Beyond the Grade Book: Using Assessment Records to Determine Patterns and Trends in Student Understanding

(Editors’ note: This is fourth in a series of articles about Assessment-Centered Teaching (ACT), a product from the Center for the Assessment and Evaluation of Student Learning (CAESL) funded by the National Science Foundation. CAESL is a collaborative partnership of WestEd, the University of California, Berkeley’s Lawrence Hall of Science and Graduate School of Education, University of California, Los Angeles’s National Center for Research and Evaluation and Student Standards (CRESST), and Stanford University.

Here, we provide an overview of different types of assessment records to determine patterns and trends of student understanding. A more complete description of this process can be found in the soon-to-be released book, “Assessment-Centered Teaching: A Reflective Practice,” Corwin, 2008.)

Are you looking for ways to understand what your students know and where they are struggling in gaining conceptual understanding? Do you wish you had a better way to organize and analyze data from student work? Assessment Records have helped many teachers get a clearer picture of what exactly is going on in their classrooms.

Assessment Records are graphic representations of student data which enable you to analyze trends in student work by population (whole-class, individual student, groups of students) and/or by content focus (item(s) or conceptually-cluttered item analysis). The display helps to trigger questions and inferences about student understanding and provides information to monitor and adjust instruction and assessment.

There are three types of records: Quantitative, Qualitative, and Hybrid. Here is a description of each type, complete with example.

Quantitative Assessment Record

The Quantitative Assessment Record contains numerical information—a list of scores or numbers for assessment tasks. This type of record provides easy ways for teachers to record, organize and summarize numeric scores and make comparisons of student performance based on those numbers. An example of the Quantitative Assessment Record in Table 1 lists students’ names (or ID numbers) in the left column and the assessment tasks (e.g., specific questions, different assessments or concepts) across the top row. Student responses are recorded in the cells.

In this example, the scoring rubric is a 3-point scale, where + (plus) indicates a complete, correct response, ✓ (check) indicates a partial or partially correct response, and – (minus) indicates an incorrect response or no response. Data are displayed for only 4 students, but summary totals are included for a hypothetical class of 20 students.

This display can help teachers find trends by asking questions such as: How many students received a ✓, ✓ or ✓-? Which students had all –? How did Student 003 perform on the entire assessment?

Did this student perform as anticipated? How did Student 001 compare with student 020 in terms of achieving the learning goal?

Trends around assessment items can be found by asking slightly different questions such as: How did students perform on item #2? How did students perform on the conceptual cluster of items #1, #3 and #5?

Qualitative Assessment Record

The second type of record is the Qualitative Assessment Record, which contains rich descriptive information reflecting different levels of student understanding and often includes specific examples of student thinking. Qualitative records may also include a place for teacher notes and comments on student performance. An example of the Qualitative Assessment Record is found in Table 2. Note that the cells contain qualitative descriptions (rather than quantitative) of student understanding. In our example, the cells contain information on students’ understandings of the concept of density and its supporting ideas as well as their ability to reason.

The Qualitative Assessment Record can be analyzed in the same ways as the quantitative record. This display can help teachers find trends by asking questions such as: How did the entire class perform on this assessment? What concepts appear to be difficult for many students? How did Student 002 perform on the entire assessment?

Summary of Class Performance by Question

Half of students still have difficulty with volume. One third of students don’t understand how to accurately calculate volume. One quarter of students understand how to discuss conclusions. Almost all students need more work on using evidence to support claims. Almost all students need more work on mass-volume relationship. Do more work on mass-volume relationship. See notes in other column. Lots of work to be done!

Hybrid Assessment Record

The third type of record is the Hybrid Assessment Record, which contains both qualitative (descriptors or information on student responses) and quantitative (numeric scores) information. Using the hybrid approach, teachers have flexible options when analyzing patterns and trends towards better understand student thinking.

An example of a Hybrid Assessment Record is found in Table 3 (page 2). This example is based on students’ responses to a juncture assessment for Earth’s Materials (Full Option Science System [FOSS], 2001).

The items were designed to assess students’ understanding of the test for the presence of a mineral (calcite). The teacher also wanted to reassess (and re-) confirm students’ understanding that rocks are made of ingredients called minerals and that minerals have properties by which they can be described. The teacher’s notes describe student learning for these areas.

Identifying Patterns and Trend

Once teachers have decided on the appropriate Assessment Record, they are ready to identify patterns and trends. We use Table 3 as an example in this process to show how the record can reveal trends in the population (whole class, individual students or entire class).

A Whole Lot Of Hot Air

A Whole Lot Of Hot Air

What’s The Big Idea?

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ASSOCIATION RECORDS, CONTINUED FROM PAGE 1

groups of students) and/or in content (item analysis, conceptually-clustered item analysis).

Whole-Class Analysis

The overall class performance can be analyzed quantitatively by calculating the frequency of items an
dressed completely, partially, or incorrectly. In Table 3, out of the 100 possible responses (20 students x 5 ques-
tions), 45 percent of student responses were complete (+) responses, while the other two types of responses
were less frequent, with 23 percent scored as partially correct (✓) and 12 percent as inaccurate/incomplete (–). To
pinpoint the specific concepts that students un
derstand, the data in Table 3 suggest that most students understand rocks are made of minerals, that one prop-
erty of mineral is hardness, and that the presence of bubbles indicates a mineral. However, students do not
understand the importance of the quantity of bubbles, or residue from evaporation as mineral indicators.
Is this analysis of whole class performance and overall trends sufficient? This question to this answer
depends on your purpose for the assessment. Whole class trend information can be a quick, formative check
of understanding. However, additional important infor-
mation can be gained from the record by zooming in
on particular students or groups of students.

Individual Student Analysis

A student’s summative score and notes with for
quality described provide an analysis of the stu-
dent’s understanding. For example, in Table 3, Student 001 answers all questions correctly, but Students 002
and 003 respond in different ways. The notes section
provides further insights into the student’s understand-
ing of the subject matter. For instance, Student 002
needs help with accuracy and completeness, while
Student 003 has a basic understanding of the concept
but requires more practice to fully grasp it.

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A Universal Call To Greatness

BY MELISSA SMITH

“B e not afraid of greatness, some are born great, some achieve greatness and some have greatness thrust upon them,” wrote Shakespeare. For a long time, I did not understand what he meant. How can the former (being afraid of greatness) have anything to do with the latter (being born into it, achieving it or being trust upon you)? If you were great by one means or the other, how could you fear it?

But I think I get it now…

MOVING ON — “The K-12 Alliance single-handedly molded me into the leader I am today,” said Melissa Smith.

Twelve years ago, I began an amazing journey with the K-12 Alliance. Imagine a second-grade teacher, sitting in the second row, arms folded, practically daring the presenters to tell me something worthwhile, and you have a very accurate vision of me on that first day. Prior to my first training session, a “friend” told me the K-12 Alliance ideas of teaching science education was misguided and ineffective. I was prepared for the worst.

Imagine my surprise, as I slowly realized how wrong my “friend” was about the K-12 Alliance. Dead wrong.

From that tenuous beginning, I have had many opportunities to work with the K-12 Alliance in varying degrees of leadership, serving as a lead teacher and staff developer. I have “volunteered” to present at many conferences than I can count. I have also been given the un- official title as “Conceptual Flow Queen.”

Working on numerous K-12 Alliance affiliated projects, I have seen first-hand the impact my involvement has had on my students, my personal teaching philosophy and my own leadership ability. It’s not an exaggeration to say that the K-12 Alliance single-handedly molded me into the leader I am today.

Recently, our district received a science CaMSP grant and I was asked to serve as the Program Director for the next three years. This means leaving the classroom and beginning a new, exciting journey in my career. Let me be the first to say, I am terrified! The expectation to be “great” is embedded deep in my heart. I want to be great for the program, for the K-12 Alliance and especially for the teachers and students who will be most affected by this grant. Many times, out of fear, I have considered passing the torch to someone with more experience!

But it is in those moments of fear when I start to understand that quote from Shakespeare. I think he is saying we can all become great by one method or another. If we choose to embrace the task, rather than being afraid of the real possibility of failure.

We all have the capacity for greatness. Each of us. So, I plan on doing my very best in this new endeavor to create a program that serves the needs of all who have enthusiasm for science education.

I have learned that greatness, no matter how it comes to you, is a state of mind. If you fear it, you can never achieve it, regardless of what position you hold.

Whatever place you may be on the leadership continuum, there is always room for one more person to become great. I ask you, will you be next?

Melissa Smith is finishing this school year as a middle school science teacher in Lake Elsinore and working as a project director for the grant part time. Starting in the fall, she will be a teacher on special assignment (TOSA) as a full time project director.

Differentiated Instruction – What Is It?

It’s the newest buzzword heard these days, but what exactly does “differentiated instruction” mean to you?

The K-12 Alliance Regional Directors have discussed it; many resources are writing about it and it seems there is a variety of ways to view this instructional method.

We want your input!

The following table includes five different examples of differentiated instruction. Which one matches your own definition? We want to know!

| Example A | All students in the same class. Teacher selects different levels of activities that match student proficiency or learning style. Different activities are assigned to different proficiency levels. |
| Example B | All students in the same class. Teacher provides a selection of different learning activities that match student proficiency levels or learning styles. All students complete all activities; the goal is that multiple experiences offer opportunities to achieve proficiency. |
| Example C | All students are assigned to the same class. The teacher diagnoses proficiency level through bennkmarks or other assessments. Teacher selects a small group of students for different or additional instruction. Students are grouped in three flexible groups according to need. |
| Example D | Students are in a “homeroom” class and receive additional support in pull out and/or after-school programs. The pull out teacher and/or after-school teacher collaborate with the “homeroom” teacher. |
| Example E | Students are in a “homeroom” class and receive additional support from a student study team. Students’ progress with other interventions is regularly monitored. Student study team services include special placement, as well as instruction for interventions, which may be used as additional support. |

Bases Loaded For MSP

Aiming to score a huge home run are new partnerships to the K-12 Alliance with the funding of three new California Math Science Partnership Grants (MSPs) in Cohort 5.

Funded by the California Department of Education, the MSPs seek to increase teacher content knowledge and pedagogical skills for mathematics grades 3-9 and science grades 3-8. The three new sites are: Chico Unified School District (science), Shasta County Office of Education (math), and Lake Elsinore Unified School District (science).

Partnerships must consist of a qualifying district (with other districts as appropriate) and an institute of higher education. Other partners may include agencies with the K-12 Alliance/WestEd.

Here’s an overview of each:

The Shasta County Math Partnership (SCMP) is a comprehensive professional development program targeting 60 math teachers from Enterprise and Redding school districts, several rural schools, Shasta College and the K-12 Alliance.

Chico Unified School District partners with several rural districts. CSU Chico and the K-12 Alliance in their Building Bridges MSP for 36 science teachers.

The Chico project brings together “old friends,” co-project director, Anne Stephens, was a member of CSIN. Kathy Jones and Michael Harris, who have been “ad hoc” K-12 Alliance members for many years, will now formalize their participation as part of Chico’s district science coaches.

Collaborating for Student Success in Science (CSS) unites Lake Elsinore USD, Temecula USD, Hilhcrest Academy, CSU San Bernardino and the K-12 Alliance in providing professional development for 50 science teachers. Over the years, Lake Elsinore has been involved in many K-12 Alliance programs including CSSN, SPAN and CAESL. However, this is their first MSP with the Alliance as a partner. Melissa Smith, an experienced K-12 Alliance Staff Developer and middle school teacher with Lake Elsinore, will serve as project director.

All three projects will use the effective Teaching-Learning Collaborative (TLC) to help teachers implement their learning in their classrooms.

The K-12 Alliance has been fortunate to be a partner with many MSPs, Montebello USD (math and science), Rialto USD (math and science), and Coachella USD (science) were funded as part of Cohort I.

Members of Cohort II include: Garvey ESD (science), Lodi USD (math and science), Tulare USD (science), and San Diego USD (science). Both Cohort I and II conclude their programs this year.

In Cohort III, the K-12 Alliance partnered with Marysville USD (science), Palm Springs (math) and Visalia USD (math and science). Just finishing their first year as the MSP program is Cohort IV, which include: Pasadenan USD (math), Lincoln USD (math) and Kelseyville (science). In addition, the K-12 Alliance also assisted Yreka (science), Wiseburn (science), Redwood City (science) and Ravenswood (math).
Hot Air ‘Rises?’

BY JODY SHERRIF WITH AL JANULAW

A t a recent Teaching Learning Collaborative (TLC), we had a deep conversation regarding the process of warm air rising and cool air sinking. One person suggested warm air rises because “air molecules spread apart and become less dense. They float up. Cold air sinks and pushes warm air up. Both are happening.”

Are molecules float? What does that mean scientifically? The more we discussed the concept, the more everyone became confused. We went to the Curriculum Topic Study resources and the internet, but we couldn’t come to an explanation that made the concept crystal clear for us.

We realized that without having a clear understanding of our concepts, we couldn’t teach the concept to students without creating misconceptions.

Finally, we contacted our wise, all knowing cadre, Al Janulaw from the Lake County CaMSP, who turned on the lights for us via e-mail. Here’s what we learned from him:

“Warm air rises” is like saying “basketballs rise.” Of course basketballs rise! But, not without a push from the hand of a person or the nose of a clever sea lion.

By saying, “warm air rises” creates the magical notion that warm air rises just because that’s its nature. The phrase “warm air rises” comes close to a four-element view of how things work. The four elements order themselves vertically with earth, water, air and fire, layered from bottom to top simply because that’s the way the universe is designed. (Or Defined within the Kreational world the four elements, earth, air, fire and water.)

Buoyancy and motion associated with buoyancy have to do with denser stuff displacing less dense stuff.

The less dense stuff is forced out of the way, and if it can’t go sideways, it goes up.

To say that a basketball rises and a person push it up at the same time leads to the slogan “basketball rises.” – unless it doesn’t make a lot of sense. Another example. The other day I was making a milk shake and some of the ice cream was stuck on the bottom of the blender. I turned off the blender and shook my hand in to free the chunk of ice cream. It melted and I placed so much milk that it ran over on the counter.

Do we conclude that because fists sink and milk rises at the same time we should say “milk rises” to help people understand how the world works?

Archimedes sat in a tub of water and the water rose. Do we need a slogan stating, “water rises”?

TV meteorologists say “heat rises” all the time. People “know” that lighter-than-air objects (i.e. balloons) go up because hot air (or helium) is “lighter” than the surrounding air. Never is it mentioned that denser stuff shows less dense stuff up.

Overall, these are useful slogans for predicting how things will behave, but they are inaccurate descriptions of how things work, which can lead to (false) misconceptions.

The spreading of air molecules as they are pushed up certainly makes the air less dense but the air wouldn’t go anywhere without being pushed.

The term “float” may also lead to magical thinking. A boat floats because it is, in sum, less dense than water. The water holds it up. If a submarine is under water and becomes less dense than the surrounding medium (by replacing water in ballast tanks with air), it is pushed up by the more dense water.

Submarines rise” and “submarines sink” depending on whether they are more or less dense than water. Would either submarine slogan help us understand density and buoyancy?

The less dense stuff a thing is, the easier it is to move it out of the way. Since it is the densest stuff there is relative to a vacuum, it will not rise, it will sink. Hot air rises only when it is displaced by a more dense fluid, which is usually cooler air.

So why bother with all this?

Well, the concern is not that people will not be able to predict what will happen with the weather or whether a hot air balloon will rise. The predictions are correct. The concern is that kids, and the resulting groups of teachers, will have unnecessary gap in their understanding of how things work.

I must emphasize “unnecessary” because we have plenty of actual gaps in our understanding of the Universe that deserve our attention more than something that is already understood but is phrased inappropriately.

Unnecessary misconceptions are denser than necessary misconceptions and displace the necessary ones in our heads, and thus waste our time.

Bottom line, warmer air is less dense than cooler air because the molecules are vibrating more vigorously thus pushing apart from each other and making the whole en masse less dense. There are also other contributing factors such as the pressure is greater deeper in a fluid.

So, there is always more pressure on the bottom of a boat than the top (assuming its right side up!).

We have even more air pressure on our feet than on our heads. Fortunately, we are so dense that this is insignificant, we can’t lift off like Peter Pan.

Lift off like Peter Pan? Hmm, if I could only get my molecules to vibrate more...no I think not, I would not fit into my clothes.

Many thanks to Al for helping us with our content understanding. This is just one example of how our cadres are there for us everyday so we can design quality science lessons free of unnecessary misconceptions for our students.

Al Janulaw is a retired secondary science teacher and university instructor as well as a past CSTA president. Jody Sherriff is the K-12 Alliance Regional Director for Northern California.

It’s Our Turn!

BY DORIS WATERS

Since the turn of the century (which is really not so long ago!), WestEd presents two awards annually to a deserving person or group within its cadre. One award is for Distinguished Contribution to the WestEd Community; the second is the Paul D. Hood Award for Dis
tinguished Contribution to the Field. Nominations are submitted by staff and voted on by a staff committee.

In 1997, Paul D. Hood was presented with the Paul D. Hood Award for Dis-tinguished Contribution to the Field. Nominations are submitted by staff and voted on by a staff committee.

Recipients are broadly acknowledged as leaders throughout their professional field.

Upon the recommendation of the committee, the current President and CEO of WestEd, Dr. Don Rumscheidt, announced that the K-12 Alliance had been selected as the 2007 recipient of the Paul D. Hood Award. We realized that after two decades of providing continuous and outstanding professional development to California teachers, we were being officially recognized for our efforts — and boy, was it exciting.

Just as the award applauds the accomplishments of our programs, projects and people, it also gives other WestEd staff and faculty members a chance to learn more about the work of the K-12 Alliance.

We are grateful for the award, pleased to be in the spotlight for this moment. But above all, with this recognition, we are now even more committed to continue our work, going forward with extra gusto, a bit more spring in our step and a little more pride in our vocations.

AWARD RECIPIENTS — This year the K-12 Alliance was honored with the Paul D. Hood Award for Distinguished Contribution to the Field. Team members recognized included from left to right: (back row) Karen Cerwin, Jo Topps, Kathryn Schulte, Gretta Smith; (middle row) Diane Carnahan, Judy Sheldone Sherriff, Cindy Anderson; (front row) Rita Starnes, Kathy DeRamus, Donna Waters. Not pictured: David Harris.

ASSESSMENT RECORDS, CONTINUED FROM PAGE 2

and 003 appear to have incomplete understandings of some of the concepts and answered at least one question inaccurately or incompletely. Student 020 appears to be struggling with all of the concepts assessed.

Consider questions such as: For what percentage of questions did Student X provide a complete (correct) answer? Which questions/tasks were Student X having the most trouble with? Did Student X appear to have consistent trouble with similar types of questions for a particular item in the learning sequence, etc.) and if so, why? Which questions/tasks were Student X able to complete accurately? Which questions/tasks were Student X missing? What is the evidence for this conclusion? As noted on page 2, the data for a specific student group can be analyzed to compare the whole class performance for each student to the whole class performance.

Specific Student Group

A student’s data for a specific student group can be analyzed and compared to the whole class performance. For example, analysis of student work from English-language learners revealed that for question 4 students were scoring either “a” or “b” but not a and b and that their responses did not include the principle of evaporation. An inference might be that the students are struggling with both the vocabulary and concept of evaporation.

Individual Items

A scan of the summary row indicates on which items the students are performing the best (or worst). In our example, most students scored well (+) on items #1 and #2 and scored poorly on item #4. By reviewing the qualitative descriptors for these items, the teacher has information on the content of student understanding.

Teachers can use information from specific items to reflect on factors that may have influenced student performance (e.g., evidence of a particular item in the learning sequence, etc.) and make informed decisions about how to use the data from the item.

Cluster of Conceptually Related Items

The items in this example can be clustered in two ways. 1) all four items indicate challenging concepts and the tests that can be used to determine whether a sample is a rock or a mineral; 2) items #3 and #4 are analyzed to determine if students understand the specific indicators for calcite (bubbles and residue). Analy-sis of both the qualitative and quantitative data for these items suggests that many students are performing at a medium to high level for the four items but at a lower level of understanding for the #3/4 concept cluster. Using the qualitative comments, the teacher recognizes that students are still struggling with understanding evaporation and residue as indicators.

In conclusion, learning to develop and use Assess-ment Records can represent a paradigm shift in think-ing about assessment — which can lead to new doors into analyzing patterns and trends. “Whole class analy-sis is a place where I really strengthened my practice,” says one academy teacher. “Before I would look at the individual student and not look at trends. Looking at trends helps me plan instruction. It’s great.”

In the next What’s the Big Idea? issue, we will ex-amine instructional interventions based on the pat-terns and trends noted in student work.

WHAT’S THE BIG IDEA?