

Learning Language within the Context of Science: The Institute for Inquiry's® Approach to Professional Development Design

This paper presents the Institute for Inquiry's approach to professional development that supports teachers in the integration of inquiry-based science and English language development. It reveals underlying principles and features of our professional learning experiences, and discusses their design and implementation as part of a collaborative project with the Sonoma Valley Unified School District.

The Institute for Inquiry's work is based on the premise that inquiry-based approaches to science require increased communication and sophisticated uses of language, thereby engaging students in linguistic work that can support their English language development. All students—particularly English language learners and others with limited literacy development—encounter language and literacy challenges and opportunities as they engage in doing science. New models for professional development are needed to help teachers respond to these challenges and opportunities and provide the necessary supports that promote students' science learning and language development.

In every part of the country, the linguistic diversity of K–12 students is rapidly growing. By most measures, students whose first language is not English do not perform as well in school as native English speakers. As the nation's classrooms become more diverse, it's critical to understand and develop the opportunities that support the intellectual achievement of all students. Districts, schools, and teachers are faced with the challenge of how to teach content and simultaneously support English language development (ELD).

Most ELD support and instruction comes in the form of isolated skill development that overemphasizes grammar and vocabulary, is decontextualized, and occurs with relatively few models of the language. Although ELD is often conceived of and delivered separately from content instruction (e.g., math, science, social studies), increasingly the content areas are seen as providing affordances for the development of language—both general English language skills and content-specific language. New approaches to professional development are needed to help teachers recognize the advantages of these affordances, introduce them to new ways of thinking about ELD, and respond to the implications of both for teachers' classroom practice.

Project context

The Sonoma Valley Unified School District (SVUSD) is a small, semi-rural district one hour north of San Francisco. The five elementary schools in the district include 90 teachers and 1,800 students. More than 55 percent of these students are classified as English language learners (ELLs)—primarily native Spanish speakers. Approximately 65 percent of SVUSD students qualify for free or reduced lunch.

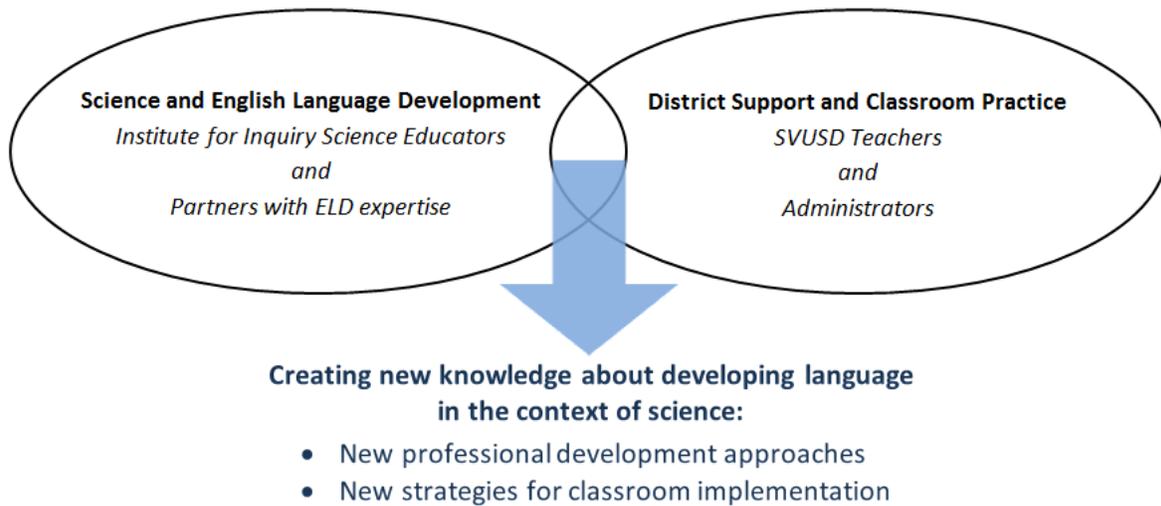
In 2008, the Exploratorium's Institute for Inquiry (IFI) began a pilot project with one school in the SVUSD. This project, funded by the Vadasz Family Foundation and the Sonoma Valley Education Foundation, engaged elementary school teachers in a program of professional development that explored the integration of English language development (ELD) and science. In 2010, in recognition of its relevance to an issue of national significance, an i3 (Investing in Innovation Fund) grant from the US Department of Education funded the expansion of this project to experiment with a district-wide approach.

At the outset of its partnership with the Exploratorium, the SVUSD faced typical challenges with respect to its science instruction and approach to language development. The district lacked adequate science curriculum and materials and teachers had not had access to professional development in science for a decade. A district-wide focus on math and English language arts left very little time, if any, for science instruction. Additionally, SVUSD separated English language development from other subjects, further contributing to the time constraints that impacted the teaching of science. English language learners were grouped homogeneously by language proficiency for ELD instruction at their grade level, and taught separately from English-only students for 45 minutes per day, four days per week.

IFI's program for professional development was designed to support teachers in developing students' language in the context of science and to reinforce the value of teaching students of varying English language proficiency side by side. The core elements of the program included a variety of professional learning experiences, a set of grade-level-specific inquiry-based science units with facilitator's guides and hands-on science materials, and opportunities for teacher leadership.

From the beginning, a major goal of the project was to foster a district-wide learning community, to take advantage of the distributed expertise represented by its partners: science-museum-based teacher educators of inquiry-based science, university-based teacher educators specializing in language development, classroom teachers, and school and district administrators. Working together, our goal was to explore the issues fundamental to integrating science and ELD in order to develop new thinking about the kinds of professional learning experiences that would best support teachers to integrate science and ELD in their classrooms. Multidisciplinary representation brought various viewpoints to bear on this shared problem, and resulted in a combination of approaches that would not have been possible without close collaboration. All parties shared in the process of experimentation and innovation that led to an evolution of professional development practices, district policies, and teachers' classroom practice.

Exploratorium and SVUSD: Establishing a Learning Community



In designing the professional learning experiences central to the project, IFI was heavily influenced by classroom experimentation and shared reflection between project partners. Designing the content and delivery of the professional learning experiences was an ever-evolving process that required thoughtful, conscious decision making. Our work was advanced by an iterative cycle of experimentation, reflection, and redesign that had implications for both classroom and professional development practices.

Our Approach

IFI's history of designing professional development for teachers and other professional developers provided a foundation for its work in Sonoma. All of our professional learning experiences are imbued with a view of inquiry as a powerful mode of learning about the natural and material world. At the heart of the inquiry process is an ongoing engagement with the science practices of asking questions, developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations, engaging in argument from evidence, and obtaining, evaluating, and communicating information. Together, these practices advance a deeper understanding of scientific phenomena and the process for learning how to do science.

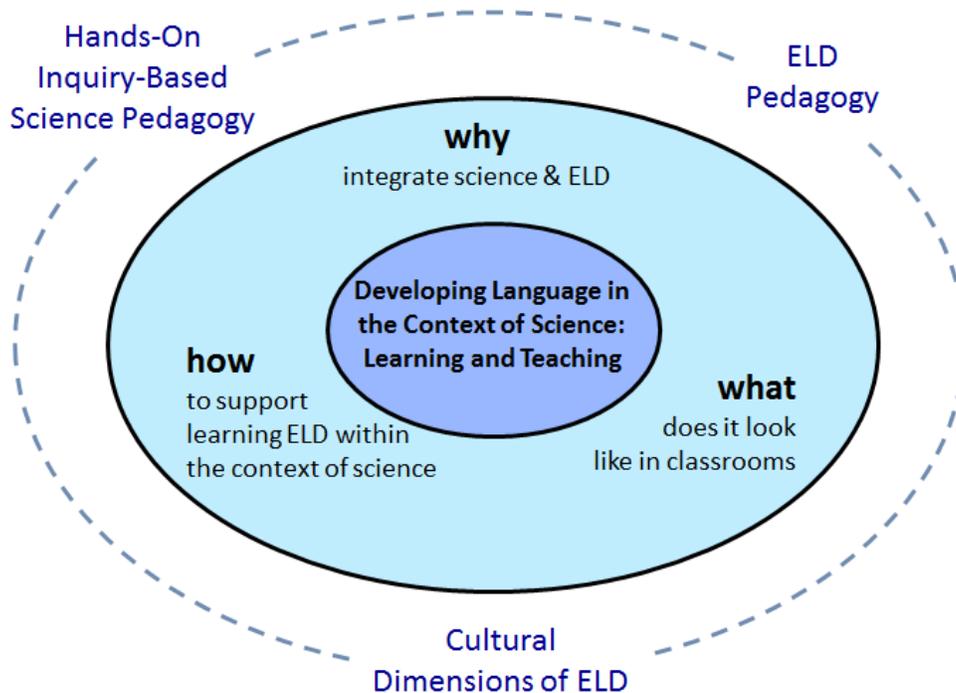
IFI's project in Sonoma is grounded in the premise that inquiry-based approaches to science require increased communication and sophisticated uses of language, thereby engaging students in linguistic work (oral and written discourse) that can support both science learning and English language development. Engaging in any of the science practices listed above is language intensive. It requires that teachers recognize and

attend to increased language demands associated with speaking, writing, listening, and reading in order to support students to participate fully, express their ideas, and understand those of others.

Adopting an inquiry-based approach to science instruction can pose a challenge for teachers who have been using traditional approaches to teach science. And for teachers with an ELD approach that focuses on grammar and vocabulary as isolated skill development, adopting an approach where science is the context for language can be equally challenging.

The following diagram, “A Framework for an Integrated Science and ELD Professional Development Curriculum,” illustrates the key components that IFI has identified as being essential for equipping teachers to understand the advantages for developing language within the context of science.

A Framework for an Integrated Science and ELD Professional Development Curriculum

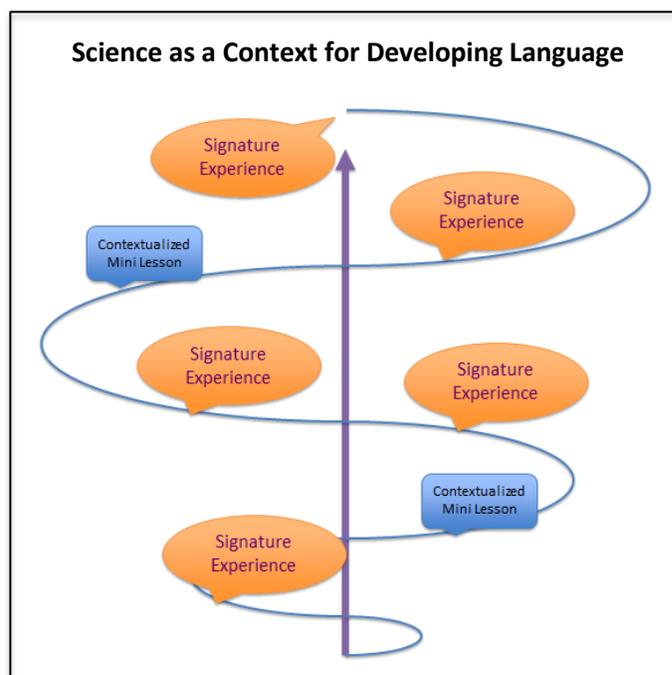


The elements of this diagram informed the content for IFI’s professional learning experiences. The outer edge of the circle includes the disciplinary topics explored through direct experiences with teachers with the goal of building their foundational knowledge of inquiry and ELD. The inner circle contains the questions from teachers that guided our development of tools and strategies needed to support shifts in their

teaching practice. The topics at the edge and inner circle of the diagram are not treated as exclusive of one another. In designing professional development experiences for SVUSD teachers, it was a priority for us to consider their intersections—for instance, how inquiry-based science experiences for teachers can offer venues for exploring ELD pedagogical strategies; how ELD pedagogy is dependent on an understanding of the cultural dimensions of language development; how classroom practices frame and are influenced by discussion of pedagogical concepts. Professional development activities and personal conversations with teachers reflected these interconnections.

While this diagram presented a useful framework for IFI when designing its professional learning experiences, a different model was needed to communicate to teachers how their new learning could be structured and applied in classroom practice. IFI developed what it has come to call the “Spiral Model for Science as a Context for Developing Language.” This model is used to illustrate for teachers the dynamic interplay between science learning and language development. It describes a process by which teachers can coordinate and support their students’ learning experiences across a single lesson or an entire unit of instruction.

At the core of the spiral model are “signature experiences”: inquiry-based science investigations, science talks, and science writing. These signature experiences serve as mechanisms to engage students in the science practices critical to doing inquiry. Contextualized mini-lessons (CMLs) are brief instructional moments that take advantage of strategic opportunities within the signature experiences to focus on language conventions. While CMLs might attend to grammatical structures or vocabulary, they are situated within learning science and are driven by the students’ need to communicate about the science ideas emerging in an ongoing investigation.



The spiral model positions science learning as a context for language development, where language is used to both develop an understanding of science ideas and communicate those ideas. These uses of language are seen as being as much a part of English language development as are grammatical and vocabulary skills. The spiral model also strategically incorporates scaffolds—mechanisms used to support English

language learners to fully engage in experiences that are central to helping them make meaning of science ideas. The spiral represents the idea that students revisit and build on science ideas, and the language associated with these ideas, as they engage in hands-on, inquiry-based science, science talk, and science writing within a unit of study. Through these multiple encounters, science understanding, and the language used in communicating that understanding, builds over time.

A full description and detailed example of the spiral model can be found in “Developing Language in the Context of Science: A View from the Institute for Inquiry,” available at exploratorium.edu/ifi/inquiry-and-eld/educators-guide/conceptual-overview.

Units and Kits

The Exploratorium addressed SVUSD’s need for science materials by designing a series of hands-on, inquiry-based science experiences that could also serve as a context for developing language. Two science units were created for each grade level, based on earth, physical and life science topics. The units included facilitator’s guides and kits with hands-on materials. While these units were created to serve as a platform for experimentation in Sonoma classrooms, the design of the professional development that was used in conjunction with them is relevant in other settings and can be applied to any inquiry-based science curriculum.

<p>Institute for Inquiry Classroom Unit Structure</p> <ol style="list-style-type: none">1. Exploration: Observing and describing phenomena, discussing prior experiences with the phenomena, and raising questions2. Investigation: Planning and doing a hands-on investigation to answer a question3. Sharing Understanding: Talking and writing about an investigation to discover what was learned4. Conclusion: Synthesizing and reflecting on what was learned from all the unit activities

Structure of Professional Learning Experiences in Sonoma

In order to accommodate the district’s objective that all Sonoma elementary teachers participate in the project—and in recognition that “one size does not fit all”—IFI developed two options for professional development. Option 1, an intensive approach, took place over the course of two years. Each year included three days of summer workshops and six two-hour afterschool study groups, for a total of 60 hours over two years. Option 2 was also two years in length. It made use of release days to provide professional development during six half-day workshops each school year, for a total of 48 hours over two years.

While the resources made available to all teachers were the same, the duration and structure of programming varied between the two options. Each year of Option 1 began in summer workshops with an immersion into the fundamental concepts of developing language within the context of science, and was followed by reflection time and focus on

classroom practice in study groups during the school year. Option 2 introduced the same concepts incrementally, in parallel with teachers' implementation of science units and experimentation with the new approaches in their classrooms.

Graduates of both two-year options have had the opportunity of continuing in study groups; about one-third of SVUSD teachers have chosen to do so.

Design of Professional Learning Experiences for Option 1 Teachers

During summer workshops, Option 1 teachers experienced inquiry-based science firsthand, with a particular focus on how the use of the science practices could support the development of an understanding of scientific concepts and how students might communicate those concepts. Teachers were introduced to science talk and science writing as critical mechanisms for learning science ideas and developing language. Discussions with teachers reinforced the importance of accepting students' everyday language as a means for expressing ideas, rather than focusing on correct answers and the use of perfect language.

In these workshops, teachers were introduced to the practice of scaffolding as a way of attending to the language demands inherent in inquiry-based science, science talk, and science writing. Classroom videos were shown and analyzed to illuminate scientific practices in action and how science ideas and language are developed from these science practices. And teachers examined the links that exist between oral and written discourse in science and English language arts.

During the academic year, study groups focused on translating the ideas and principles explored during workshops into practical strategies for classroom implementation. The intent of the study groups was three-fold: to address questions and needs that might arise as teachers experiment with new approaches; to provide new learning experiences connected to classroom practices to help advance teachers' understanding of integrating science and ELD; and to provide a setting for reflection and collaboration to promote the growth of a district-wide learning community.

<p style="text-align: center;">Institute for Inquiry Design Principles for Professional Learning Experiences</p> <ol style="list-style-type: none">1. Emphasize first-hand, immersive experiences of inquiry-based science that provide an opportunity for teachers to engage as learners of the same principles they are expected to implement with students2. Illuminate how inquiry-based science experiences can create a content rich and language-rich environment that provides affordances for English language development.3. Attend to the social and cultural dimensions of language development.4. Create lesson analysis and planning tools to identify a lesson's language demands and the scaffolds that support students at various language levels to achieve the lesson's goals.5. Provide ample time for teachers to reflect on and share their teaching practices.6. Create a balance between the contributions of professional development providers and teacher participants, ensuring that the expertise of all parties is recognized and shared.

In a typical study group, participants began by working in a whole-group setting. Together, teachers built on the pedagogical practices for learning science and developing language that were introduced in the summer workshops, and made deeper connections to classroom practices. Discussions and experiences revolved around the following ideas:

- Organizing students into small, collaborative groups to experiment with hands-on materials, make meaning, and communicate their understanding through oral and written discourse
- Forming heterogeneous groups in recognition of the language learning that happens through interaction between students of varying levels of language proficiency
- Providing opportunities for a variety of science talks and science writing experiences throughout the units in order to make meaning and communicate ideas and understanding
- Identifying moments where language demands occur, and exploring the scaffolds necessary to provide appropriate support

Midway through a typical study group session, participants were separated into grade-level groups to share lessons learned while implementing their science units, analyzing student work, and collaborating on enrichments to the units.

The spacing of the study groups (about every five weeks) during the school year made them an ideal mechanism for “checking-in,” gradually building teachers’ understanding as they worked through the units and using their feedback to refine the professional development to make it more responsive to their needs.

Concurrent with their participation in workshops and study groups, teachers had frequent opportunities to take on leadership roles and support one another. Over the course of the project, a cadre of seventeen teacher leaders emerged. They presented at workshops and conferences, opened up their classrooms as observation sites, mentored new teachers, demonstrated “model” lessons for colleagues and project documenters, enriched science units through additions, revisions, and annotations, and engaged in research projects to understand classroom practices at a deeper level. As new teachers joined the project, experienced teacher leaders took on increasingly important roles, sharing best practices gained from experience, introducing the units at their grade level, and advising on classroom management and lesson planning.

Lessons Learned

Through these three threads of programming—intensive workshops, study groups, and teacher leadership—all elementary teachers in Sonoma have participated in a unique partnership with the Institute for Inquiry. Developing leadership in Sonoma has been critical to sustaining a long-term professional learning community where teachers continue to deepen their understanding of the integration of science and ELD. Successive years of professional learning experiences and classroom implementation have allowed them to make the work their own and contribute to a professional culture that is committed to the integration of science learning and language development. What began as a pilot project in a single school has developed into a district-wide reform effort that—through teacher leadership and ongoing district support—is positioned to continue and to serve as an example for other educators and districts.

The lessons learned and approaches developed in this project will be incorporated into future partnerships with other districts and integrated into IFI’s repertoire of professional development offerings for teachers, teacher educators, and professional development providers from districts, universities and museums across the country.

The Institute for Inquiry (IFI) is a professional development program that addresses the theory and practice of inquiry-based science education. IFI workshops and seminars are tailored to a variety of participants, including professional developers, administrators, lead teachers, national education reform leaders, out-of-school educators, and educators in the museum and university communities worldwide.

For more information about IFI’s program of professional development in Sonoma, see the project website, “Educators Guide for Inquiry-based Science and English Language Development,” at exploratorium.edu/ifi/inquiry-and-eld/educators-guide.

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