

STUDENT PROGRESSIONS IN SCIENCE AND LANGUAGE DEVELOPMENT

Progress in Developing Positive Attitudes and Confidence

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 of how children build their knowledge over time. The *student progressions* lens can illuminate specific critical dimensions of ELD and science learning, such as developing thinking skills or science content knowledge, as well as affective aspects of learning that are critical precursors to students' academic success. The *student progressions* concept is presented here to show how SVUSD students-at-large made positive, and often dramatic, progress in developing confidence and positive attitudes about their learning. The data is gleaned from a range of sources: classroom observations conducted by researchers from both Inverness Research and the Research Group at the Lawrence Hall of Science, teachers' survey responses, teacher reflections from interviews and written testimonies, as well as exemplars of student oral and written thinking.

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 kind of classrooms help students develop positive attitudes and confidence?

Magnets Attract!

In Ms. Diamond's¹ 2nd grade classroom children are huddled around tables that have been pushed together into make-shift science lab benches. Paper plates filled with various materials are lined up in front of students whose faces are all focused on some phenomenon occurring in the center of this hub.

¹ Although the name of the teacher is fictitious to maintain anonymity, this classroom vignette is based on one of the actual observations conducted over the duration of the Integrating ELD and Science program.

All that can be seen are students' backs and shoulders, but they are talking avidly. For the most part their voices remain at a regular volume, but once in a while there is a voice that raises to a squeal or yelp... "Wow!" ... "Look!!" "No, no... let's try *this!*"

The teacher is also involved, hunched over one of the groups. She is asking questions, probing... *What did you say about this earlier? What do you think now? Do you have other ideas that might make the magnet change in a different way? Tell me what you think...* Then she moves on to the next group, observing what students are doing, asking more questions, jotting down notes.

A scan across the classroom reveals that there is not one pupil who isn't engaged in some way with the hands-on materials. No one is sitting back. Science notebooks are open, students are carefully observing and studying how magnets work, and then writing or drawing diagrams, documenting what they see and think. At the same time, LOTS of talk continues happening—all focused on testing magnets, which seem to the students to behave in almost magical ways. These students are doing science, using language, and simply having a great time at it!

This vignette represents a typical day in a 2nd grade classroom participating in the Integrating ELD and Science program in the Sonoma Valley Unified School District. Students are learning science through a guided inquiry approach. They are encouraged to use oral and written language spurred by carefully designed pedagogical scaffolds such as guided questions, sentence frames, or thinking maps—all structured to produce thinking and "language-ing" in open, non-judgmental ways.



The teacher explains: *We have a multilingual setting here at our school, not just bilingual, and in general we're finding that all the kids love science. The children don't realize they are getting rich science content in this program. They are getting a chance to play with magnets and do experiments that involve variables they can control. So it's real science and they are enjoying it... As an example, after our first Science Talk on magnets, a little boy from Turkey raised his hand and said, "These Science Talks make me feel so smart."*²

Ms. Diamond has been involved in the Integrating ELD and Science program since its inception. She is dedicated to this integrated approach to teaching science and language and her enthusiasm spills over to her students. Their enthusiasm transforms into more than just excitement, however—it transforms into pride in the knowledge they are generating for themselves, and most importantly into a generalized positive attitude toward learning and a confidence in their ability to succeed in school.

Why is a positive attitude toward learning important?

Teachers frequently lament that bright, but low-achieving students lack motivation. Such students are "unengaged" in school, their attitude presenting a major roadblock to learning and academic

² 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.

rewards. What may be problematic for English-fluent students is confounded for English Language Learners (ELLs) who are just learning to understand (and later speak) a new, second language, as well as to negotiate (and later master) a new, second culture. It is not uncommon to observe ELL students sitting mutely in class, relying on others to respond to questions, speaking rarely and writing minimally.

Experts in second language acquisition talk about an “affective filter,” e.g., anxiety, embarrassment, fear of failure, that influences how and when a second language develops, especially expressive language (speaking and writing). Holding back because they feel uncertain of the environment in which they find themselves is a natural response for English Language Learners, not because of a lackluster attitude toward school. Good teachers recognize that ELL students’ silence and their reluctance to participate in class are not because they are without interest in learning, but rather because these behaviors are indicators of the necessary and predictable first stage of second language learning when students are absorbing and processing new information. Teachers also know that participation (for all students) is the key to active learning, that positive attitudes and confidence are foundational to learning.

With the goal of supporting second language learners in lowering their “affective filters” and passing through the “silent period” as quickly as possible, teachers seek to create classroom environments that serve as strong antidotes to lack of engagement. They aim to achieve classrooms that are safe, kind, egalitarian, and interesting, where all children, including ELLs, can question and contemplate, share and discuss their ideas with one another, and readjust and refine their thinking—in other words, classrooms where children want to learn.

The Integrating ELD and Science program offers teachers a near perfect mechanism for achieving these pedagogical goals, as illustrated in Ms. Diamond’s classroom. In fact one of the greatest achievements of the program has been to stimulate students’ very rapid progress in developing positive attitudes and confidence, important precursors for active learning.

What do school principals have to say about how the program contributed to students’ progress in developing positive attitudes and confidence?

Even in the first year (Fall 2011) of full implementation of the Integrating ELD and Science program, five of six principals interviewed reported that teachers at their schools were very enthusiastic about teaching science because of the very positive reactions of their students. The principals who had visited classrooms to observe integrated ELD and science teaching corroborated their teachers’ reports: “Kids love the lessons. They are 100% engaged.”

The principal from one of the larger elementary schools in the district explained how the program aided ELL students’ positive self images around science learning and “leveled the playing field” for them.

... I have always felt that hands-on science was, first of all, the only way to teach kids science, and that it is a great equalizer. The students for whom English is their second language are really equal in something like hands-on science to the students who are fluent. It’s a wonderful way to help kids participate and engage, and learn vocabulary, and of course to really learn about science. As you know, that’s super important ... we want to open up science for all children.

What do teachers have to say about how the program contributed to students' progress in developing positive attitudes and confidence?

- ✓ *96% of teachers surveyed said the program contributed to developing students' positive attitudes about **learning science**, e.g., excitement, motivation, etc.*
- ✓ *78% of teachers surveyed said the program contributed to developing students' positive attitude about **learning English as a second language**, e.g., greater attention, eagerness, willingness to participate in activities.*

Their comments explain their high ratings:

- *Activities that are context-embedded and high-interest activities are getting my students excited about class. They have more comments to contribute.*
- *Interest was high in the Integrating ELD and Science program. Students learn better with hands-on experiences, time to talk, listen, model, and have experiences. Children love science, exploration, and experimentation ...*
- *Engagement is the key ... students love to learn if they are active in their learning.*
- *It has given them the confidence that they can learn about science and understand it.*
- *I love our Integration of ELD and Science program. Every single student benefits. Their enthusiasm and zest for science exploration transcends and supports language development. So powerful.*
- *They are excited about science and like talking about it. They don't see it as "work".*
- *Working and observing with each other and the materials was engaging and of high interest for the children.*
- *Having physical control of materials and their manipulation gives students a boost in their own abilities to manage real things in their world, and in their ownership of science.*
- *... all of a sudden they develop a personal conviction. It's not that somebody is telling them something anymore—they have actually had the experience and they have shared it with somebody.*
- *Kids have a natural curiosity, a desire to socially connect, and an inclination to seek out fun, engaging activities. The trick with teaching is to lasso all three of these things together into learning experiences that are open-ended enough to allow real discovery and conversation. In 16 years of teaching I have not seen a more successful way to accomplish this than through our integration of Science and ELD.*

Excerpt from an interview with a 3rd year teacher

INTERVIEWER: You just told me that you had been nervous about conducting a Science Talk with your 2nd and 3rd graders, but that you were surprised by what ended up happening. They talked enthusiastically for 45 minutes! Why do you think that happened for your students? You mentioned that even some of your students who had never participated before spoke up easily... Why?

TEACHER: I think a lot of it goes back to the hands-on experiences. As a teacher, one of the most important lessons I've learned this year is the value and importance of hands-on learning, as well as the value and importance of shared experiences in the classroom. In the past, I might have done special projects or held special discussions with just one group of students, and in those cases not everyone in the class had the same experience. But with this Integrating ELD and Science program, including all the investigations and science talks and journal writing that we all do together, everyone is on a level playing field. No matter what their socio-economic background, no matter what their outside experiences have been, we are all learning the same material together. That's been huge, that's been amazing for me.

INTERVIEWER: Keep going. Back to what you were saying about the Science Talks?

TEACHER: Yes, sure ... there's a kind of positive feedback cycle happening. I think talking for 45 minutes in a Science Talk was a contributing factor. The kids were excited about the material initially, but then the questions that were in the curriculum to guide the conversation or to expand on it did just that, sparking new conversations about the topic. So it's a circle of investigation, discussion, more questions and ideas. I wish I had an example.

INTERVIEWER: Can you think of one?

TEACHER: ... we were just wrapping up Snails. Toward the end, the program guide always asks the students "What else do you want to know and what do we want to learn more about?" At the beginning of the unit, kids asked pretty simple questions, like, "Why are snails slimy?" But at the end of the unit, the questions were based in the children's experience. They had questions like, "Why do snails get slimy when we are peeling them off of the sand paper?" The conversation and questions grew to be so much more based on what they were doing with the investigations.

I really think that it all goes back to those shared experiences, those investigations and those hands-on experiences, and working in groups. They also had their journals ... they were a great reference, a great resource for them, when they were talking and when they were recording information. They would reference back to it whether they were doing a science talk in a small group or whether they were writing, so they had those at their disposal.

It was very much student time, with me just facilitating and giving some explanations for how to proceed, but it was very much them carrying out the investigation ... I just gave them ownership.

INTERVIEWER: I hear you talking about some psychological aspects of learning. I think you are talking about what happens when kids take responsibility, having the confidence to author their own experience.

What is an example of a student progression in developing positive attitudes and confidence about learning?

Alfonso Gains Confidence in Learning Science and Language

Alfonso is a 5th grade ELD student who comes from a family that values education and school involvement. He loves sports and is regarded highly by his peers as an excellent athlete. In class Alfonso is a good student in mathematics, so he is quick to demonstrate his data-organizing skills in the charts and tables he can readily produce, but writing is a major challenge for him. He lacks confidence in verbalizing answers or sharing his thinking during Science Talks that are an integral part of the Integrating ELD and Science program. Unless he is encouraged to speak he most often defers to either his partner or others in his group.

Alfonso's teacher, Ms. Faulkner, decided that pairing Alfonso with a particular type of student, a GATE student with many world experiences, would give him more opportunity to become more engaged and to share his ideas orally, thus gaining the confidence he needed to participate more fully in class.

I just felt that if we had a range of ideas pooled together, cumulatively they had had so many life experiences that the examples might be richer if they could share with one another. It might draw Alfonso out and raise his confidence in his ability to speak about his science ideas.

During the beginning 5th grade unit on dissolving, Alfonso's teacher presented this focus question: *What are some examples of things that you know about that disappear?* She recorded what happened in Alfonso's conversation with his new partner.

Student Partner Science Talk Exchange:

What are some examples of things that you know about that disappear?

Partner: Some things can disappear like banana peels.

Alfonso: Or like fog dissolves in the air

Partner: Or the water evaporation. If water or a popsicle melts, it can evaporate.

Alfonso: Or like cliffs. It has lots of pressure from the water on it and it goes into the water.

Teacher: Do you mean into the ocean?

Alfonso: Yes, the pressure from the water makes it go away. Animals disappear... people hunt them.

Partner: Maybe when you put sand in water or pepper in water it can break down.

Alfonso: Trees disappear ... plants ... maybe even houses. People can destroy them.

Partner: Maybe even trash disappears.

Teacher: What does dissolve mean?

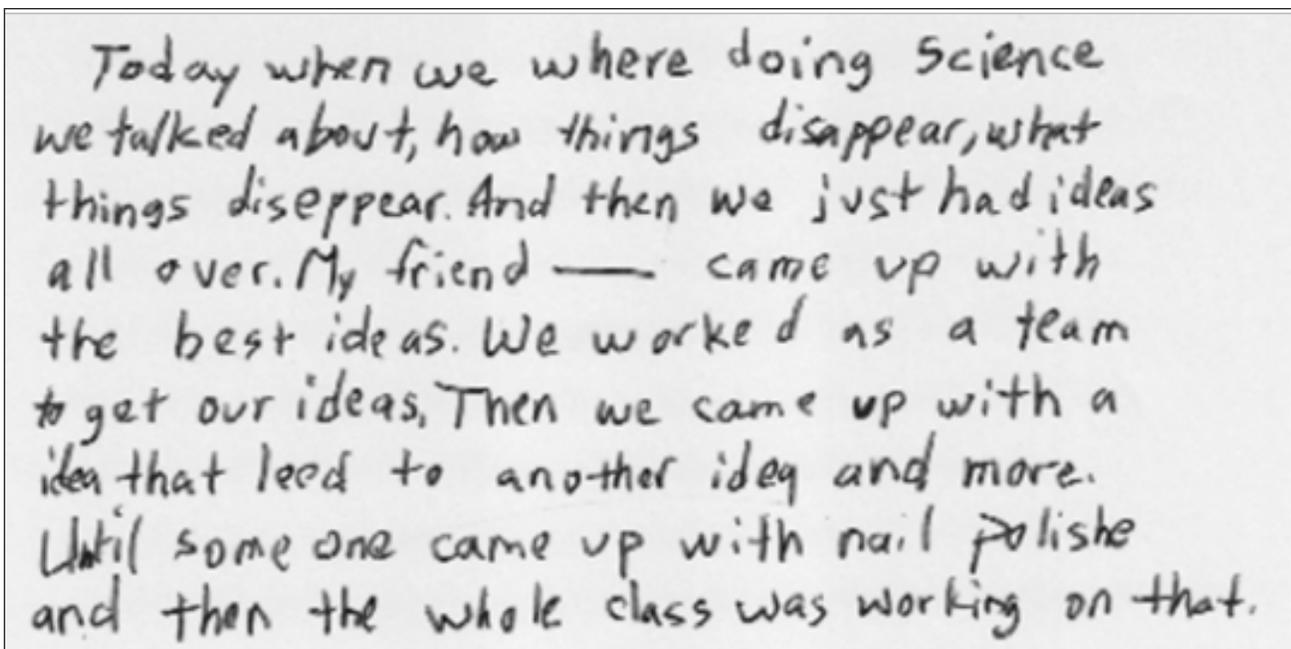
Alfonso: Like break down ...

Partner: Yeah.

Alfonso: The particles are still in there but they're breaking down.

For the very first time, during this partner exchange, Alfonso jumped in and grabbed the idea baton. *I see that in the conversation, the student that I paired Alfonso with was leading the brainstorm Science Talk with examples of things that disappear. But there was a shift where Alfonso began to offer more information, and his partner started to listen more, and things turned around. His partner was the one who began adding to Alfonso's original thoughts, instead of vice versa.*

This “shift in leadership,” as the teacher described it, shows a boost in Alfonso’s confidence, enough of a boost for him to share his thoughts more assertively. According to Ms. Faulkner, his new-found voice carried over to participation in the whole group Science Talk. She noted: *Alfonso was clearly more confident offering his ideas about things that disappear. When it came to write his reflection in his journal, Alfonso wrote more than usual.* But, as the teacher noted, he still attributed the best ideas to his partner. Alfonso’s writing shows his gains in confidence are in progress. It also shows that he understands that sharing ideas is a group effort!



Today when we where doing science we talked about, how things disappear, what things disappear. And then we just had ideas all over. My friend — came up with the best ideas. We worked as a team to get our ideas. Then we came up with a idea that lead to another idey and more. Until some one came up with nail polische and then the whole class was working on that.

“Let give them science to talk about!”

Although the Integrating ELD and Science program aimed to create student interest, what erupted was beyond the greatest expectations of everyone—program leaders, administrators, and teachers. “Let’s give them science to talk about!” was the slogan that spontaneously emerged from what teachers observed happening in their classrooms as they taught their first Integrating ELD and Science units. The enthusiasm and engagement of the vast majority of their students, many of whom had been shy, retiring, and reticent in class before, took them by welcome surprise. In turn, with such a positive affective response from their students, teachers were motivated to continue teaching the program. It is fair to say that the students’ interest and gusto for the program accelerated the implementation effort.

The intriguing hands-on materials, the interactive processes, and the emphasis on inquiry, meaning-making, and constructing knowledge created the kinds of classroom environments and student experiences where all students, but especially second-language students, felt equal and respected. With their “affective filters” lowered by the excited activity and the effusion of communication the program

offered, ELL students leap-frogged into science and language learning. They gained confidence in doing science—raising their own voices in a second language to share their thinking, and seeing themselves as competent and successful learners.

An elementary teacher who participated in the Integrating ELD and Science program from its inception said:

We see tremendous growth in our English Language Learners. They feel safe to try out their ideas through the manipulation of objects, and then speak them aloud. They borrow ideas from each other, self-correct, and prompt each other with academic vocabulary. Once the teaching focus is taken off the formal language instruction and onto exploration, kids jump into the language, sharing their ideas and getting better at expressing through daily practice. As a result, we have kids who are practicing and talking science every day... not only at school, but at home with their parents and friends. If this is not success, then I don't know what is.

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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