

STUDENT PROGRESSIONS IN SCIENCE AND LANGUAGE DEVELOPMENT

Progress in Learning Science Content

The Integrating ELD (English Language Development) and Science program, a partnership between the Exploratorium and Sonoma Valley Unified School District (SVUSD), offers elementary students wide-ranging opportunities to interact with and make meaning of natural phenomenon through science inquiry. In turn, students' individual and collective investigations create rich and varied opportunities for using language. The kind of student-centered and student-generated learning produced by the Integrating ELD and Science program happens in deep and complex ways, but often "below the radar screen" of what can be detected through formal standardized student assessments.

As an alternate construct to achievement testing, the concept of **student progressions** provides a view into how children build their learning over time. The **student progressions** lens can illuminate specific critical dimensions of ELD and science learning, such as developing science content knowledge. The **student progressions** concept is presented here using teachers' reflections and survey responses,¹ as well as exemplars of two students' actual work, illuminating how SVUSD students at large made positive progress in their understandings about science content during an instructional year.

What Is the Partners in Innovation: Integrating ELD and Science program?

The goal of the Partners in Innovation: Integrating ELD and Science program was to enhance K-5 students' English Language Development and science learning. Over five years the program promoted the implementation of an integrated ELD and science instructional approach by providing concrete supports to teachers in four critical dimensions: curriculum, professional development, professional learning community, and district backing. With its focus on learning language in the context of hands-on science, the program aimed to establish a robust, districtwide elementary science program as well as to accelerate the language development of its English Language Learners.

What do teachers say about how the program contributed toward students' progress in learning science content?

- ✓ 96% of teachers surveyed said that the program contributed to **developing their students' positive attitudes** about learning science.

I see the students owning their own knowledge. What I mean is that they are writing about science with enthusiasm. The kids who don't like to write do write about science, and they draw diagrams, and label their diagrams. They come up with amazing ideas for things to try out to see if they will work or not. I think of a particular student, Jason Martinez,² who always hated writing. He is writing now because he can't help it. He wants to get it down so that other people can see what he has been doing. That is magical! So I see this program involving students who have been struggling to learn math and reading, and all of a sudden they

¹ For the first four years of the Integrating ELD and Science program, Inverness Research and the Research Group at the Lawrence Hall of Science, UC Berkeley, administered a teacher survey to participating teachers. The data cited here is from the 2014 teacher survey results, the final of the four annual surveys.

² Although the names of the students and teachers are fictitious to maintain anonymity, the actual activities, student work, and teacher comments are drawn exactly from the documentation generated by the examination of focal student work intended to illuminate the nature of student progressions.

are actually doing things for real, in the real world, and being able to write about them. Wow, the day just went so fast. Why is that? “Can we do science again?” is the kids’ response. I have a guitar class and one of the kids—I am only bringing this incident up because it is not unusual—the student wrote a song about how they love science.³

- ✓ 91% of teachers reported that the program **allowed students to use their prior knowledge to make connections** between the science ideas they were encountering in class and their own experiences.

The Integrating ELD and Science program gives students not only science, but experience with real-life connections—firsthand experiences with snails, worms, sinking and floating, potatoes, liquids—all of those things that are everyday, real-life things in the classroom. Yet it is science. It is also building a capacity for the awareness that science is all around and that inquiry is all around us as well. The benefits (of the program) to students were huge, because they (topics) are all real-life things that they could connect between the classroom and their own life. Shadows might be something that we learned inside the classroom, but they all could take that learning and transfer it to home, to family, to a camping trip, or whatever. It made the science and real-life connection huge.

- ✓ 97% of teachers indicated the program made great contributions to **students’ abilities to be able to talk about science**, thereby supporting them in developing **science terms and vocabulary**.

I found that the Science Talks were a great way to open students up to new language. The units had many opportunities that allowed students to converse in whole group, small group, and in partners, so they quickly picked up the appropriate academic language as it was enforced through communication. Students who were usually too nervous to talk were very confident during Science Talks. Because there were no wrong answers, merely opinions and data interpretations, students felt completely comfortable sharing and responding to one another.

- ✓ 89% of teachers reported that the program contributed to **student growth in science content learning**, in acquiring knowledge about basic science concepts, e.g., life cycles or buoyancy.

My class recently did some practice for the upcoming state science test that 5th graders take. Many of the release questions dealt with the human body. It was a delight to see so many students feeling confident with the material. There was even a test question that was constructed in a way that brought back memories of one of the first activities we did in the Human Body Systems kit, where my students had taken all of the parts of the digestive system and placed them on the body outlines according to the order in which they thought we digested food. The students did this as a kind of pre-test—they remembered how wrong they had been, like putting the stomach at the end or like mixing up the intestines. But when it came to the test question many months later, they knew the order of the digestive system without a doubt!

What are representatives of student progressions in learning science content?

Diana Learns about Dissolving

Diana is a conscientious 5th grade student who has participated in a support program for English Language Arts the last two years. Her teacher notes: *She is dedicated to her studies even though she is pulled out of class for many occasions and even though her parents often bring her to school late.* At the beginning of the unit on dissolving, the teacher asked students to list **things that disappear**. Diana generated a very long, but seemingly unrelated list that included things like orange peels, salt, water, soap, hand sanitizer, sugar, bananas, rain, flies, garbage, cotton candy, trees, pencil lead, meat, baking soda, oil, pee, ghost, wood, fog, time, teeth, etc.

³ Quotes are taken directly from interview transcripts and edited for both grammatical correctness and readability. The integrity of the quotes has been maintained; intent and meaning have not been altered.

After reviewing the list, the teacher asked students to respond to the following prompt in the science journal—*Questions about Dissolving*. Diana had just two questions, shown at the right.

Following on these initial activities that showed the teacher the beginning levels of Diana's knowledge about the concept of dissolving, the class engaged in a month-long set of investigations. Using materials such as salt, sugar candy, water, and oil they learned firsthand what dissolving is and how it functions. At the end of the unit the teacher gave the class a culminating writing assignment, asking them to describe what they had learned about dissolving. The following are excerpts from Diana's writing:

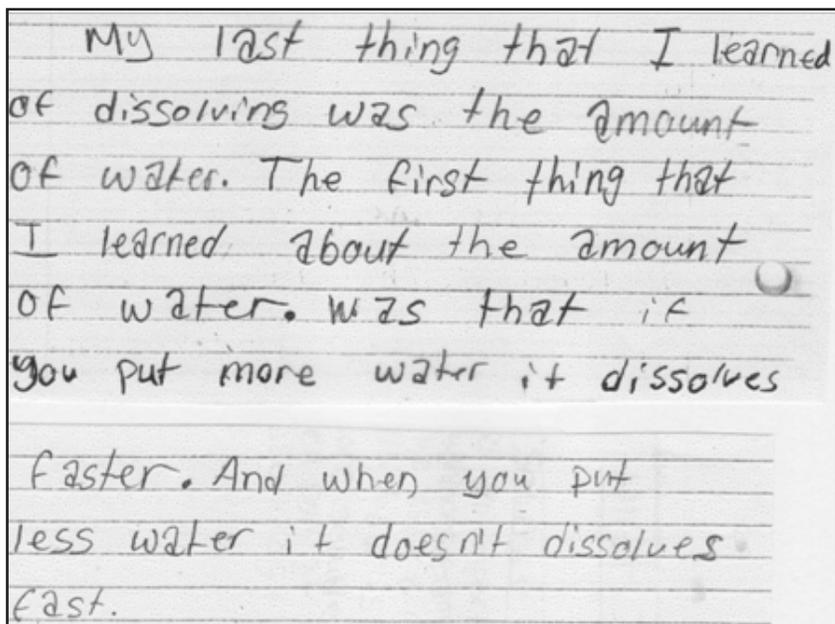
"Questions about Dissolving"
Why almost food could dissolved?
What happens if we mix a lot of salt with a lot of water.

What I know about dissolving
I am going to tell you about what I learned of this units of dissolving.
There's 3 things that I learned were movement, temperature, amount of water
For those experiments we use life savers or if you want to do this experiment at your house you could use different solids. It doesn't need to be life savers. And you don't need to use water you could use Canada dry soda, ~~serie~~, oil.

Another thing that I learned about movement is that the faster you move it the faster it dissolves.
Temperature another thing that I learned in this unit of dissolving is the temperature. That the temperature it effect the rate of dissolving. And that hot water dissolve much faster then cold water.

Just a few weeks later, Diana's first sketchy notions about dissolving have developed into a coherent and logical set of assertions, an organized essay that describes key understandings about the nature of dissolving where she comfortably uses extensive science vocabulary and terms. Words such as *movement*, *temperature*, *amount*, *experiments*, *effect*, and *rate* are all used meaningfully. Reflecting on Diana's learning progression in science content her teacher notes:

I think that when children, and people in general, are comfortable with science content they practice talking, and then the fluency comes more naturally... so the fluency and the grammatical structure are natural consequences of feeling comfortable with the content.



My last thing that I learned of dissolving was the amount of water. The first thing that I learned about the amount of water was that if you put more water it dissolves faster. And when you put less water it doesn't dissolve fast.

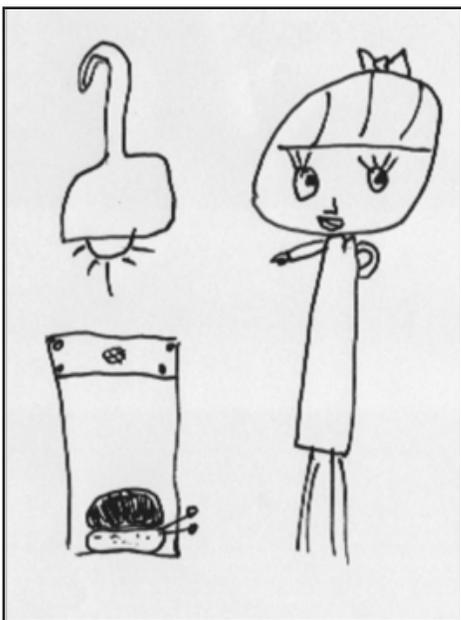
Yolanda Learns to Focus on Science Phenomena

A third grade teacher reflected on the science content learning progression he saw represented in the science journal of one of his most challenged ELD students, Yolanda. Studying both her writing and drawing, he wrote:

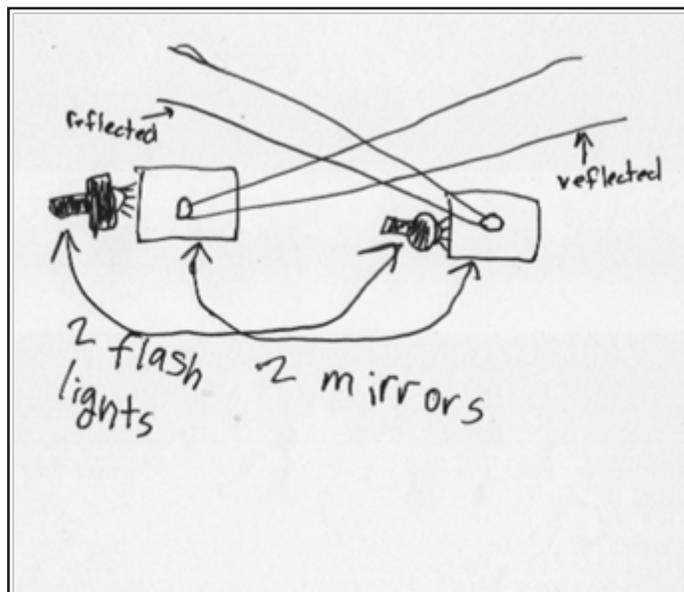
She shows movement from pure observations into more internalized knowledge. But she starts off in her early writing talking about "We observed, we observed, we observed," and then she grows into writing "I know" by April. Now, a few months later, her language tells me she is internalizing what we are doing in science and that she has a stronger, more personal connection.

Yolanda's scientific drawings also reveal progress over the school year in learning science content:

Fall 2014



Spring 2015



Her teacher comments:

Over time, her drawing shifts and it moves more into a scientific sort of drawing where there is less focus on the people and more focus on the actual phenomenon that was happening.

Early in the year during the Snails unit, Yolanda focused on depicting herself in detail—with a bow in her hair, bangs, eyelashes, and pointing her hand at the snail. Later in the school year her drawing is no longer self-centered, but science content-centered. It accurately depicts the parts of the light system, the actual science phenomena that was the topic of class study. The drawing includes labels as well as arrows showing cause and effect relationships, and readily reveals the science content she had learned.

How do teachers explain why the program contributes to student progressions in learning science content?

- ✓ Students have **more opportunities to learn science**.

Assessing the extent to which lack of time for science learning was a barrier before the Integrating ELD and Science program began, 70% of teachers responded “1,” “2,” or “3” on a scale of 1 to 5, with “1” being “almost impossible” to teach and “5” being “no barrier” to teaching. Four years later, in the 4th year of the program, responding to the question of whether or not lack of time was a barrier to science learning, 71% responded “4” or “5.”

Teachers also noted that time for science learning was a function of district priorities. The effect of limited district support for science was rated “1,” “2,” or “3” on a scale of 1 to 5, with “1” being “almost impossible” to teach and “5” being “no barrier” to teaching, by 76% of teachers before the program. Afterwards, by the fourth year of implementation of the program, 97% of teachers rated this a “4” or “5.”

- ✓ Students **learn science through firsthand, interactive investigations**.

Assessing the extent to which lack of hands-on materials for science learning was a barrier before the Integrating ELD and Science program began, 68% of teachers responded with a “1,” “2,” or “3” rating on a scale of 1 to 5, with “1” being “almost impossible” to teach and “5” being “no barrier” to teaching. Four years later, in the 4th year of the program, 100% responded to the same question with a “4” or “5.”

- ✓ Students have **more time to talk about science through the Science Talks** that are an integral part of each unit.

In response to the question of how much talking about science contributed to students’ growth in understanding English language and science, 96% of teachers responded “4” or “5” on a scale of 1 to 5, with “1” being “not at all” and “5” being “to a great extent”.

- ✓ Students have **more time to write about science through their Science Journals** and other activities.

To whether or not participation in the program contributed to their students’ growth in increasing writing competency in English, 88% of teachers responded with a “3,” “4,” or “5” on a scale of 1 to 5, with “1” being “not at all” and “5” being “to a great extent”.

As the Integrating ELD and Science program evolved it became increasingly apparent to teachers, administrators, and project leaders—those who had opportunities to directly observe and interact with students—how much science SVUSD students were learning. The student work demonstrated in Diana’s and Yolanda’s samples represents just two of the many unique and rich instances where progressions in SVUSD students’ science content learning were revealed through children’s actions, talking, questioning, drawing, and writing.

A 2nd-3rd grade teacher describes how she knows her students have progressed in learning the science content they studied through the Integrating ELD and Science program:

As a second and third grade teacher I am lucky because my 2nd graders last year are now my 3rd graders this year. These 3rd graders did the Ladybugs 2nd grade unit with me last year, and I got to see what effect that had when we went to our school garden the other day with our school garden coordinator. The students were looking for ladybugs. I heard them able to recall the life cycle of a ladybug and to talk with one another about it. They used words like “larva” and “aphids” as we discovered aphids on the plants ... they had such content-rich background knowledge they brought to the garden experience, rather than just going to look at ladybugs. They brought all of the scientific knowledge they received last year.

Partners in Innovation: Integrating ELD and Science
Exploratorium/Sonoma Valley Unified School District

Project Portfolio

INTRODUCTION AND OVERVIEW
The Innovation and Its Contributions

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WHAT ARE THE CONTRIBUTIONS TO TEACHERS?

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STUDENT PROGRESSIONS IN SCIENCE AND LANGUAGE DEVELOPMENT:

An Introduction and Rationale

Progress in Developing Positive Attitudes and Confidence

→ **Progress in Learning Science Content** ←

Progress in Developing Science Practices and Thinking Skills

Progress in Developing Language Fluency and Complexity

Inverness Research, a national education evaluation and consulting group headquartered in Northern California, has over 25 years of experience studying local, state, and national investments in the improvement of education.

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