurements. When the box was turned, the length became the height, so what was the appropriate label and measurement?

A solution was devised from the interviews: use colored pens to mark the edges of the box—one color for the height, another for the length, and a third for the width. This color-coding allowed the students to track and record the measurements as the box was rotated and they quickly mastered the concept of volume.

This issue of the SCOE Bulletin was written by Joan Easterday and edited by Suzanne Gedney

SEEING IF A LINE OF REASONING MAKES SENSE TO STUDENTS

Through interviews, a team of kindergarten teachers identified the thought process students used to sort materials, then planned a lesson that developed this line of thinking. They created this lesson design chart to explain the thinking sequence that was revealed by the students, then developed teacher questions and sentence frame responses that would help students describe and justify their reasoning.



Teacher questions	Sentence frames for student responses
What do you see in your group?	The ____ have ____ and ____.
What is the same?	These are the same, because they are ____.
What is different?	These ____ are ____ and these are ____.
How are these different?	These are ____ and these are ____.
Why did you put ____ in this group?	I put ____ in this group, because it has ____.
How did you sort them?	I sorted by ____ and ____.
Where would this one go?	It would be in this group, because it is ____.
Why didn't you put this one in the group?	It does not belong in this group, because it is not ____.

REHEARSING TEACHER QUESTIONS; LISTENING TO STUDENT RESPONSES

Adopted mathematics textbooks provide limited opportunities for students to explain and express their mathematical understanding—and yet this is a critically important skill. In order to help students verbalize mathematic conjectures and justifications, teachers need to increase their level of questioning, just as the kindergarten teachers did in the sorting lesson above. Student interviews give teachers the opportunity to practice asking higher-order questions and hear how individual students respond to those questions.

A third-grade lesson study group from Bellevue School implemented this idea when they observed

that their students were not understanding the commutative property of multiplication. (The commutative property means that two numbers can be multiplied in any order and the product will be the same.) As they interviewed individual students, the teachers asked them to build arrays of **5 x 4** and **4 x 5** cubes. Next, the teachers asked, "What is the same and different about these two arrays?" This led students to observe that there were the same number of cubes in each array, although the cubes were arranged differently. Students also noticed that the first array could be rotated to match the second. The teachers then asked, "Will the same thing happen with a **6 x 5** and **5 x 6** array?"

These explicit questions were designed to develop understanding of the definition of the commutative property and give students the opportunity to see that the definition was true. By "testing" the questions in individual student interviews, the teachers determined that student learning would be enhanced if those same questions were incorporated into whole-class lessons.

Student interviews can also reveal misunderstandings. After learning to separate objects into groups of two to determine whether they represented an even or odd number (if there was a leftover, the number was odd), fifth-grade students at Healdsburg's Fitch Mountain Campus were interviewed by a teacher from the lesson study team. When asked about the number 50, one student wrestled with the question and said it was both odd and even. The interviewer asked, "Why? How do you know that?" The student explained that if you broke 50 into groups of ten, there were five groups, and if you put those five groups into pairs, there was one group left over—making it odd. However, if 50 was broken up into groups of five, it was an even number because there were ten groups that could be paired with no leftover.

Here, the interview revealed a confusion and opened up an interesting issue that might impact the development of future instruction, especially if other students express this same confusion. Teachers might also find that asking "why" and "how do you know" questions provides opportunities for whole-class discussions of concepts students have misunderstood and that these discussions can effectively correct misconceptions.

DETERMINING THE "LEARNING RESIDUE" OF A LESSON

After a lesson about slope, a team of Healdsburg Junior High teachers chose to interview three students who were second-language learners: a girl with no previous schooling who had lived in the United States for two years, a boy who had gaps in his understanding and many responsibilities beyond the school day, and a boy with health issues that caused him to miss significant class time.

In all three cases, the students had learned the concept presented in the lesson and could represent the pattern on graph paper or using cubes. They could use a graph to determine if a number fit the pattern and indicate the slope. With support, each student could represent the slope with an equation, but they all needed more experience articulating how the components of the equation were represented on the graph.

Through the interviews, the teachers pinpointed what the students learned and identified their next steps: teaching the names of the elements of the slope equation and confirming that the students understood the connection between the equation and the rate of change, or slope, on the graph.

There is so much information collected in student interviews that it is often difficult for teachers to synthesize and articulate what they've learned. Sonoma County's lesson study teachers have established a clear debriefing process and concentrate on answering these two questions after they have observed a set of student interviews:

- What case can be made for what students know or don't know (conceptually or in regard to fluency and/or problem-solving skills)?
- What evidence supports that?

By focusing on these questions, teachers can zero in on what students are thinking as they work through mathematical problems, exposing missteps as well as forward movement. Listening to students reveal what they know and hearing what they don't know enables teachers to anticipate instructional moves for more successful lessons and greater student understanding. ◆

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