

INTRODUCTION AND OVERVIEW

The Innovation and Its Contributions

- ✓ **How can limited English proficient students learn science?**
- ✓ **How can learning science help limited English proficient students develop their language fluency?**
- ✓ **How can elementary teachers support students in learning science and developing their language fluency?**
- ✓ **How can professional development support teachers in enhancing science and language instruction?**

These were the core questions that drove the Integrating English Language Development (ELD) and Science program, a partnership between the Exploratorium and Sonoma Valley Unified School District (SVUSD), to seek answers through innovation.

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 were the problems the Integrating ELD and Science program aimed to resolve?

It is well understood that students whose primary language is not English frequently do not perform as well academically as those proficient in English. In districts all over the country—represented here by SVUSD, where almost two thirds of students were classified as English Language Learners (ELLs)—the gap between proficient and limited English speakers is especially pronounced in the sciences. Rich opportunities to experience science that can generate interest, confidence, and motivation to pursue learning more science are often denied second language learners, effectively blocking one of the major pathways to their academic progress beyond the elementary grades.

Exacerbating the problem of providing K-5 students in general, and ELLs in particular, with high-quality instruction in science are dilemmas indigenous to elementary schools:

- limited amount of instructional time devoted to science
- unintended consequences of No Child Left Behind legislation that focuses instruction exclusively on language arts and math
- accountability pressures on schools and teachers

- unexamined assumptions about what ELLs can understand and do conceptually
- and, most typically, elementary teachers' unfamiliarity with science and teaching science.

What was the purpose of the program?

The Integrating ELD and Science program offered elementary students wide-ranging opportunities to interact with and make meaning of natural phenomena through science inquiry. The program had two major educational purposes:

- 1) to teach science content, practices, and thinking skills to students, and
- 2) to simultaneously stimulate, accelerate, and expand their language development.

Funded by the U.S. Department of Education through the Investing in Innovation Fund (i3) intended to create projects that seek to provide innovative solutions to common education challenges, the Integrating ELD and Science program took a synergistic approach to the historically persistent and intractable problem of “closing the achievement gap” of limited English proficient students.

What was the innovation, and what were the key design features?

The Integrating ELD and Science program, with its approach to resolving key questions of how best to boost ELD students' academic progress, was multi-leveled. It consisted of the following key design features:

- A **unique partnership** between a school district and a science museum in which strong instructional leadership and science expertise joined forces.
- Solid **support from the district** for the program, which gave teachers both permission and encouragement to expand their instructional repertoire.
- A **central pedagogical approach**, integrating English language development and science instruction.
- Emphasis on **hands-on, inquiry-based science**, grounded in the science practices advocated by the Next Generation Science Standards (NGSS), that gives rise to both language and conceptual development in students.
- **Curriculum units** integrating ELD and science, developed by the Exploratorium, that gave teachers access to the new instructional approach.
- **Ready to use kits and materials** keyed to the curriculum units that were distributed to teachers.
- **Professional development** events and activities focused on understanding second language acquisition and development, inquiry science, and the grade level curricula.
- A **professional learning community** that emerged over the years of the program implementation, furthering the innovation effort.

What was the integrated ELD and science approach?

The integrated approach combined firsthand science inquiries into inherently interesting, real-world phenomena with language practice that occurred in authentic interactions as students pursued their questions and started making meaning of their experiences. Underlying the integrated approach the program presented to SVUSD teachers was the premise that making sense of the natural world both motivates students to share their thoughts and generates multiple opportunities for students to hear as well as use science ideas and practices, and to hear and use language in context. The result is students learning science and language synergistically. Thus the two essential pieces of the integration were science, taught with a hands-on inquiry-based approach, and language development, viewed as a social process between learners and speakers of the language with emphasis on comprehending and expressing thinking and meaning rather than on flawless form.

What was the theory of action?

Best represented in the diagram that follows, the theory of action of the Integrating ELD and Science program followed a straightforward, logical flow.



How are the findings of the Integrating ELD and Science program portrayed by the qualitative evaluation?

In the first two years of the project, the qualitative evaluation and research team at Inverness Research provided formative feedback to the program leaders. As the project matured, we at Inverness Research focused on understanding and illuminating for others the range of benefits that the program produced at multiple levels of the system.

We relied on standard qualitative data-gathering mechanisms such as attendance at and observation of leadership team meetings and professional development events, interviews with a range of participants, classroom observations, annual teacher surveys, and analyses of students' CST (California Science Test)

scores and other Exploratorium and district data. In addition we convened a group of six experienced teachers to serve as Teacher Partners in Research (TPIRs) to document, analyze, and discuss sample student work gleaned over the course of an academic year. The purpose of the extended dialogue among TPIRs and researchers was to understand as fully as possible, from a very close-up view, the kinds of benefits to students the Integrating ELD and Science program effected in SVUSD classrooms.

Data and insights from these various sources inform a series of deliberately brief and informal reports aimed at general audiences. They are compiled into an Integrating ELD and Science program Project Portfolio. The Project Portfolio is available both through the Inverness Research website and the Exploratorium website: exploratorium.edu/ifi/inquiry-and-eld/educators-guide/project-studies.

Several principles defined our stance toward developing these modular reports. We focused on best cases and successes in order to show both the feasibility and the potential of the innovative approach developed by the Integrating ELD and Science program. We relied on classic qualitative research tools, such as observations and interviews, to provide not only information and evidence for the findings, but also illustration and color. We also adhered to the principle posed by William Blake, that it is possible “To see a world in a grain of sand ...” We often and deliberately relied on a single individual—either teacher or student story or portrait—to illustrate what we had learned was true for many.

This first report, “Introduction and Overview—The Innovation and Its Contributions,” starts the reader with a summary description of the Integrating ELD and Science program and provides a synopsis of the program’s major achievements. Additional reports follow that are modular in design and need not be read in the order they are presented. One focuses on the benefits of participation in the program for teachers. Others are organized as a set that introduce the notion of *student progressions* as an alternative to student assessment via standardized test measurements. This set of reports examines student learning progressions in key areas such as learning science content or developing language fluency and complexity. A chart listing each of these reports appears on the last page of this report.

What were the major contributions of the Integrating ELD and Science program to the [district](#)?

Based on administrator and teacher interviews, teacher survey data, and records of science kit distribution maintained by both the district and the Exploratorium, the Integrating ELD and Science program contributed to the growth of capacity of the district in the following ways:

- ✓ Almost 100% of SVUSD teachers participated in the professional development offered by the Exploratorium. Because the teaching staff is fairly stable in the district, **a pool of teachers knowledgeable about integrating ELD and science instruction** remained in place.
- ✓ Almost 100% of SVUSD’s classroom teachers provided integrated ELD and science instruction to their students, teaching at least 2 of the units they were provided each year. As a result, **students in the district as a whole received instruction in science**, a subject matter that few knew before the district-wide program was initiated.
- ✓ The program designated a **Program Coordinator** who served in that position for all five years of the grant, acquiring knowledge, experience, and practical know-how along the way, thereby

developing **ever-increasing capacity for implementation and leadership of the program.**

- ✓ **A leadership cadre** consisting of administrators, teachers, funders, and museum personnel emerged as the program progressed. At the conclusion of the i3 grant it still stands as a group willing and able **to advocate for and promote** a district-wide integrated ELD and science approach. This group has the potential to sustain the innovation.
- ✓ At the conclusion of the i3 grant, **SVUSD has a comprehensive ELD and science program in place**, one that includes all the necessary (but alone not sufficient) components including curriculum, materials, refurbishment system, Teacher on Special Assignment (TOSA) support, teacher leaders, and a majority cadre of teachers trained in using units and key strategies.

What were the major contributions of the Integrating ELD and Science program to teachers?

Based on administrator and teacher interviews, teacher survey data, professional development, and classroom observations, as well as records of science kit distribution maintained by both the district and the Exploratorium, the Integrating ELD and Science program contributed to the growth of capacity of SVUSD's teachers in the following ways:

- ✓ The program provided teachers with **a curriculum that exemplified the innovative approach.** Teachers could get started with integrated instruction without having to invent it themselves.
- ✓ The program provided teachers with **readily available science kits and materials, everything teachers needed in one convenient place.** They did not have to think through, purchase, or scrounge materials for their classrooms.
- ✓ Through the Exploratorium, teachers had access to professional development that focused primarily on the **implementation of the grade-level units** provided by the program, but also offered **information about child development, science inquiry, and second language acquisition.** In other words, the professional development provided teachers with what to do, as well as why to do it.
- ✓ Most **teachers reacted to the program very enthusiastically** because they saw their students, especially their ELL students, responding to what they were teaching with excitement, motivation, and a profusion of language. In this sense the Integrating ELD and Science program provided teachers with successful and effective teaching experiences.
- ✓ The program helped create **a professional learning community for teachers.** Through professional development experiences teachers had opportunities for collegial learning and reflection, and both individual and collective knowledge building.
- ✓ The program also offered teachers **a range of leadership roles and activities** centered on sharing innovative and best practices. As the program progressed, many classroom teachers contributed to the professional events, e.g., sharing strategies or practices they had developed or leading grade level discussions. Many also took active leadership roles at their schools, advocating for the program, communicating with parents, and promoting the pedagogical approaches embedded in the Integrating ELD and Science program.

What were the major contributions of the Integrating ELD and Science program to students' opportunities to learn?

Based on administrator and teacher interviews, teacher survey data, and especially class observations, the Integrating ELD and Science program contributed to the expansion of SVUSD's students' opportunities to learn in the following ways:

- ✓ Students had **more opportunities to learn**. Through the program they received **more science instruction**. For example, among the first two cohorts of teachers, science instruction increased from 121 minutes a week in the first year, to 166 minutes per week in the third year of the program. Students also received **more integrated ELD and science instruction** than before the program. Among the first two cohorts of teachers, the percentage of teachers who reported that they integrated ELD and science instruction increased from 65% after the first year of the program to 88% in the third year.
- ✓ Students had **more consistent opportunities to learn**. The program produced two curriculum units/kits per grade level and almost all SVUSD teachers used them regularly. As a result, the reach of the program was such that by calculating from its inception, by 2015 the following percentages of students reaching 5th grade would have benefitted from integrated ELD and science instruction: 25% of students for 5 years, 21% for 4 years, 32% for 3 years, and 21% for 1 or 2 years.
- ✓ The opportunities to learn provided by the **program enabled students to become activated learners**. Students exhibited a high level of authentic interest, engagement, and motivation when they participated in the hands-on, inquiry-based science program. A third grade teacher who served as a Teacher Partner in Research explained what his colleagues also observed in their students as they taught the units: *If a child is excited and engaged in the content, which is one of those great things about the science units, they want to express themselves and they want to participate. That affective filter of 'Oh, gosh, am I going to be correct?' becomes less and less. The child is freer to communicate ideas about the content, and less hung up on whether or not they are using the correct English verb tense or the perfect vocabulary word.*¹
- ✓ Almost all SVUSD teachers using the Integrating ELD and Science program, which was deliberately designed to promote student-centered learning, created classroom environments that were respectful and nurturing of students' development. As a result, **students developed positive attitudes about learning** science, about learning English, and about learning in general.
- ✓ Students' opportunities to learn through the program **improved their receptive and expressive language**. Though it was anticipated, everyone involved was surprised at the depth and breadth of the explosion of language among students as teachers began using the Integrating ELD and Science program. "Let's give them science to talk about," became the motto. As one example among many, all the Cohort One teachers who were interviewed in the early years of the program reported that their students, especially their ELLs, were using language during the lessons: *It just made them talk, even the students who don't normally talk.* In later years, 98% of teachers rated their students' increase in oral language fluency as a 3, 4 or 5 on a scale of 1 (not at all) to 5 (to a great extent).
- ✓ **Students learned, practiced, and improved cognitive processes and thinking skills** that enhanced both their English language development and their science knowledge. Simply by virtue of having

¹ 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.

firsthand interactive experiences with intriguing science phenomena such as snails or shadows or magnetism, students were obliged to actively talk, listen, struggle for the right word, share information, observe closely, ask questions, and come up with ideas, hypotheses, and explanations to communicate with others. The Integrating ELD and Science materials and activities provided **authentic experiences for students, which in turn triggered a complex of intellectual experiences.** Ninety-four percent of teachers rated their students' increase in using science process skills as a 4 or 5 on a scale of 1 (not at all) to 5 (to a great extent.)

- ✓ Teachers reported that the opportunities to learn provided by the integrated approach helped **students gain, retain, and use knowledge and understanding in both ELD and science.** Teachers felt that because student opportunities to learn were not through telling or other second-hand methods, but rather through authentic experiences, **their learning was strong and sustained.** In other words because students acquired the meaning of language in context their learning was self-constructed and therefore more readily retained.

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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