BaySci:

A Partnership for Bay Area Science Education
Supporting Districts and Teachers to Improve
Science Education in Bay Area Schools

Evaluation Report

November 2011

Inverness Research
The Research Group at the Lawrence Hall of Science

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Executive Summary

The goal of BaySci is to increase the likelihood that students in Bay Area elementary schools encounter high-quality science education and have access to engaging opportunities to learn science. Over the past three years, BaySci has worked with five BayArea school districts to reach this goal by focusing primarily on two aspects of district-wide improvement — building district-level capacity to implement a high-quality, inquiry-based elementary science program and providing targeted, in-depth professional development for teachers and teacher leaders.

The findings presented in this report are based on the data gathered by Inverness Research, the exteral evaluator, and the Research Group at the Lawrence Hall of Science. They focus on the contributions of BaySci to the participating school districts, the challenges and constraints in working with these districts to improve elementary science education, and the lessons learned about the BaySci investment.

BaySci Contributions

The BaySci initiative made a number of contributions to the participating districts. These include, but are not limited to: 1) elevating the priority of science in each district and influencing district and school culture for supporting science; 2) increasing district-level capacities to support and improve elementary science education; 3) increasing school and teacher-level capacities to support and improve elementary science; 4) increasing and improving opportunities for students to learn science.

1) Elevating the priority of science in each district and influencing district and school culture for supporting science

BaySci support, aligned with the implementation of the FOSS curriculum, has resulted in keeping elementary science a priority in each of the districts. There are many pressures and demands made upon schools, and elementary science is easily lost in the fray. In its work with district leaders BaySci has provided a presence for science in multiple ways: Science has been the focus of district-based professional development days; the positions of district science coordinators and specialists have been instituted and/or maintained; district budgets continue to include allotments for science materials replenishment; and clear messages are being communicated from central administration to school sites that science is important and needs to be taught regularly.

2) Increasing district-level capacities to support and improve elementary science education

The mission of BaySci has always been to find ways to increase the ability and capacity of the participating districts to improve their science programs. The key capacities that allow the districts to pursue continuous improvement of their own elementary science programs are as follows: developing a concrete plan and vision; developing distributed leadership for science improvement; and support for materials management. The BaySci effort has been able to contribute to a range of capacities and to customize its support for each district with the result that different districts grew their science programs in different ways and at different rates.

3) Increasing school and teacher-level capacities to support and improve elementary science.

BaySci has fostered and improved school and teacher-level capacities at each district in multiple ways.

- *Professional Development Dissemination and Implementation Beyond BaySci Offerings*. Professional development capacities show increases for all four districts. The teacher leaders who have participated in BaySci workshops have imported materials and ideas into workshops at their own districts. This is particularly true in the areas of inquiry and integration of science and literacy.

- *Enhancing Teacher Preparedness and Confidence*. As a result of access to high-quality materials and an increase in professional development, teachers across the districts are beginning to feel more confident and prepared to teach hands-on science to their students. On surveys, Newark and Novato teacher self-reported preparedness data showed the mean score across all survey respondents on the preparedness scale increasing from the beginning of the first year (September, 2009) to the end of the first year (June, 2010). This new value was then maintained into the beginning of the second year (September, 2010) and again increased during the second year (June, 2011).

4) Increasing and improving opportunities for students to learn science

Through supporting the improvement of the district science program and by helping teachers feel better prepared and more confident, BaySci is contributing to the districts' ability to provide high-quality opportunities to learn science.

- *Quantity of Elementary Science*. BaySci is helping districts create an environment in which science is more likely to be taught. Analysis from Newark and Novato teacher surveys showed sixty-eight percent

(68%) of K-5th grade teachers in Newark and Novato reported spending more than 60 minutes each week on science. This suggests that more science is being taught in these BaySci districts over the past two years than was being taught across the Bay Area in 2007 or than is being taught, on average, statewide (2011).

- *Quality of Elementary Science Instruction.* The four districts involved in BaySci in 2010-2011 exhibited higher quality lessons than would be found in the typical California elementary classroom. Quantitative analyses of teacher survey data show that teachers who participate in more intensive forms of professional development show increased levels of preparedness and implementation of investigative-oriented and science-literacy integrated practices in classrooms.
- *Benefits to Students: Attitudes and Achievement.* Recognition existed early on that it would be ideal, but not necessarily probable to see impact on student achievement, and the data we collected was quite limited. That said, the evidence we do have suggests that students in classrooms that had teachers who benefited from more intense forms of BaySci intervention were more likely to have positive attitudes and self-efficacy related to science than those in classrooms of teachers who did not. Over the course of the three years, all of the BaySci districts also saw an increase in the mean of the 5th grade scores on the science California Standards Test (CST).

Challenges

While BaySci worked to strengthen science programs, there were growing contextual forces that favored the diminishment and erosion of elementary science programs across the state. The forces that constrained and challenged BaySci included the ongoing statewide financial crisis, national accountability pressures, instabilities and "churn" within the system, and issues related to intermittent external support and the scale of the investment.

Impact of the State Financial Crisis

Over the last three years, the already poor situation of CA state funding for K-12 public education has experienced an even sharper decline. This has been a severe shock to the system, with districts fighting to maintain operations and bare minimum instructional services. This has put very strong constraints on the use of any resources for science education.

Pressures of Accountability

NCLB and standardized testing cause explicit pressure on teachers to concentrate highly on those subjects that are tested. Especially for schools under Program Improvement there is heavy pressure to raise reading and math scores; this leads to little or no teaching of science.

Instability and Churn within the System

Over three years BaySci districts have experienced significant transition of administrative leadership at the district and school level. All of the four have had changes in central office administrators in charge of curriculum and instruction, and three of the four have new superintendents. While these changes can cause potential disruption of critically important administrative support for a district-wide science improvement initiative, they should not be considered to be anomalous — such turnover is the norm, not the exception, and highlights the importance of distributed site and teacher leadership within an organization.

Intermittent External Support and the Scale of the Investment

Two of these districts have had National Science Foundation or other forms of external funding, which have helped them to develop their elementary science programs. External funding allows districts to improve on their programs and hopefully their long-term capacities for sustaining those programs; nonetheless it is difficult for the districts when the funding ceases, especially in a time of heavy fiscal constraints. Short-term, episodic funding causes uneven progress and even disruptive events. Uncertainty in funding makes it hard for districts and SREIs to plan and build the momentum necessary for improvement. For these reasons the year-by-year funding of BaySci introduced uncertainty and delays into the initiative that lessened its overall momentum and made for disruptive gaps in planning and implementation.

Lessons

A number of lessons have emerged from the BaySci experience to-date that are worthy of note:

- BaySci concretely helped districts in the implementation and management of their adopted instructional and curricular materials (FOSS).
- Intensive professional development opportunities contributed to increasing teachers' self-assessment of their preparedness for inquiry-oriented science and supported improved classroom practice, albeit in ways that were uneven over time, across districts, and across differing

levels of professional development intensity. Further investigation is warranted to understand the factors that explain the unevenness.

- Embedding professional development within a more comprehensive approach to science education reform may create synergistic effects among different professional development offerings. The BaySci focus on both administrative and teacher leadership has been effective and has helped develop the human capital critical for initiating and sustaining local improvement efforts in elementary science.

- BaySci is an example of the value of external investments that support progressive and cumulative improvement of elementary science education in Bay Area districts and schools. As with BaySci, such investments have to be highly leveraged as no external investment is either large enough or permanent enough to deliver large-scale enduring changes in the classroom across the entire Bay Area.

Introduction

BaySci: A Partnership for Bay Area Science Education was established in response to growing concerns about the diminishing status of elementary science education both nationally and in the Bay Area. According to The Status of Science Education in the Bay Area, a report summarizing the results of study conducted by the Lawrence Hall of Science and WestEd in 2007[1], 80% of Bay Area elementary school teachers spend 60 minutes or fewer on science; many elementary teachers felt unprepared to teach science and most teachers received little professional development in science; and, almost half of the Bay Area districts reported no capacity within the central office administration to support science education. In addition, according to a national study more than half of elementary science lessons are rated low in quality.[2]

BaySci is a partnership among two Science-Rich Education Institutions (SREIs—the Exploratorium and the Lawrence Hall of Science), five Bay Area school districts, Inverness Research, and the funders — the S. D. Bechtel, Jr. Foundation and the Gordon and Betty Moore Foundation. BaySci represents an investment in concurrently building the capacity among the providers (SREIs) and participants (districts) so that they can work together to improve the elementary science programs of the participating districts. The hypothesis underlying the BaySci investment is that a partnership of science centers and districts can support each of the involved districts to strengthen their own elementary science program; in turn, stronger district-wide programs will support teachers in providing more and better science instruction — with the ultimate result that students experience improved opportunities to learn science.

Inverness Research has served as the external evaluator and as a design partner of the BaySci Project (the District Capacity Building Program and Teacher Professional Development Program) for the past three years. In these capacities, we have provided an independent, third-party perspective on the evolving BaySci effort; we have participated in design deliberations; and collected data about the strengths, weaknesses, and, ultimately, the value added to the districts involved in the BaySci initiative. We have discussed findings and implications with project leaders, and actively participated in strategic planning sessions.

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[1] Dorph, R., Goldstein, D., Lee, S., Lepori, K., Schneider, S., Venkatesan, S. (2007). *The Status of Science* Education *in Bay Area Elementary Schools*. Lawrence Hall of Science, University of California, Berkeley.

[2] Weiss, I., Pasley, J., Smith, S., Banilower, E., Heck, D. (2003). Highlights Report, Looking Inside the Classroom: A Study of K-12 Mathematics and Science Education in the United States. Horizon Research Inc

The Research Group (formerly the Center for Research, Evaluation and Assessment) at the Lawrence Hall of Science has partnered with Inverness Research to evaluate the impact of the BaySci Teacher Professional Development Program 2009-2011. The role of the Research Group has included: surveying teachers regarding attitudes, classroom practice, preparedness, school/district culture, and the quantity of science teaching (see Appendix C for more detail regarding the content and analysis of teacher surveys); surveying students regarding interest and engagement; observing BaySci events; participating in key planning and design meetings; analyzing quantitative data; and collaborating with Inverness Research on data analysis, interpretation, and reporting. (For the BaySci outcomes, data collection methods and analysis plans, see Appendix A.)

This report highlights the key findings of the multiple efforts to document and study BaySci. It focuses on what has been learned to date about the BaySci investment, drawing upon the collected data and documents included in the attached appendices. We first provide a contextual background with a brief description of each district, then present the contributions of BaySci in terms of the value-added to the participating districts, followed by a discussion of the challenges and constraints in working with these districts to improve elementary science education. We conclude with a summary of what has been learned about the BaySci investment and how this information can inform conceptualizations and strategies for continued investment in the improvement of Bay Area science education.

I. BaySci Overview

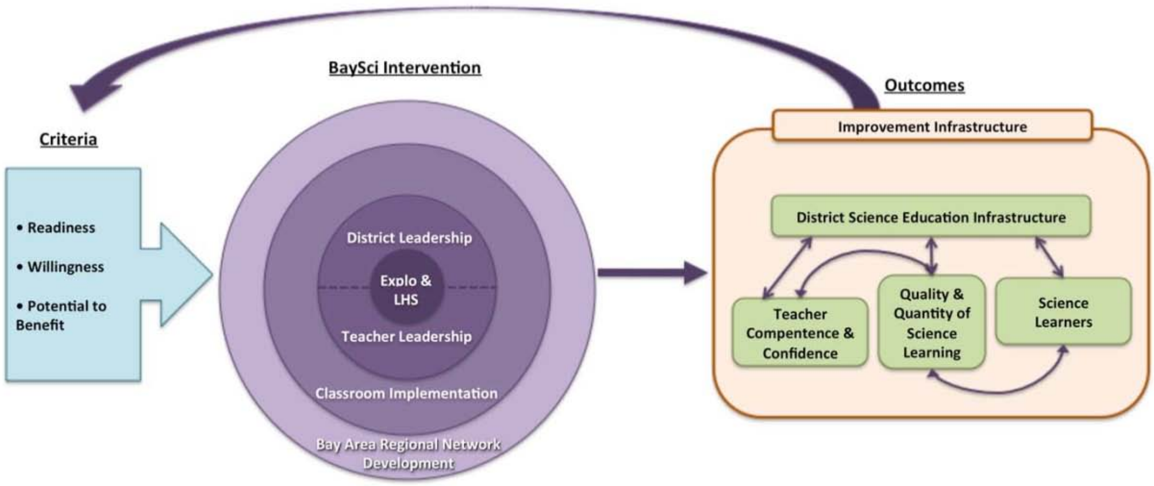
The goal of BaySci is to increase the likelihood that students in Bay Area elementary schools encounter high-quality science education and have access to engaging opportunities to learn. In order to reach this goal, BaySci focuses primarily on two aspects of district-wide improvement — 1) building district-level capacity to implement a high-quality, inquiry-based elementary science program and 2) providing targeted, in-depth professional development for teachers and teacher leaders. This design is research-based, and the design elements reflect research findings that indicate improving the quality of elementary science lessons is related to a combination of ongoing professional development and the use of high-quality materials.[3] The multi-year ongoing BaySci effort thus supports interventions centered on district-level leadership development and capacity building, teacher professional development, and advocacy for elementary science through regional collaborations. Through BaySci SREIs work collaboratively with districts and school sites to identify and support

[3] Weiss, I., Horizon Research, Inc. (2006.) *Research on Professional Development for Science Teachers*. [Presentation]. Paper presented to the Astronomical Society of the Pacific.

district administrators, school personnel, and classroom teachers to be science education leaders within their communities.

In BaySci, the partnership of the two SREIs provides content and pedagogical expertise to the teachers, but more importantly, supports the development of local science leaders to support districts, schools, and teachers' elementary science efforts. Moreover, the entire effort was designed with the SREIs as leading support institutions with the mandate of developing the capacity of the districts, schools, and teachers' elementary science undertakings. Through professional development opportunities, workshops, and meetings, partnering school districts collaborate with other districts. Through the BaySci network of leaders and teachers, existing knowledge is exchanged and new knowledge and ideas formed to further district- and teacher-based science reforms. Overall, the program strives to improve the science infrastructure of all program partners. Targeted outcomes include: the larger improvement infrastructure, such as increased SREI capacity and improved Bay Area educator connections; increased district science education infrastructure, such as district capacity (functioning curricular/instructional materials management system and understanding of the role that science can play in addressing California state accountability); and, increased teacher competence and confidence which determines the quality and quantity of science teaching and learning, and the opportunity for development of young science learners (see Figure 1. BaySci Theory of Action).

Figure 1. BaySci Theory of Action



BaySci District Programs and District Selection

In 2007, with funding from two private foundations, staff carefully planned the BaySci program to build district leadership for inquiry-based science education. A key feature of the intervention continues to be the program's agility to address the specific individual needs expressed by district partners by taking strategic advantage of the programs, resources and expertise of SREIs. The opportunities provided by BaySci assist participating schools, districts, and teachers to improve in capacity, coordination, planning, and science curriculum implementation. Districts are supported in a systematic and strategic way to create and sustain thoughtful and feasible elementary science education plans and goals. Additionally, districts generate plans to bolster teacher leadership and improve on the implementation through literacy/language development integration and by enhancing the levels of student inquiry within the classroom.

In year two, coinciding with the State of California elementary science curriculum adoption and funded by the S.D. Bechtel Jr. Foundation, BaySci selected five districts (Newark, Novato, Emery, Palo Alto and Petaluma) to participate in a suite of district capacity building and professional development opportunities for district and teacher leaders along with district-level planning meetings. BaySci SREI leaders also provided technical assistance focused on leadership and district-level capacity building around science education. In order to determine which BaySci districts would receive support three selection criteria were applied: readiness, willingness, and potential to benefit. The readiness criterion is defined as nascent district infrastructure and high-quality adopted science curricular/instructional materials. Willingness is characterized by district and teacher commitment to science and willingness to commit to the various reform effort activities and requirements, something that is not taken lightly with the various and ever-changing constraints under which school districts currently operate. Districts are gauged on their potential to benefit, which establishes that the district has a modicum of administrative stability and the capacity for improvement from the particular support the reform effort provides.

Three BaySci districts (Emery, Novato, and Petaluma) in this initial year of program implementation adopted the Full Option Science System (FOSS) curriculum while Newark and Palo Alto had already been using the curriculum, and all districts have continued to teach with these materials to date. Top-level district and school site leaders participated in the following activities aimed at prioritizing high-quality science instruction within their school districts and building leadership capacity at various ranks within district administration.

- Leadership Seminars: A major goal of the leadership seminars is to develop a collaborative learning community of science education leaders focused on long-range planning for elementary science, critical elements for an effective science program, and thinking about supporting science instruction in concrete ways. Total number of participants: 73

- Planning Meetings: BaySci staff meet with top-level district leadership to address topics related to milestones, needs, and challenges of a district's elementary science reform effort.

- Technical Assistance: Combined with a district's plan for supporting science instruction, BaySci staff respond to individual district needs through consultation and customized support for these plans, including planning for district-wide professional development initiatives.

- Instructional Materials Management: Districts learn to develop solutions and strategies for a functioning elementary science materials management system, including science kit refurbishment and distribution. Total number of participants: 39

In year three, the initial effort aimed at district capacity building continued. At the same time with funding from the Gordon and Betty Moore Foundation, two of the BaySci districts (Newark and Novato) were selected to receive more extensive intervention. With the new two-district teacher professional development program in place, the intervention added the components of classroom implementation and teacher leadership support, which was provided to teachers through curriculum implementation academies at each grade and leadership academy cohorts. Teachers could also participate in more than one professional development offering (curriculum or leadership academy) over the span of the project. These academies concentrated on the adopted Full Option Science System (FOSS) curriculum and are described below:

- **FOSS Implementation Academy Level 1 (Intro to FOSS)**: Teachers participate in workshops to support the active implementation of the FOSS curriculum. Workshops provide teachers with a basic introduction to individual FOSS modules and were solely provided by the Lawrence Hall of Science. Total number of participants: 101.
- **FOSS Implementation Academy Level 2 (Advanced FOSS)**: Teachers engage in reflective practice about one's own instructional decision-making and are introduced to inquiry-based approaches and strategies for integrating science and literacy. This level is an important stage in teacher leadership recruitment and development. The FOSS Implementation Academy Level 2 workshops were provided in two separate strands by the Lawrence Hall of Science and Exploratorium. Total number of participants: 112.
- **Teacher Leadership Academy**: District teachers attend summer institutes to support their development as teacher leaders and learn to become capable extending and enriching the FOSS curriculum through inquiry-based approaches and the integration of science and literacy. Academic year follow-up sessions reinforce strategies for improving classroom practice and prepare teachers for assuming leadership roles within their district. Two separate Teacher Leadership Academies were provided by the Lawrence Hall of Science and Exploratorium. Total number of participants: Academies 122; Academic year follow-up sessions 108; Leadership opportunities 60.

The BaySci program also funded district science festivals that provided opportunities for children and parents to engage in science learning experiences together, and for district science coordinators to assist in the facilitation of the elementary science reform effort within their districts.

BaySci District Partners

Together, the BaySci school districts represent an interesting group in which to learn about supporting elementary science in the Bay Area. All the districts are categorized as either large suburban or small city. The number of elementary schools per district range from 6 (Petaluma) to 12 (Palo Alto). Both Novato and Newark have eight elementary schools. In terms of student demographics, Newark has the highest percentage of minority students (55%), English language learners (25%) and students eligible for free and reduced lunch (47%). Palo Alto has the lowest percentages in these categories (53%, 10%, and 8% respectively). Average spending per pupil (from lowest to highest) is Novato ($7,729), Newark ($8,399), Petaluma ($8,816) and Palo Alto ($12,923).

Newark and Palo Alto have a more centralized district structure and decision-making process. Both of these districts have a relatively long history of elementary science improvement efforts. Novato and Petaluma have strong site-based management practices in place and little or no history in district-wide science reform, although some teachers have had considerable elementary science professional development and a few individual schools had a strong focus on science before BaySci. Newark and Palo Alto have a centralized science materials center responsible for distributing science kits and refurbishing them after use. In the two other districts, each school site coordinates site schedules of kit use and maintenance. For more information about each district, see Appendix B.

BaySci Challenges

BaySci implementation was not without several challenges and unanticipated events that have influenced the shape of the program. In year two, one (Emery) of the five districts involved in the program discontinued due to lack of implementation of the various capacity-building components of the program. In year three, BaySci experienced a late start in the implementation of the district leadership and planning components. Changes within districts also presented various challenges for the district science reform effort. Additionally, while funding concerns are often an issue in schools, the current California state budget shortfall and national economic crisis presented increasingly severe challenges. Following the science curriculum adoption year in 2008-2009, California entered a statewide budget crisis of at least $11.2 billion. Still in a financial crisis today, the projected deficit is projected to top $40 billion. At times, these challenges affected district morale as well as workshop recruitment and evaluation data collection efforts.

Alongside the statewide financial crisis, the demands of No Child Left Behind (NCLB) require low performing schools to be categorized in a way that, in some cases, resulted in mandated trade-offs between the opportunity to learn science, the arts, and social studies for a narrow focus on curriculum and instruction targeting the improvement of math and language scores. Under No Child Left Behind, various BaySci schools entered California State Program Improvement (PI) status, which left them responsible for implementing certain federal and state requirements during each year that they were in PI. Within these schools, time for and priority of science instruction experienced a decrease due to these requirements. In 2009, National Assessment of Educational Progress (NAEP) results indicated that only one third of fourth grade students nationally were proficient in science. In California it was about one fifth.[4]

In summary, BaySci has operated in a fiscal and educational environment that has not been supportive of science education improvement. The BaySci role has been to provide support for elementary science education in a time when few other supports were available.

II. BaySci - Augmenting and Adding Value to District, School-wide, and Classroom Improvement Efforts

An underlying design principle for BaySci is that it provides supports to administrators and teachers such that they will be further motivated and empowered to strengthen their own elementary science education programs. The goal of the work of BaySci is to create supports that meet the evolving needs of each district so that work of BaySci is resonant with the emerging needs and opportunities in each district. In this way, BaySci seeks to add value to each district's efforts to strengthen its own program. Hence the contributions of BaySci are not uniform; each district benefits from participation in different ways depending upon the current status of their program and the improvement work they choose to undertake. For two of the districts involved (Newark and Novato) in the BaySci Teacher Professional Development Program, BaySci has provided them with a systemic approach to developing science programs with deep teacher and classroom-level capacities for supporting elementary science.

Although the school districts vary in their level of development and in the work they undertake with BaySci assistance, looking across the four districts, it is possible to identify common ways in which BaySci is augmenting their efforts and adding value to their elementary science education programs. BaySci contributions include, but are not limited to: 1) elevating the priority of science in each district and influencing district and school culture for supporting science; 2) increasing district-level capacities to support and improve elementary science education; 3) increasing school and teacher-level capacities to support and improve elementary science; 4) increasing and improving opportunities for students to learn science. We discuss each of these major areas of contribution in what follows.

[4] Fensterwals, J. (2011). *Low scores, low priority for science: NAEP results shouldn't come as a surprise*. Silicon Valley Education Foundation. Retrieved at http://toped.svefoundation.org/2011/02/16/ low-scores-low-priority-for-science/

1) Elevating the Priority of Science in Each District and Influencing District and School Culture for Supporting Science

BaySci support, aligned with the implementation of the FOSS curriculum, has resulted in keeping elementary science a priority in each of the districts. There are many pressures and demands made upon schools, and elementary science is easily lost in the fray. In its work with district leaders BaySci has provided a presence for science in multiple ways: Science has been the focus of district-based professional development days; the positions of district science coordinators and specialists have been instituted and/or maintained; district budgets continue to include allotments for science materials replenishment; and clear messages are being communicated from central administration to school sites that science is important and needs to be taught regularly.

A couple of examples from different districts illustrate some of the specific ways in which BaySci has raised the stature and priority of science:

- In Petaluma the district administration has committed funds for kit replenishment and consumables. BaySci empowered science advocates to raise their voices about the importance and necessity of science, and without BaySci's encouragement and support, the need for these funds would not have been recognized.

- In Palo Alto the superintendent pledged staff development time for science for 2010 and 2011, a commitment informed and influenced by the teacher and administrative leaders' voices that have been raised and brought to the table because of BaySci.

- In Novato a district leader asserted:

  The ongoing consistent message from the district office [to the schools] is that they are to be supporting science… and this is in part because of the BaySci grant…. The district is committed to science and we say to the schools, 'this is what we stand by and this is what we are willing to do'. This message gives everybody at the school sites an incentive to find ways to teach science in ways that they wouldn't have otherwise.[5]

- In Palo Alto one principal said that attending the BaySci meetings makes him think about science in a way that he might not otherwise have done. Having to present at BaySci leadership meetings forced him and his team to articulate both what they have accomplished and what they need to do in very specific ways. This has helped him keep focused on science at his own school:

[5] The quotes in this report have been lightly edited for clarity without changing the intended meaning of the speaker.

[Because of state accountability] we have had to really push math and literacy the last two years…. If I had not been part of BaySci, I wouldn't be looking at or thinking about science at all. I can now see how science can be integrated into our curriculum a way that I didn't four years ago.

- BaySci also supported the mission and vision for science in Newark Unified School District and kept the focus on the importance of high-quality instruction in science and literacy. As the grant activities end with the elimination of the BaySci Coordinator position, NUSD will continue to support the activities initiated by BaySci through the leadership and efforts of the Teacher Leaders and some principals in the district.

Additionally, in looking at the survey data collected from the Newark and Novato school districts combined, teachers showed a general trend of increasing mean scores on the District and School Culture scale[6] (supportive district and school culture) between the first survey administered in September 2009[7] and the last survey in June, 2011. More specifically, the mean response remained hardly changed in the first year and stayed about the same at the beginning of the second year (September, 2010). At the final time point at the end of the second year (June, 2011) the value of the response for the District and School Culture scale increased significantly above what it had been previously.

[6] The mean responses in the table indicate the average response across all survey respondents (respondents from both districts at all professional development levels) at different time points. We can use these responses to gauge the changes in both districts over the two years. However, it remains unclear if the changes are due to changes in who responds to the survey or changes in the actual response of individuals. It is important to note that at the beginning of each year (time points 1 and time points 5) the response rates were much higher than at later time points.

[7] Note that this first survey administration occurred after one year of BaySci district work had already been underway.

Table 1. Teacher Survey District/School Culture Scale Descriptive Statistics

District/School Culture	N	Mean	s. d.	Min.	Max.
September, 2009	247	3.28	0.50	1.71	4.70
June, 2010	163	3.33	0.45	2.22	4.74
September, 2010	199	3.26	0.51	1.52	4.77
June, 2011	141	3.51	0.53	1.86	5.00

2) Increasing District Capacities to Support and Improve Elementary Science Education

It is important to re-iterate here that the mission of BaySci has always been to find ways to increase the ability and capacity of the participating districts to improve their science programs. BaySci does not directly impact science education in the districts in which it works. Rather BaySci needs to find ways to increase the ability of the participating districts to improve their own programs. Hence, BaySci is primarily in the business of capacity-building, where the key capacities to be focused on are those that allow the districts to pursue continuous improvement of their own elementary science programs.

Drawing on previous work[8] Inverness Research refined a previously used instrument for measuring changes in district capacity over time. This "BaySci District Capacity Framework" is designed to document the degree to which, and the ways in which, each district was developing the capacities that are necessary to grow and sustain a strong standards-based elementary science education program. The purposes for developing and using this Framework were multiple: to document the current status of district capacities, to gauge the contribution of BaySci to these capacities, and to provide feedback to the SREIs and districts about needs and opportunities for targeted transformation.[9]

The framework instrument identifies several key capacity dimensions that have been identified as significant or critical for improving elementary science education programs. These areas include: a) the vision and plan the

[8] St. John, M., Century, J., Tibbitts, F., Heenan, B. (1994). *Reforming Elementary Science Education in Urban Districts: Reflections on a Conference in Inverness, California*. Retrieved from http://www.inverness-research.org/abstracts/ab1994-01_Rpt_UESC_UrbanSciEduc.html.

[9] The 2008 BaySci District Capacity Framework was also used in part to help select the two districts that would be supported by the Moore foundation as part of the BaySci Teacher Professional Development Program.

district has for improving its program; b) the strength and distribution of expertise that can provide leadership for improvement efforts; c) the capacity of the district to design and deliver professional development, high-quality curricular materials, and appropriate assessments; d) the district policies and priorities that shape how much science gets taught.

In addition the Framework also assesses the strength and nature of those external contextual conditions that most influence the teaching of science at the elementary level. These conditions include finances, accountability, and instability in the system. (See Appendix D for the actual framework.)

In 2008 and again in 2011 Inverness Research rated each school district in terms of their capacity for developing and supporting its elementary science program along 25 dimensions using the District Capacity Framework. Ratings were also given for the degree to which BaySci contributed to each dimension and extent to which contextual factors have had a negative impact on capacity.

The following chart highlights some of the district capacity ratings, noting increases over time, BaySci's contribution, and impact of contextual forces. (The ratings of district capacity are circled. A grey circle signifies low capacity (i.e., rating of 1 or 2 on a 5 point scale). A green circle signals medium or high capacity ((i.e., rating of 3, 4 or 5). The size of the circle indicates how low or high, with a large grey circle meaning 1, very low capacity, and a large green circle meaning 5, very high capacity). Using a similar format, arrows indicate the degree to which BaySci has contributed to the development of capacity as well as the extent to which contextual factors have prevailed. (Upward arrows portray an increase or positive influence; downward arrows describe diminishment or negative influence. A larger arrow means a greater influence or effect.)

There are several things to note about the chart on the next page:

- There are many different capacities that contribute to a district's ability to develop, maintain and improve its elementary science program. The more capacities that a district has developed, the more likely it is to be able to support a strong elementary science program.
- Districts vary greatly in these capacities, and they change over time for a variety of reasons.
- These capacities can be developed - and they can be lost.
- BaySci has contributed significantly to the development of many of these capacities, in different ways for each district.
- BaySci is working to build and strengthen these capacities at the same time the context has limited the growth or even eroded many of them.

BaySci District Capacity Ratings 2008 - 2011

	Newark				Novato				Palo Alto				Petaluma			
	2008	2011	BaySci contrib	Context	2008	2011	BaySci contrib	Context	2008	2011	BaySci contrib	Context	2008	2011	BaySci contrib	Context
I. Vision and Reality																
A Plan And Concrete Vision of The Development And Implementation	4	4	4	3	4	5	5	2	4	4.5	4	2	3	3	4	4
A Widely-Shared Programmatic Vision	4	4	4	2	3	4	5	1	4	4.5	4.5	1	2	3	3	3
A Widely-Shared Common Vision of Good Science Teaching	4	4	4	2	3	4	5	2	4	4.5	4	3	3	3	3	4
II. Leadership																
Core Group	3	4	5	4	4	4	5	3	4	5	4	1	3	3	4	4
Science Lead Teachers	3	3	4	3	3	4	5	2	2	4	4	2	2	3	5	3
An Elementary Science "Point Person"	3	5	5	3	4	3	5	3	4	5	3	1	3	2	4	4
District Elementary Science Coordinator or Science Specialist	1	5	5	3	1	3	5	3	1	5	3	2	1	1	4	4
National connections and expertise	5	5	5	1	3	4	5	1	3	4	4	2	2	2	3	2
The Superintendent	4.5	?	4	5	3	?	4	5	4	4	4	2	3	2	4	4
III. Instructional Improvement Capacities																
Capacity to Design and Offer PD (utilizing internal and external expertise as appropriate)	2.5	3	4	3	3	4	5	2	4	5	5	1	2	3	5	3
Professional Development: Use of the materials	3	3	5	4	3	4	5	2	3	5	4	2	3	3	4	3
Inquiry-based instruction	3	3	5	2	3	3.5	5	2	4	5	5	2	2	2	3	2
Professional Development: Language Development and Literacy: for Teachers	2	4	4	1	3	4	5	2	3	5	5	2	?	1	?	?
Curriculum: Curricular Leadership	3	3	4	3	3	4	4	3	4	5	5	1	2	2	4	3
Professional Development Leadership	4	3	4	4	3	4	5	3	4	5	4	2	2	2	4	3
Curriculum: Well-established Curricular Expectations	4	3	3	4	3	4.5	4	3	3	4	4	2	3	2	3	3
Curriculum: Program and Instructional Materials	5	5	1	2	3	5	4	1	4	5	4	2	3	4	4	3
Curriculum: Instructional Materials Support System	5	5	1	1	3	4	4	1	5	5	3	1	2	3	4	3
IV. District Policies and Priorities																
District Priority	4	3	4	4	4	3	5	4	4	4	4	2	3	2	4	4
V. Contextual Conditions That Influence The Development of an Elem Science Program																
District Professional Culture and Climate	3	2.5	3	4	3	4	4	3	4	5	4	1	2	2.5	3	2
VI. Summary Judgments																
Trajectory	3	3	4	4	4	?	5	4	4	4.5	5	2	3	2	4	5
Overall ... Internal Capacity	3	3	4	4	3	4	5	4	4	5	4.5	2	2	2	4	4
Intentionality	4	3	4	4	5	?	5	4	5	4	4	2	3	1	4	5
Visible Success in Program Development	3	3	4	3	2	4	5	2	3	4	3	1	2	3	4	3
Signal-to-noise Ratio	3	2	3	5	4	?	5	4	4	3	4	2	2	2	?	5

Based on the district capacity framework ratings and our interviews with administrators and teachers, we have selected and described a few significant dimensions in which there is common and strong growth in capacity across the districts:

Developing a Concrete Plan and Vision

The BaySci leadership seminar brought together district leadership teams (composed of district administrators, principals, and teacher leaders) providing them with a chance to learn about science reform and some key steps in building strong science programs. The seminars also created the opportunity and time for districts to revisit their goals, accomplishments, most pressing needs and next steps. This opportunity to reflect on accomplishments and challenges, and to strategically plan within each district and across districts (during time provided for sharing goals, accomplishments and next steps) supported an iterative and generative process of planning and visioning. The shared and public process of planning, laying out goals, and reporting progress encouraged districts to be accountable to each other. This helped to keep science "on the front burner" and to actually implement the plans they created.

During the final leadership seminar this year, focus group interviews were held with district teams. We draw on these focus group interviews throughout this section.

- In Novato there is a more consistent and uniform approach across the district for science teaching and learning occurred because of BaySci:

  I think we are a lot more uniform in our approach to science between the different schools now than we were before. It also provided a common language and so when we are talking about inquiry, I think everyone across the district knows what you are referring to. If you are talking about notebooking, everyone understands and when we are talking about the connection between literacy and science, we have a common language that says there have been these trainings and that conversation happens at every site and we have something to connect and talk in the same way, having the same conversation. There is a greater articulation.

Developing Distributed Leadership for Science Improvement

Through its leadership seminar BaySci contributed to the collective and individual leadership in each district. Importantly, through institutes, workshops and technical assistance, BaySci provided additional supports for the development of teacher leadership. This has meant that teachers are "at the table" when program decisions are made, and in many cases facilitating meetings or sharing ideas about effective science instruction at staff meetings, professional development days, and at BaySci workshops.

- In Petaluma a group of leading teachers in elementary science has emerged out of BaySci and been recognized by administrators and teachers throughout the district. They have supported each other as they work with other teachers at their schools; they have helped facilitate district-wide staff development days, and have presented workshops at other schools sites. Some have presented at CSTA and one has published an article in a NSTA publication. This group is a good example of how BaySci is empowering teachers to teach teachers and shows the secondary effects of building leadership capacity. District leaders and teachers report that without BaySci this cadre of teachers would not exist.

- In Newark, the "FOSS + Guided Language Acquisition Design (GLAD) Planning Guide" designed by Kim Nickerson, a BaySci teacher leader provided a useful guide to teachers:

  A planning tool NUSD teachers can use to integrate their knowledge, experience and skills about GLAD Strategies, science talk, FOSS storylines, and focus questions.

  Additionally, "How to Teach with FOSS Kits in Combination Classes" was developed by BaySci teacher leaders Greg Swartz, Michelle Dattke, Linda Simpson, Pamela Hughes and Leonor Rebosura (BaySci Science Coordinator). This resource guide was written to provide teachers of combination classes with practical planning and instructional information will be available to NUSD classroom teachers to use in August 2011.

- In Novato a member of the BaySci district leadership team noted:

  Teachers on the leadership team have directed our district in guiding the development of the science program…. The teachers see that their ideas really are shaping what we are going to do in science as a district.

  In January this year Novato organized a district-wide daylong professional development day for science. Members from the Lawrence Hall of Science and the Exploratorium presented workshops related to science inquiry, literacy and language connections, and FOSS in the morning, and teachers who had participated in BaySci professional development workshops facilitated grade level group meetings for teachers from all elementary schools in the afternoon. BaySci provided some technical assistance and guidance for the day, but the district leadership team for science took the lead in organizing and facilitating the day. The BaySci-funded district science coordinator noted:

Building leadership capacity is the quiet part. It is truly expanding beyond the core group. Teachers are stepping up in confidence…. There is a core group that will step up peer-to-peer in the system.

And the director of curriculum and instruction indicated the science scores (for 2010) had all gone up except for one school:

You have empowered us, you really have — I'm thankful. We will continue on this journey. It is a powerful relationship.

- In Palo Alto, during the first year of BaySci, the science TOSA had two teacher participants in her science study group. By September of 2010 the number of science study group participants has risen to 15. One district administrator had this to say about the teachers on their leadership team:

  I think that the strength of our team is that it includes classroom teachers, principals, district level administrators, and TOSA people…. I think that the professional development we do is so much better because teachers are involved in the leadership — they are advising the direction and talking about the utility of various strategies, and they are being honest and forthright about what is challenging…. So BaySci does not need to provide a workshop to every single teacher in our district…. That is why teacher leadership is essential in science…. or indeed in any subject area.

  Palo Alto draws on its own leadership and expertise to offer a summer institute for its teachers on science, literacy, and math with five follow-up days. BaySci has provided technical assistance with planning and offering these workshops and follow-ups, assisting the Palo Alto leadership team with planning and in some cases presenting, but the district itself offers this PD.

The membership of all of the BaySci district leadership teams has evolved in the past three years — changing in numbers and members. Each district has maintained some ongoing member(s) across the three years. These members carry the momentum, institutional memory and vision of the work into the next year, while new members bring new ideas, perspectives and some familiar questions — which always push the group again to reflect and re-articulate its vision and plans.

Support for Materials Management

BaySci pursues a strategy of implementing high-quality materials. BaySci contributed significantly to two of the districts by helping them create a systemic, dependable and responsive way to provide the materials and equipment classroom teachers need to teach hands-on, inquiry science in a regular and dependable fashion. Central to this capacity is a school — or district-based person who is responsible for seeing that the curriculum kits are stocked, and delivered to schools and classrooms at the right times.

- Petaluma, Novato, Newark, and Palo Alto were all supported through the District Capacity Building Program's Instructional Materials Management workshops. In Newark and Palo Alto, the managers of the Instructional Materials Centers (IMCs) that serves to re-furbish, check out and in FOSS kits attended, and in Novato and Petaluma, the lead teachers at each site that supported the site-based materials management attended.

- In Novato the materials system is still school-based, but through the course of the program it became more systematized, with the district learning from the two other BaySci districts that have a centralized system. Though still school-based, now each school has an appointed lead science teacher who gathers materials order forms from teachers submits them to the district. One teacher noted:

  We are spoiled because we have funds that provide for kit replenishment and we have grade-level representatives who help us with re-assembling the kits and taking an inventory so we can compare the difference between what's still in the boxes and what needs to be replaced. One other great thing is that we have a small storage room where we can keep some of the overflow, especially of kits we are not currently teaching and that's really helpful…. And then our principals give us prep days — we just had one for science recently — and we can go to the storage space and gather our materials for our kits.

- In Newark, a Science BaySci Coordinator, a 0.5 FTE position funded by the BaySci grant, provided communication, coordination of grant activities and management of additional grant funding. From January-June 2011 due to personnel changes in the district, the BaySci Coordinator also assisted in the supervision of two Educational Services departments: Instructional Materials Center (IMC) and Science Resource Teachers (SRT).

  In April, the BaySci Coordinator applied to Cargill, Inc. for a grant to purchase additional FOSS Kits for 4th & 5th grade classrooms. Cargill awarded NUSD $16,000 in May. Ed. Services will purchase the additional FOSS Kits will be ready for use by August 2011. A similar grant will be submitted in the fall of 2011 for additional kits for Grades 1-3. The additional kits may eliminate the current FOSS rotation schedule and improve access to the kits and curricular integration of science.

Summary of Impact on District Capacity

Data from the district capacity framework ratings indicate that districts varied considerably in terms of their capacity for both supporting and improving their elementary science education programs. They also show that the BaySci project has been able to contribute to a range of capacities and to customize its support for each district with the result that different districts grew their science programs in different ways and at different rates. Overall, the findings from the capacity framework ratings indicate the importance of the efforts of BaySci to address key issues in the districts, and to focus attention on the ongoing need to develop the ability of the districts to strengthen their elementary science programs.

In terms of the contribution to the districts' capacities, BaySci contributed substantially or a great deal to 11 capacities in all four districts (i.e., BaySci contribution was rated 4 or 5 in each district):

- A plan and concrete vision of the development and implementation
- Core group
- Science lead teachers
- Curriculum: curricular leadership
- Professional development: use of the materials
- Capacity to design and offer professional development (utilizing internal and external expertise as appropriate)
- Professional development leadership
- District priority
- Overall development of increased internal capacity
- Intentionality
- Trajectory

In addition, BaySci contributed substantially or a great deal to nine capacities in three districts (i.e., BaySci contribution was rated 4 or 5 in three districts):

- A widely shared common vision of good science teaching
- A widely shared programmatic vision
- An elementary science "point person"

- District elementary science coordinator or science specialist
- National connections and expertise
- Curriculum: program and instructional materials
- Inquiry-based instruction
- Professional development: language development and literacy for teachers (III.)
- Visible success in program development (VI.)

The district capacity ratings illustrate the ongoing dynamic struggle between developing and losing an elementary science program. It is not possible to predict long term whether the support of BaySci is stronger or weaker than the eroding forces of the non-supportive context. It is an ever-changing balance varying from district to district and time to time.

3) Increasing School and Teacher-level Capacities to Support and Improve Elementary Science

BaySci has fostered and improved school and teacher-level capacities at each district in multiple ways.

Professional Development Dissemination and Implementation Beyond BaySci Offerings

The ratings on the district capacity framework for professional development capacity show increases for all four districts. The teacher leaders who have participated in BaySci workshops have imported materials and ideas into workshops at their own districts. This is particularly true in the areas of inquiry and science literacy.

- In Palo Alto, the Teachers on Special Assignment (TOSAs) for Science and for Literacy collaborated throughout the BaySci Project. They planned and conducted summer institutes in the district that were focused on this integration, with technical assistance support by BaySci. Their work was also shared and used by other BaySci Districts. The Literacy TOSA explained:

  I think integration has become much more central in our district. After the literacy adoption… [the Science TOSA] and I worked really closely on aligning literacy and science. We collaborated on buying the reading books for all of the FOSS kits; we have supported that with a lot of professional development around science, and we have embedded English Language Development (ELD) into the work we are doing.

- Because of BaySci, there is a group of teacher leaders focused on elementary science education in Petaluma. Within the District, this team is seen as a group of leaders. They work on helping each other and helping other elementary teachers teach science and support them in hanging in there despite the difficult context (finances, in particular). This group helped facilitate the district-wide staff development days focused on science during the first year of BaySci. During this first year they also went to sites and presented workshops. Teachers value learning from the teacher leaders who have real classroom experience teaching science and using FOSS. This group is committed and interested in growing this leadership cadre. In 2010, one member of this group noted:

  Without BaySci, this teacher leader cadre would not exist. There has never been an effort in the District to have a District team with teacher leaders and an administrator that serve as a science committee.

- With technical assistance from BaySci, Newark was able to support eight (8) teacher leaders to design, plan and facilitate a district-wide professional development workshop on "Supporting Academic Language Development for Students in Science and Other Core Content Areas". Additionally, nine (9) teacher leaders also designed, planned, and facilitated grade-level specific workshops that supported teachers with the integration of FOSS and Guided Language Acquisition Design (GLAD), a district-wide initiative for language acquisition and literacy among all students.

Enhancing Teacher Preparedness and Confidence

As a result of access to high-quality materials and an increase in professional development, teachers across the districts are beginning to feel more confident and prepared to teach hands-on science to their students. Perhaps no district capacity is more important than having a teacher workforce that is willing, prepared and even eager to teach science.

- One teacher explained how the combination of BaySci supports helps teachers with being more likely and better able to teach science in their classrooms:

  What we [got] is a way to approach science with inquiry — how to ask questions of our students…. Also we have learned how and why to do notebooking and how the notebooking process leads students to make better observations and come to better understandings. It also leads to literacy and being able to write about what they see… I don't think that there were a lot of people (doing this) before we started BaySci. I think all of this is invaluable.

- Another teacher in Novato explains the importance of developing a shared language and understanding of science teaching across the district:

  I think we are a lot more uniform in our approach to science between the different schools now than we were before. BaySci has provided us with a common language and so when we are talking about inquiry, I think everyone across the district knows what you are referring to. If you are talking about notebooking, now everyone understands what you mean… and when we are talking about the connection between literacy and science… we have a common language…. We have something we all can connect with… we are all having the same conversation…. There is a lot more science going on in every single classroom, even among those people who did a lot of science. I think it is more cohesive and I think it is more consistent and I think it makes it easier. There is a greater articulation.

Analysis of survey data collected from Newark and Novato district teachers showed little to no change (no significant change) in teacher self-reports of instructional practice from year to year. However, teacher self-reported preparedness data showed the mean score across all survey respondents on the preparedness scale increasing from the beginning of the first year (September, 2009) to the end of the first year (June, 2010). This new value was then maintained into the beginning of the second year (September, 2010) and again increased during the second year (June, 2011).

Table 2. Teacher Survey Preparedness Scale Descriptive Statistics

Preparedness Scale

	N	Mean	s. d.	Min.	Max.
September, 2009	243	2.89	0.53	1.35	4.06
June, 2010	163	2.98	0.50	1.06	4.06
September, 2010	196	2.99	0.53	1.12	4.06
June, 2011	140	3.12	0.52	1.38	4.06

The work of BaySci in these four districts has begun to enable districts to provide their teachers with better professional supports and better materials. And, the additional influx of professional development in Newark and Novato supported statistically significant changes in teachers' self-reports of preparedness. Together these elements are slowly beginning to improve the will and ability of teachers to teach science at the elementary level.

4) Increasing and Improving Opportunities for Students to Learn Science

Through supporting the improvement of the district science program and by helping teachers feel better prepared and more confident, BaySci is contributing to the districts' ability to provide high-quality opportunities to learn science. Below we discuss the amount of science taught, the quality of that teaching, and some summary data on student achievement.

Quantity of Elementary Science

BaySci is helping districts create an environment in which science is more likely to be taught. Our survey and interview data suggest that high-quality, credible and sustained programs create an array of supports that help teachers find the time and ability to teach science.

According to the survey data from the Status of Science Education in Bay Area Elementary Schools study (Dorph, et al. 2007), eighty percent (80%) of K-5th grade multiple-subject teachers who are responsible for teaching science in their classrooms reported spending 60 minutes or less per week on science, with 16% of teachers spending no time at all on science. BaySci quantitative analyses from Newark and Novato teacher surveys showed only thirty-two percent (32%) of K-5th grade teachers reported spending 60 minutes or less per week on science. Sixty-eight percent (68%) of K-5th grade teachers in Newark and Novato reported spending more than 60 minutes each week on science. The average amount in K-3 classes is 77 minutes/week; while the average in the 4-5 grade classrooms 107 minutes/week. This suggests that more science is being taught in these BaySci districts over the past two years than was being taught across the Bay Area in 2007.

- Most of the teachers interviewed reported that they are teaching more science and that more science is being taught at their school. As a Novato teacher explained:

  There is a lot more science going on in every single classroom, even among those people who did a lot of science before…. I think the teaching is also more cohesive more consistent.

Quality of Elementary Science Instruction

During the 2008-2009 school year and again in 2010-2011, Inverness observed a sample of science lessons in all of the BaySci districts.[10] A

[10] In 2008-2009, the number of lessons observed in each district is as follows: Novato 9, Newark 15, Palo Alto 9, and Petaluma 7. In 2010-2011, there were a total of 33 lessons observed (Novato 13, Newark 11, Palo Alto 5, and Petaluma 4). The group of teachers represented a range of participation in BaySci and did not receive uniform intervention.

modified version of the Horizon classroom observation instrument was used to compare the NSF-funded Local Systemic Change projects and a national study of science and math classrooms to the BaySci classrooms.[11] Ratings of overall lesson quality indicate that elementary science lessons in the BaySci districts are higher than a national sample.[12] In looking at the last round of observations, thirty percent (30%) of the lessons in BaySci districts were rated of high-quality versus seventeen percent (17%) in the *Looking Inside the Classroom Study*[13] conducted by Horizon Research Inc. (HRI) in 2003. Twenty-four percent (24%) of the lessons in BaySci districts were rated as low quality (a "1" or "2"). However, none of the lessons were given the lowest rating of "1". This is substantially better that the national sample in the HRI study where 54% of the lessons were deemed of low quality and 20% of those lessons were rated "1".

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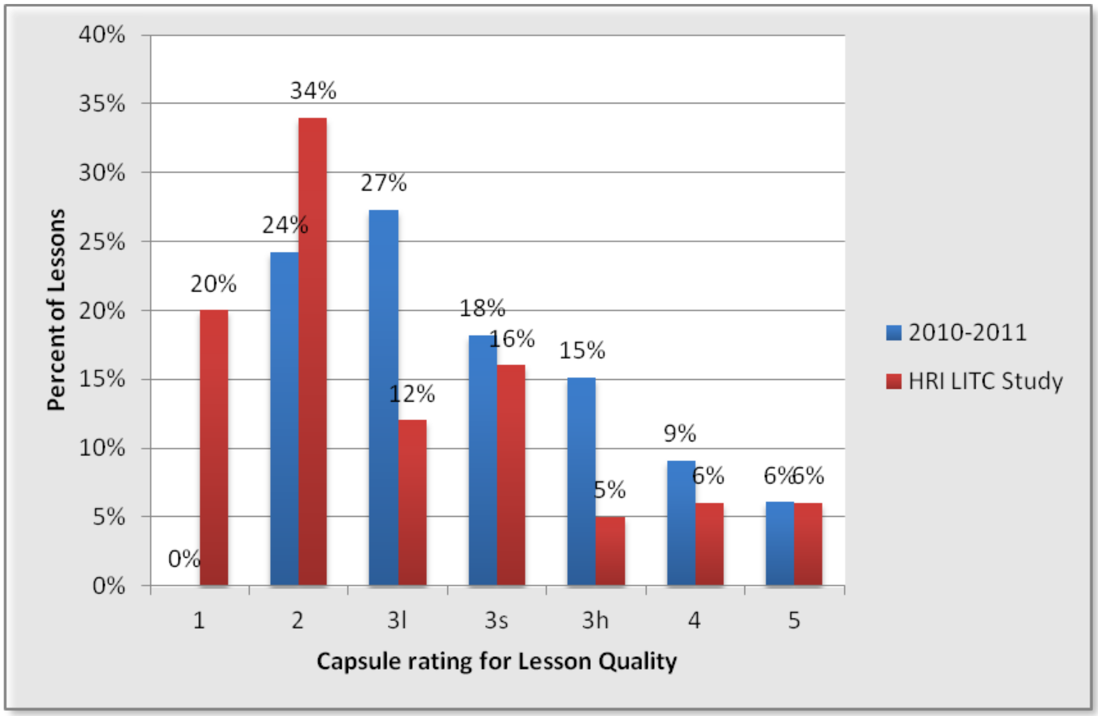
[11] See Appendix F BaySci Classroom Observation Protocol.

[12] These are capsule ratings of overall lesson quality are based on the classroom observation protocol created by Horizon Research. Ratings of 1 and 2 indicate low quality lessons. Ratings of 3 low or 3 solid are given for lessons that are medium in quality. Ratings of 3 high, 4 and 5 designate high-quality lessons. See Appendix F BaySci Classroom Observation Protocol.

[13] Weiss, I., Pasley, J., Smith, S., Banilower, E., Heck, D. (2003). *Highlights Report, Looking Inside the Classroom: A Study of K-12 Mathematics and Science Education in the United States*. Horizon Research Inc.

Figure 2. Classroom Observation Capsule Ratings Comparison: BaySci 2010-2011 & Looking Inside the Classroom Study



The results of observations cannot be overgeneralized, but we believe it is fair to say that the four districts involved in BaySci in 2010-2011 exhibited higher quality lessons than would be found in the typical California elementary classroom. The steady and consistent usage of the FOSS kits has helped to create a "foundation" of quality at the "2 and 3" level. And for those more ambitious and/or experienced teachers they are able produced lessons at the "high 3", "4", and "5" levels. We note that BaySci has not "fixed" all classrooms. Rather it might be useful to think of BaySci as helping to raise the tide of science education in its participating districts and thus slightly lifting all boats (teachers). BaySci provides an upward pressure on science teaching, and the result is not uniform excellence in teaching across the entire district, but rather a raising of all levels and overall providing better quality instruction than otherwise would be the case, and better than the national or state average.

When we look specifically at those two districts that had the additional infusion of professional development services, we note additional impacts. Quantitative analyses of teacher survey data show that ***teachers who participate in more intensive forms of professional development show increased levels of preparedness and implementation of investigative-oriented and science-literacy integrated practices in classrooms than those who did not participate.*** We conducted analyses in Newark and Novato in which we collapsed the responses of teachers in the BaySci

Teacher Professional Development Program professional development groups (Intro to FOSS, Advanced FOSS, and the Teacher Leadership Academy) to compare them against the responses of teachers in the BaySci District Capacity-Building Program group and the Control Group. That is, we examined the difference in the mean response at the end of each year (for both year one and year two) between teachers at more intensive professional development levels against teachers at less intensive levels and adjusted for their initial scale score at the beginning of the year.

Examining the Preparedness scale, we found that teachers in Intro to FOSS, Advanced FOSS, and the Teacher Leadership Academy rated themselves higher on the preparedness scale at the end of the first year compared to teachers in the District Capacity and Control groups after adjusting for beginning of each year responses. However, this difference was not maintained in the second year. The results also indicate that across both years the Classroom Instruction scale mean response for teachers in the Teacher Leadership Academy, Advanced FOSS, and Into to FOSS groups are statistically significantly higher than those of the Control group. That is, as teachers' transition from the Control group to any of the more intensive professional development levels (Teacher Leadership Academy, Advanced FOSS, and Into to FOSS), their predicted score on the Classroom Instruction scale increases by a statistically significant amount.

Relatedly, in comparing the 2008-2009 to the 2010-2011 classroom observation ratings for Newark and Novato,[14] the latter data set shows us that the quality of elementary science lessons still mixed but there are slight increases in lesson quality along the rating scale. In Newark, fewer lessons were rated to be of low quality (a rating of a 1 or 2) and the majority of lessons were rated in the 3 range. In Novato, the picture is more bifurcated. While the number lessons rated a 2 increased, so did the number of lessons rated a 3 high.

[14] In 2008-2009, 9 teachers were observed in Novato and 15 in Newark. In 2010-2011, 13 different teachers were observed in Novato and 11 in Newark.

Figure 3. Classroom Observation Capsule Ratings Comparison: Newark 2008-2011

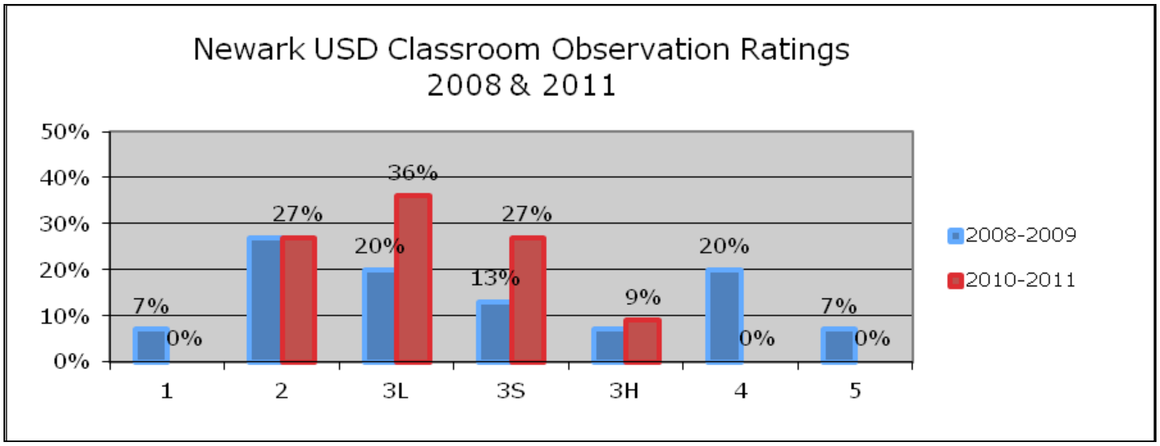
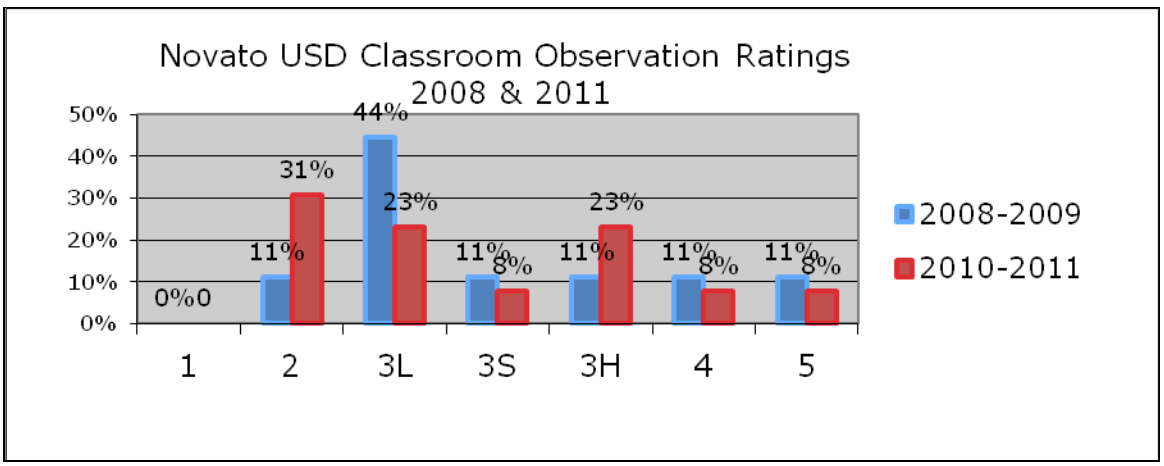


Figure 4. Classroom Observation Capsule Ratings Comparison: Novato 2008-2011



Quantitative analyses of Newark and Novato data also point to some interesting and unanticipated results regarding BaySci. Analyses were conducted to determine if there were differential growth rates for individuals who experienced different types of professional development across both the District Capacity Building Program and the Teacher Professional Development Program.[15]

[15] To account for the types of professional development available to teachers in the model, a dummy coding strategy was used. Each level of professional development was coded as being present or absent for the individual at the time of each survey. Because teachers increased and decreased how much professional development they participated throughout the year, only the highest level of professional development was modeled at

(footnote continued)

In exploring responses to the teacher survey Classroom Instruction Practices, Preparedness, and District/School Culture scales over time by professional development participation level (see Appendix C), we found that there were very few teachers (<10) from the District Capacity professional development level that completed surveys after the first time point (September 2009), indicating that these teachers either stopped filling out surveys or experienced another form of the professional development experience. Interestingly, at the end of the first year (June 2010) and at the end of the second year (June 2011), the highest mean scale scores among the various professional development levels on all three scales was the Advanced FOSS (FOSS Level 2) group. This is in fact the case at every time point and on every scale except for in February 2010 on the Classroom Instruction scale when the Teacher Leadership Academy group is just slightly higher. The Control Group was often the lowest scores on the scale.

The values on the Classroom Instruction scale remain fairly flat through time for the Control Group. The District Capacity group is lower in the second year than in the first year. The Intro to FOSS (FOSS Level 1) group fluctuates substantially with the changes in the number of survey respondents (e.g., when there are fewer respondents the mean values tend to be lower). The mean value on this scale for the Advanced FOSS respondents (FOSS Level 2) increases during the first year then remains at that elevated level throughout the second year. Finally, the responses from the Teacher Leadership Academy level seem to fluctuate over time without a clear pattern.

It must also be noted that for the District and School Culture scale, changes on this scale indicate a large increase in the survey mean from the beginning of the second year (September 2010) to the end of the second year (June 2011) across all the professional development groups.

Ultimately, these findings suggest that the overall BaySci investment supported improved classroom practice albeit in ways that were uneven over time, across districts, and across differing levels of professional development intensity. More intensive professional development offerings seems to support initial increases in feelings of teacher preparedness and confidence in teaching science, as well as instituting more reform-based science classroom practices. In particular, the specific professional

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a given time. For any given time period a teacher cannot be in multiple PD groups so the highest level observed within the time period was assigned to the teacher. The depth of professional development experience for an individual could, therefore, change through the year. Additionally, all individuals either started in either the Control Group (District Professional Development Day category) or the District Capacity category at the first time point. It should also be noted that District Capacity professional development may have occurred before the first survey, however, professional development types accounted for in our analyses occurred after the first survey.

development intervention of the Advanced FOSS (FOSS Level 2) is one example of where relatively low investment (one-day professional development) produces high yield (sustained elevated levels of reform-based classroom practices in science).[16]

Benefits to Students: Attitudes and Achievement

During interviews, teachers also report influences on their science teaching resulting in benefits to their students, reporting in different ways that their science instruction has changed and that the learning of their students has improved. Main areas of BaySci contribution included increases in use of inquiry-based instruction and integration of science with literacy (e.g., use of science notebooks and science talks

- A teacher from Palo Alto said:

  When I hear the kids describe their thinking it really helps me understanding how much they are grasping and the science talks lend themselves well in that area. In our district we are spending more time talking and listening (for ELL especially). Each year I always think that I'm going to have more of an immersed classroom in science, but we get more things added to our plate.

- Another described in very specific terms strategies she uses to integrate:

  I have vocab cards with little pictures on them now so the students have a better idea of what we're doing. I also ask a focus question… this time it was "what are the parts of a fish" and I also added academic language, "observe" "communicate" I also do the "read it, write it, think it" piece. So I use notebooks more and more effectively. All of the things I'm doing are things that support each other and help the kids learn more. We've been working in our district to integrate curriculum more.

- A teacher from Newark discussed the value of student discussion in science:

  The work on science talks has been really helpful. It isn't in FOSS, but it has been very eye opening for me to hear what my students have to say. I have a better understanding of how my students are doing.

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[16] However, as previously stated, the mean responses indicate the average response across all survey respondents within a particular professional development group at different time points. We can use these responses to gauge the changes in these groups over the two years, although it remains unclear if the changes are due to changes in who responds to the survey, changes in the actual response of individuals, or small and/or fluctuating survey respondent populations.

- A Novato teacher had this to say about the use of science notebooks, inquiry and questioning:

  The notebooks were really great. Also during the Inquiry workshop there was a section on dialog and discourse and how to really use questioning to do inquiry; that was really impressive. Before that point I'd really felt myself get frustrated in my attempts to get discourse in my classroom.

Quantitative data analyses of 3rd through 5th grade student surveys[17] in Newark and Novato do not provide any conclusive statistical data on the improvement of student attitudes over the duration of the BaySci Teacher Professional Development Program (2009-2011). Student attitudes decreased in the first year of the program only to rebound at the beginning of the second year, followed by a decrease again.[18] However, in year two (2010-2011) ***students in classrooms of teachers who participated in more intensive forms of BaySci PD showed significant positive differences in self-efficacy related to science compared to those in classrooms of teachers of teachers that did not participate.*** More specifically, on the Self-Efficacy student attitude scale score, we found a marginally statistically significant difference in the mean response between students who had teachers at the more intensive professional development levels compared to students who had teachers at the less intensive levels after adjusting for initial scale scores at the beginning of the year. Students who had a teacher in the Intro to FOSS, Advanced FOSS, and the Teacher Leadership Academy groups had a higher mean scale score on the Self-Efficacy scale than students who had teachers in the District Capacity and Control groups in year two. There was no difference in these means for year one (2009-2010).

However, district leaders also talk about a deeper and more reflective discourse about science amongst teachers regarding the work going on in classrooms with students:

- *I see teachers thinking about how to bring science in, on a more consistent and successful basis, whereas before it tended to be "here is the FOSS kit and I am doing it today and then I am moving on… But now the inquiry, the room observation, the science talk has started to evolve…*

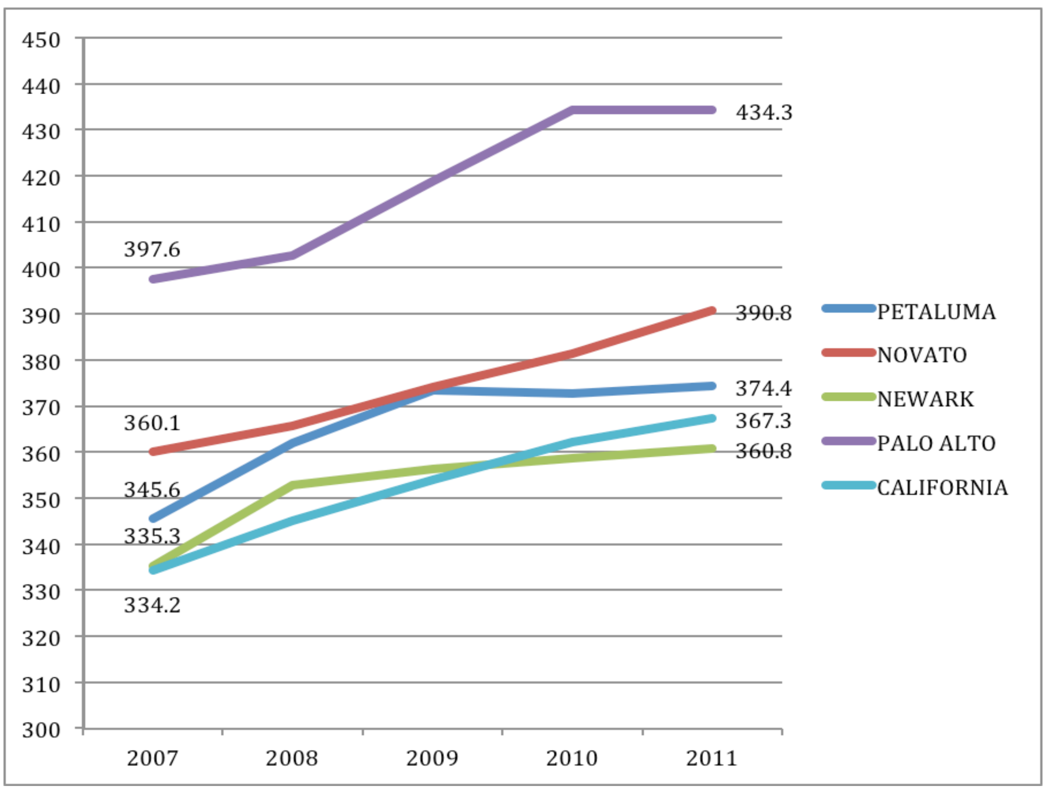
[17] Students in Kindergarten through 5th grade in both school districts were given an adapted version of the Feelings Towards Science Inventory. The surveys for students included four scales (Affect, Self-Efficacy, Identity and Interest), however the Kindergarten, 1st grade, and 2nd grade survey data proved of little utility given the difficulty of using survey methods to collect valid and reliable data at these early grades. Response rates on the survey administered in grades 3-5 were quite low, calling into question the utility of the analysis presented herein.

[18] This finding may be due, in part, to the consistent decrease in number of classrooms and overall students over the course of the two-year student survey administration.

- *I have been in a lot of science groups around the district and in other districts and the level of sophistication and conversation in this group is amazing to me…. I go to those meetings at the science resource center and I listen to what my peers are saying and it just blows me away, like wow, these people understand science teaching at a level I have never seen.*

- *The teachers who have participated do more questioning and thinking with their students and they do more 'science talks'…. I can tell when those students come to me. I think that in general their science instruction is now more real science and less guided. They understand more about how to let kids discover on their own.*

Over the course of the three years, all of the BaySci districts also saw an increase in the mean of the 5th grade scores of the science California Standards Test (CST) of at least 25 points. In 2011, three of the four districts (Novato, Petaluma, and Palo Alto) earned mean scores above the state average and also had higher percentages of students scoring *advanced* than the state average. (See Appendix E for more detailed breakdown of scores).



We interpret this strength as evidence of districts that put a priority on science, who develop strong programs, and who provide good materials and professional development and are, thus, likely to have better student learning experiences and support student achievement. BaySci supports districts and teachers to achieve those goals.

III. Challenges to Improving Elementary Science Programs

At the same time that BaySci worked to strengthen science programs, there were growing contextual forces that favored the diminishment and erosion of elementary science programs across the state. Thus it is important to understand that BaySci worked "against a headwind"; often progress consisted of "staying even" and BaySci provided a countervailing force against the pressures that threaten to eliminate science. The forces that constrained and challenged BaySci included ongoing statewide financial crisis, national accountability pressures, and instabilities and "churn" within the system.

In an external research summary conducted by FSG Social Impact Advisors in early 2011, the researchers outlined barriers to elementary science education. Specifically, interviewees identified the following barriers: teachers continue to be inadequately prepared to teach elementary science education (both pedagogy and content), and do not have resources for materials or prep time for science; districts frequently lack a coordinated, organized approach to elementary science learning; due to pressures from No Child Left Behind (NCLB) and accountability focused on literacy and math, districts typically provide few requirements or time for elementary teachers to teach science in the first place; and, issues of teacher turnover and lack of resources, which can limit the ability of districts to implement quality science education, have been exacerbated given budget cuts and layoffs. Additionally, according to the 2010 report, *Strengthening Science Education in California*,[19] 86% of parents surveyed believe that it is very important or essential to teach science in schools, however, anecdotal information from FSG's interviewees suggests that parents are following the state's lead in emphasizing math and literacy and are not acting to advocate for science in the classroom. They found there is little coordination of activities and agendas among various stakeholders (including communities, SREI's, and out-of-school service providers) interested in advocating for elementary science. They also discovered that local businesses — a potentially influential group for driving and supporting change based on the experience of other benchmark organizations — often do not make the connection between their priorities and elementary science education.

[19] The Center for the Future of Teaching and Learning. (2010.) *Strengthening Science Education in California*. Retrieved from http://www.cftl.org/documents/2010/2010SciCFTL4web.pdf.

Impact of the State Financial Crisis

Over the last three years, the situation of state funding for K-12 public education has gone from poor to horrible. This has been a severe shock to the system with districts fighting to maintain operations and the bare minimum instructional services. This has put very strong constraints on the use of any resources for the ***improvement*** of education.

Newark USD provides an illustrative case that exemplifies the stresses districts in California are now dealing with. The district has a severe budget crisis with its overall budget dropping substantially each year. Class sizes have increased dramatically; teachers with less seniority fear for their jobs; the science resource teacher ranks are half of what they were at the beginning of BaySci. High turnover has occurred at all levels including the superintendent's office (in June 2009 and 2011). The district-funded elementary science education coordinator position was eliminated in June 2009. Many teachers report that they are worn out, stressed out, and demoralized.

Pressures of Accountability

NCLB and standardized testing cause explicit pressure on teachers to concentrate highly on those subjects that are tested. Especially for schools under Program Improvement there is heavy pressure to raise reading and math scores; this leads to little or no teaching of science.

- One teacher summed up her sense of the challenges for teaching science this year:

  Our school has lowest reading test scores in the district at our 4th-5th grade levels. So at the semester break, our principal, along with the teachers, decided to level 4th and 5th graders and divide them up among all the 4th and 5th teachers to do reading groups in the afternoons across those grade levels. It is also our responsibility to handle other subjects taught in the afternoon block, which include both social studies and science. As a result, with the focus being so strongly on improving reading, my afternoon class of 4th and 5th graders has done very little science. I feel awful about it, but that's the reality we are dealing with.

The state curricular adoption cycles, including recent language arts and math adoptions, can shift districts' scarce professional development resources further away from science.

- One principal talked about how essential BaySci is for keeping science going in light of these adoptions:

We have had to push the last two years on math and literacy and if I hadn't been part of this, I wouldn't be looking or thinking about science, at all.

Instability and Churn within the System

Over three years BaySci districts have experienced significant transition of administrative leadership at the district and school level. Three of the four districts now have new superintendents. All four have had changes in central office administrators in charge of Curriculum and Instruction. While these changes can cause potential disruption of critically important administrative support for a district-wide science improvement initiative, they should not be considered to be anomalous — such turnover is the norm and not the exception. Turnover is even more likely for districts that serve low SES, high EL, and other underserved populations.[20]

Other forms of "churn" also tend to disrupt district-wide improvement efforts. Changes in teaching assignments (shifting schools and/or grade levels) requires the re-training of teachers in science on the particular units they are to teach at the new grade level. The recurring threats (and realities) of teacher lay-offs demoralize teachers and make them less likely to participate in professional development activities or to devote time and energy to the teaching of new science units. Changes in standards, tests, and mandates from the state make teachers less willing to invest their time in a reform effort that may be soon outdated. Overall this kind of churn makes the environment unfavorable for a systemic science improvement effort.

In Petaluma, for example, both the central office administrator and principal leading the BaySci leadership team retired in June 2009, after one year with BaySci. Over the next two years, two more central office administrators cycled through the team. The teacher leaders on the BaySci team have not been able to make as much progress due to so much turnover and varying levels of administrative support. Although, this district has not been as impacted by the state budget crisis as other urban districts, there has still been a number of teachers changing grade levels and some school restructuring.

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[20] Annenberg Institute for School Reform. (2006.) *Leadership Transition Reviews*. Retrieved from http://www.annenberginstitute.org/wedo /LeadershipTransition.php; West Ed. (2003.) *Creating Excellence for All Students: Transforming Education in Los Angeles*. Retrieved from http://www.wested.org/online_pubs/LA-Alliance-Report.pdf; Peters, A. L. (2011.) *(Un)Planned Failure: Unsuccessful Succession Planning in an Urban District*. Journal of School Leadership, v21 n1 p64-86.

Intermittent External Support and the Scale of the Investment

Two of these districts have had National Science Foundation or other forms of external funding, which have helped them develop their elementary science programs. External funding allows districts to improve on their programs and hopefully their long-term capacities for sustaining those programs; nonetheless it is difficult for the districts when the funding ceases, especially in a time of heavy fiscal constraints. Short-term, episodic funding causes uneven progress and even disruptive events. Uncertainty in funding makes it hard for districts and SREIs to plan and build the momentum necessary for improvement. For these reasons the year-by-year funding of BaySci introduced uncertainty and delays into the initiative that lessened its overall momentum and made for disruptive gaps in planning and implementation.

IV. Discussion

The report above highlights multiple ways in which BaySci has helped to build the capacity of the districts, increase the priority and maintain the momentum of elementary science, and to improve teacher preparation, instruction and student learning experiences. The report also summarizes those forces that tend to limit science program improvement and even erode the infrastructure that is needed to support those programs.

BaySci Contributions

BaySci has been a very important force in a challenging time for elementary science. BaySci has helped leaders and teachers maintain focus on science in the four districts it has served. In spite of the countervailing forces, BaySci has supported implementation of new programs in two of the districts and maintained momentum in the other two districts with a history of elementary science reform.

BaySci offers a source of programmatic and intellectual nourishment for participants. BaySci has learned how SREIs can provide critical supports (leadership, professional development, instructional materials) to the most ready districts, schools and teachers. There is an array of evidence to suggest that the work of the BaySci districts to improve their own science programs has furthered a process of better preparing teachers, improving instruction, and providing better science education to elementary students. BaySci has helped to generate a community of shared interest that both contributes to and draws upon its SREI and district members. This community has its own collective momentum and is well positioned as a nucleus for further expansion. Moreover, BaySci has furthered the collaboration of the Exploratorium and the LHS. This partnership could be the first step in the development of an infrastructure composed of Bay Area SREIs – an infrastructure that could provide support to other districts, schools and teachers in the future.

Design Lessons

There are also important design lessons that have been learned through the BaySci experience. There seemed to be a real benefit from the workshops and other supports that concretely helped districts implement FOSS and manage the FOSS materials. Survey results and interviews show that relatively small amounts of support for FOSS implementation have made significant contributions to solidifying and strengthening district-wide implementation of FOSS.

Professional development opportunities provided to Newark and Novato contributed teachers' self-assessment of their level of preparedness for inquiry-oriented science. At the same time, data from the surveys and classroom observations does not show great differences in classroom practice related to the intensity of professional development dosage. That is to say, the most intensive intervention did not result in the highest increase in inquiry-oriented classroom practices. This may well be because the Teacher Leadership Academy (the most intensive dosage) did not reach a threshold level, may not have been coherent enough, extended over a sufficient period of time, or allowed for sufficient follow-up and ongoing support or coaching (or all of these). Further, in delivering the professional development offerings, the Lawrence Hall of Science sometimes worked with one group of lead teachers and the Exploratorium with another. In some cases teachers participated in offerings from both institutions. Our interviews and observations show that this leads to a somewhat bi-furcated teacher leadership effort. At times, teachers reported confusion between mixed approaches and messages. Perhaps it would have been better to invest more intensively and more coherently with a smaller group of teacher leaders for that explicit purpose.

The findings here, as well as the evaluation team's experiences with more intensive initiatives funded by NSF and others suggest that this initiative was important at the district-level but not deep or sustained enough to directly, immediately or substantially influence teaching quality district-wide over the long term. BaySci data does not allow us to definitively determine whether the most intensive of the professional development offerings, the Teacher Leadership Academy, resulted in significant improvements to the quality of classroom practices. Perhaps, additional long-term investments for more ongoing support and coaching to follow up on the complex pedagogical approaches presented in the Teacher Leadership Academy professional development would yield more definitive results.

The BaySci model also suggests that embedding professional development within a more comprehensive approach to science education reform may create synergistic effects among different professional development offerings. The BaySci focus on both administrative and teacher leadership has been effective and has helped develop the human capital, which is critical for initiating and sustaining local improvement efforts in elementary science. Administrators have been inspired and enabled to provide a more supportive context for elementary science in their districts. At the district level Superintendents, Assistant Superintendents, Curriculum Coordinators all help to support the district-wide program development effort; at the school level principals are key. Teacher leaders have infused the perspective of the classroom into district decision- making, and they take the lead in making a science program a reality at the school level. Teacher leaders also provide the "horsepower" for doing the work of professional development and curricular support within schools and districts that are critical to ongoing professional learning opportunities beyond BaySci.

Implications for Future Investments

The BaySci experience points to the value of external investment that supports progressive and cumulative improvement of elementary science education in Bay Area Schools. As with BaySci, such investments have to be highly leveraged as no external investment is either large enough or permanent enough to deliver large scale enduring changes in classroom practices across the entire Bay Area. Further, the BaySci experience to-date offers ideas about what makes sense in terms of future investment strategy. It makes sense to focus on those districts, schools and teachers who are most ready and committed to pursuing improvements in their own local settings. It makes sense to focus on curriculum implementation as the leading edge with professional supports focused on implementing and then improving the teaching of well-designed materials. It makes sense to build capacity for improvement simultaneously at the district, school and teacher levels. It makes sense to provide steady support for long enough time and intense enough levels to develop the human capacity, programmatic knowledge and policy climates, which can sustain improvement efforts after the initial funding is gone. It also makes sense to build communities of districts, schools and individuals who are committed to and expert at improving elementary science. And, it makes sense to invest in SREIs as the platform for organizing and building that community.

With a comprehensive approach to science education that integrates district capacity building, instructional materials implementation, and professional development, BaySci has made significant progress in developing a foundation for future investment and future work that pursues all of these avenues toward improving elementary science education in the Bay Area.

Appendix A:

BaySci Evaluation: Outcomes, Data Collection Methods and Analysis Plans According to Each Program

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District Capacity Building Program

Outcomes	Collection Methods (Group Responsible)	Analysis Plan
District Capacities – Increased district capacities to support and improve its elementary science program	• administrator interviews (IR) • teacher interviews (IR) • focus groups with district leadership teams (IR)	Pre- and post- data analyzed to measure changes in district capacities on multiple dimensions.
Classroom Instruction - Measuring the opportunity to learn in BaySci districts.	• classroom observations (IR) • teacher interviews (IR)	Pre- and post-data analyzed to measure change in quality and quantity of classroom science instruction.

Teacher Professional Development Program

The districts participating in the Teacher Professional Development Program (Newark & Novato) had the following additional elements:

Outcomes	Collection Methods (Group Responsible)	Analysis Plan
Classroom Instruction - Improved quality and quantity of classroom instruction in science delivered by participating teachers.	• classroom practice survey (RG@LHS) • classroom observations (IR) • teacher interviews (IR)	Pre- and post-data analyzed to measure change in quality and quantity of classroom science instruction.
Teacher Outcomes - Improved teacher attitudes (confidence, preparedness, etc.) towards science teaching.	• teacher interviews (IR) • teacher surveys (RG@LHS) • classroom observations (IR)	Pre- and post-data analyzed to measure change in teacher attitudes on multiple dimensions.
Student Learning Experiences - Increased student interest, engagement and positive attitudes for science in participating classrooms.	• classroom observations (IR) • student surveys (RG@LHS) • student focus groups (IR & RG@LHS)	Pre- and post- data analyzed; Comparison of BaySci districts CST data to CA state averages.

Appendix B:

Description of BaySci Districts

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Newark USD: Located in Alameda County Newark Unified School District has a solid history in science education reform, participating in LASER and the PS3 Local Systemic Change grant. By joining BaySci, Newark hoped to continue to keep science as a priority in the district, and to continue having access to high-quality professional development for its teachers. Historically, Newark has had a supportive superintendent and administration, as well as a long collaboration with the Lawrence Hall of Science. The most recent superintendent had a strong science background, and was able to clearly articulate the vision for the science program in the district. The district has been using FOSS for many years and has an established, well-run science instructional materials center that refurbishes kits and delivers them back to schools on a rotating basis. The district expectation is that all three FOSS kits (earth, physical and life science) are taught at each grade level during the school year. Since 1993, elementary schools have had Science Resource Teachers (SRTs) responsible for teaching all students, grades 1-3 once a week and grade 4-6 twice a week. Last year, due to budget cuts, half of the SRT positions were eliminated, and students in grade 4-6 now have science with the SRT once a week. Over the last two years the district provided Guided Language Acquisition Design (GLAD) training to all teachers and many are integrating the language arts program with their science instruction. The district serves a highly diverse population of students.

Palo Alto USD: Located in the northwest corner of Santa Clara Valley this district has a long history of participating in science improvement efforts. This includes a supportive superintendent, administration, community and collaborations with informal science education institutions including the LHS and Exploratorium. The district has been using FOSS for many years and the district expectation is that all three FOSS kits (earth, physical and life science) are taught at each grade level during the school year. Each school maintains autonomy in terms of their approach to teaching science and kit implementation. The implementation of the FOSS materials was inconsistent and uneven at the beginning of BaySci. District leaders viewed BaySci as an important support that would help them bridge the past years of science reform with a more established district-wide effort and focus on elementary science. A central materials refurbishment facility has long been in existence and a new facility was built in 2010. For several years the district has had a full time Teacher on Special Assignment (TOSA) who oversees and supports the elementary science program, as well as a position for managing the science materials and equipment facility, including kit refurbishment. There is a strong interest in the literacy-science connection and integrating the two, and the science TOSA and literacy TOSA have worked closely and collaboratively for several years. BaySci provided an opportunity to advance this work. This district serves two distinct populations –children of parents at Stanford in the west part of the city and children in families who live in East Palo Alto who are much more diverse in terms of SES and ELL.

Novato USD: Located in northern Marin County, Novato does not have a long history of developing its science program. The initial impetus to get involved with BaySci was as a result of a superintendent who became enthusiastic about science at the CalSci Consortium Forum (precursor to BaySci) held at the Exploratorium. Novato is often described as a district with strong site-based management with many key decisions made by the school site administrators. The first year of BaySci coincided with a number of important district events – a newly created vision and a focused effort to develop "essential standards" for elementary science, the adoption of FOSS as the elementary science instructional materials, interest in integrating science with other subjects, and a strong feeling among principals that science would be a good vehicle for the implementation of a professional learning model.
Prior to BaySci, classroom teachers were expected to teach science, although the amount of science and the way it was taught varied by teacher, grade level and school. Teachers in Novato are now strongly encouraged to teach a minimum of two kits, and the kits are housed and managed at each school and rotated among the teachers. There isn't a central materials center, but a materials ordering system does exist. The district demographics have changed considerably over the past 10 years with the Hispanic population growing by over 10% and increasing the numbers of English Language Learners in the district.

Petaluma City Schools: Located in southern Sonoma County, Petaluma joined BaySci with a limited history with science reform and a less than strong elementary science program. This district also has a strong reputation of site-based management. There is a long history of school autonomy and for many years there has been little district-wide agreement about common report cards, curriculum, materials, shared visions or expectations for the amount of science taught, etc. As a result the amount and nature of science teaching, along with the type of instructional materials used, were highly episodic and idiosyncratic, depending on the interest and inclination of individual teachers and principals. A centralized materials management center was beyond consideration. In 2008-2009, three significant changes happened: the district developed the district science "power standards", FOSS was adopted district-wide, and professional development in science was identified as the priority and focus of the two district-wide staff development days. For the first time ever all schools agreed on a common set of elementary science instructional materials and this has led to the beginning of a district-wide elementary science program. The district serves a mixed population with just over 25% Hispanic students.

Appendix C:

BaySci Teacher Survey Analysis

Appendix C: BaySci Teacher Survey Analysis

The Lawrence Hall of Science Research Group study examines the impact of a large-scale district capacity and teacher professional development program designed to strengthen inquiry-based elementary science instruction in the two BaySci school districts, Newark and Novato Unified School Districts. District capacity building and professional development activities were conducted from 2008-2011, and this study focuses on results of the evaluation that took place in two districts in 2009-2011.

Evaluation efforts for the intervention in these two districts were designed to study the implementation and impact of this program on several related outcomes: a) the quality and value of the BaySci work with teachers; b) teacher confidence and preparedness; c) the quantity and quality of elementary science teaching in the districts; and, and d) student engagement. This paper presents findings that rely on the quantitative data collected by The Lawrence Hall of Science's Research Group in the Newark and Novato Unified School Districts. The paper examines the comparative impact of various elements of the intervention on elementary teacher confidence, preparedness, and classroom practice in science and student attitudes in these classrooms.

The data and analyses described herein offer the opportunity to explore several critical research questions related to professional development efforts in the context of whole district comprehensive science reform: What professional development strategies and activities best support teachers to develop and increased feeling of preparedness to teach investigation-oriented science? What dosage levels (quantity and quality of professional development engagement) are required to support changed teacher practice and student attitudes in science in elementary school classrooms? How do capacity building efforts designed to develop supportive district and school cultures enhance the probability that science education reform efforts will be successful when they hit classrooms?

Methods

Participants

In 2009-2010, the second year of district capacity intervention and first year of teacher professional development intervention, Newark Unified School District served eight non-charter elementary schools with a total of 148 teachers and 3,655 students of which 148 teachers and 3,452 students participated in the evaluation data collection. In Newark, the largest ethnic group was Hispanic or Latino, with the following breakdown of percentages for other ethnic groups listed in Table 1. Special program enrollment for students in Newark is listed in Table 2.

Table 1. Total Students by Ethnicity 2009 – Newark Unified School District[1]

	Enrollment	Percent of Total
American Indian or Alaska Native	31	0.40%
Asian	858	12.40%
Native Hawaiian or Pacific Islander	145	2.10%
Filipino	642	9.30%
Hispanic or Latino	3,314	47.90%
Black or African American	504	7.30%
White	1,284	18.60%
Two or More Races	134	1.90%
None Reported	8	0.10%
Total	6,920	100%

Table 2. Total Students in Special Programs 2009 – Newark Unified School District[2]

	Number of Students	Percent of Enrollment
English Learners	1,717	24.80%
Free/Reduced Price Meals	3,370	48.70%
Compensatory Education	2850	41.20%

In the same year, Novato Unified School District served eight non-charter elementary schools with a total of 179 teachers and 3,557 students of which 168 teachers and 3,503 students participated in the evaluation data collection. In Novato, the largest ethnic group was White, with the following breakdown of percentages for other ethnic groups listed in Table 3. Special program enrollment for students in Novato is listed in Table 4.

[1] Source: California Department of Education, Educational Demographics Office (CBEDS, sifb0910 10/22/10).
[2] Source: Educational Demographics Office, Language Census (elsch09 8/19/09); School Fiscal Services Division (frpm2009 8/24/10); District & School Improvement Division.

Table 3. Total Students by Ethnicity 2009 – Novato Unified School District[3]

	Enrollment	Percent of Total
American Indian or Alaska Native	24	0.30%
Asian	396	5.00%
Native Hawaiian or Pacific Islander	22	0.30%
Filipino	72	0.90%
Hispanic or Latino	2,351	29.70%
Black or African American	270	3.40%
White	4,371	55.20%
Two or More Races	368	4.60%
None Reported	41	0.50%
Total	7,915	100%

Table 4. Total Students in Special Programs 2009 – Novato Unified School District[4]

	Number of Students	Percent of Enrollment
English Learners	1,312	16.60%
Free/Reduced Price Meals	2,180	27.50%
Compensatory Education	2,204	27.80%

Comparatively, both Newark USD and Novato USD had 95% full-time teachers, with Newark having a lower percentage of teachers with less than two years experience. Teacher and student profile data from 2010-2011 is not yet available.

The professional development participants from both Newark and Novato were organized into professional development groups for the purpose of analyzing outcomes related to BaySci professional development levels of intensity. The groups were identified, as follows, in descending order of professional development intensity: Teacher Leadership Academy; Advanced FOSS (FOSS Level 2); Intro to FOSS (FOSS Level 3); District Capacity (workshops from the District Capacity-Building Program); and, District Professional Development Day (the control group in which all other teachers in both districts participated in a district-wide

[3] Source: California Department of Education, Educational Demographics Office (CBEDS, sifb0910 10/22/10).
[4] Source: Educational Demographics Office, Language Census (elsch09 8/19/09); School Fiscal Services Division (frpm2009 8/24/10); District & School Improvement Division.

professional development day at their district)[5]. Because group designations for a given teacher participating in a given professional workshop may have changed over the course of the year, both the participant numbers and evaluation respondent numbers fluctuated per survey time point.

Measures

The data analyzed for this study looks at the impact of the 2009-2011 intervention on district capacity, teacher confidence and competence, and student attitudes and learning. This larger study, includes multiple data sources: teacher surveys and student surveys. Teacher survey protocols were adapted (additions and deletions) from the Horizon Research Local Systemic Change through Teacher Enhancement program[6] (2005-2006). Adaption of this instument was chosen due to Horizon Research's established evidence of reliability and validity for measuring various constructs such as topical content and instructional strategies that included investigative practices among teachers. Student surveys measured students'attitudes towards science and used a validated survey titled, the Feelings Towards Science Inventory.

The analysis presented herein draws from teacher and student self-report collected through pre-, during, and post-survey data. Survey questions asked teachers about, (1) their beliefs about their own preparedness to teach science in an investigative oriented approach utilizing the FOSS materials (Preparedness Scale), (2) the instructional practices they employ when teaching science in their classroom (Classroom Instructional Scale), and (3) their perceptions of relevant elements of district and school culture (District/School Culture Scale). Each scale was composed of items with response options ranging from a minimum value of 1 to a maximum value of 4 or 5 with higher values being indicative of more favorable responses.

Preparedness Scale: Items on this scale used a common stem—"Please rate how prepared you feel to do each of the following". These items also used a common scale for responses- not adequately prepared, somewhat prepared, fairly well prepared, very well prepared. Seventeen items were included in this scale.

Classroom Instructional Scale (CIS): Items on this scale used one of two common stems—"In the last month, about how often did you do each of the following in your science instruction" or "In the last month, how often did students in this class take part in each of the following types of activities as part of their science instruction". These items also used a common scale for responses —never (no science lessons); rarely (almost no science lessons); sometimes (some science lessons); often (almost every science lesson), always (every science lesson). Twenty-seven items were included in this scale.

[5] All individuals participated in the District Professional Development Day and were marked accordingly as the first time point.

[6] Source: www.horizon-research.com/LSC

District/School Culture Scale (DSCS): Items on this scale used a common stem—"Please provide your opinion about each of the following statements". These items also used a common scale for responses – strongly disagree; disagree; no opinion, agree, and strongly agree. Twenty-three items were included in this scale.

Survey questions asked students about (1) affect towards science, (2) self-efficacy beliefs about science, (3) science-related identity, and (4) student interest in science. Each of these four scales was composed of items with response options ranging from a minimum value of 1 to a maximum value of 4 with higher values being indicative of more favorable responses.

Data Analyses

Analyses were conducted using ordinary least squares regression and hierarchical linear modeling. We also examined the reasons for missingness in the data. Data used in this analysis were collected over the course of a single school year, thus missingness from teacher turnover was minimal. Most of the missing data came from individuals (students and teachers) who failed to respond all of the surveys.

Table 5 shows: (1) differences in the mean response across professional development levels for a given scale at a given time point; and, (2) differences within a professional development level over time on a given scale.

Table 5. Teacher Survey Scale by Professional Development Levels

Classroom Instruction

	Control	(n)	District Capacity	(n)	Intro to FOSS	(n)	Advanced FOSS	(n)	Teacher Lead. Academy	(n)
Sep. 09	3.10	(240)	3.28	(28)						
Nov. 09	3.00	(118)	3.31	(8)	3.18	(22)	3.30	(17)	3.27	(45)
Feb. 10	3.16	(76)	2.98	(9)	3.02	(15)	3.37	(14)	3.39	(27)
Jun. 10	3.12	(85)	3.08	(9)	3.23	(22)	3.42	(17)	3.34	(32)
Sep. 10	2.84	(112)	2.73	(9)	2.62	(10)	3.46	(16)	3.08	(53)
Feb. 11	3.07	(52)	3.01	(8)	3.16	(19)	3.45	(31)	3.33	(47)
Jun. 11	3.06	(47)	2.96	(5)	3.32	(20)	3.45	(32)	3.24	(42)

Preparedness Scale

	Control	(n)	District Capacity	(n)	Intro to FOSS	(n)	Advanced FOSS	(n)	Teacher Lead. Academy	(n)
Sep. 09	2.83	(220)	3.13	(28)						
Nov. 09										
Feb. 10										
Jun. 10	2.91	(85)	2.99	(9)	2.87	(22)	3.32	(17)	3.08	(31)
Sep. 10	2.89	(110)	3.07	(9)	3.16	(10)	3.29	(16)	3.05	(51)
Feb. 11										
Jun. 11	3.09	(45)	3.13	(5)	3.01	(20)	3.26	(31)	3.08	(39)

District and School Culture Scale

	Control	(n)	District Capacity	(n)	Intro to FOSS	(n)	Advanced FOSS	(n)	Teacher Lead. Academy	(n)
Sep. 09	3.28	(220)	3.30	(27)						
Nov. 09										
Feb. 10										
Jun. 10	3.32	(85)	3.22	(9)	3.26	(22)	3.56	(16)	3.33	(31)
Sep. 10	3.16	(112)	3.25	(9)	3.27	(10)	3.62	(16)	3.36	(52)
Feb. 11										
Jun. 11	3.37	(46)	3.53	(5)	3.49	(20)	3.80	(31)	3.46	(39)

Table 6. Estimates of Fixed Effects

						95% Confidence Interval	
Parameter	Estimate	Std. Error	df	t	Sig.	Lower	Upper
Intercept	3.73	0.17	905.65	22.43	0.000	3.41	4.06
Teacher Lead. Academy	0.19	0.06	694.20	3.44	0.001	-0.30	-0.08
Advanced FOSS	0.20	0.07	660.51	2.77	0.006	-0.34	-0.06
Intro to FOSS	0.21	0.07	859.22	2.84	0.005	-0.35	-0.06
District Capacity	0.19	0.10	693.25	1.92	0.055	-0.37	0.00
Centered Time	-0.01	0.01	263.29	-1.73	0.084	-0.03	0.00
Centered Time Squared	0.01	0.00	213.82	3.31	0.001	0.00	0.01

Appendix D:

Growing the Ability of a School District for Implementing Elementary Science Education Reform: A Framework of Key Dimensions and Supportive Capacities

Appendix D. Growing the Ability of a School District for Implementing Elementary Science Education Reform: A Framework of Key Dimensions and Supportive Capacities

BaySci - October 2008

Overview

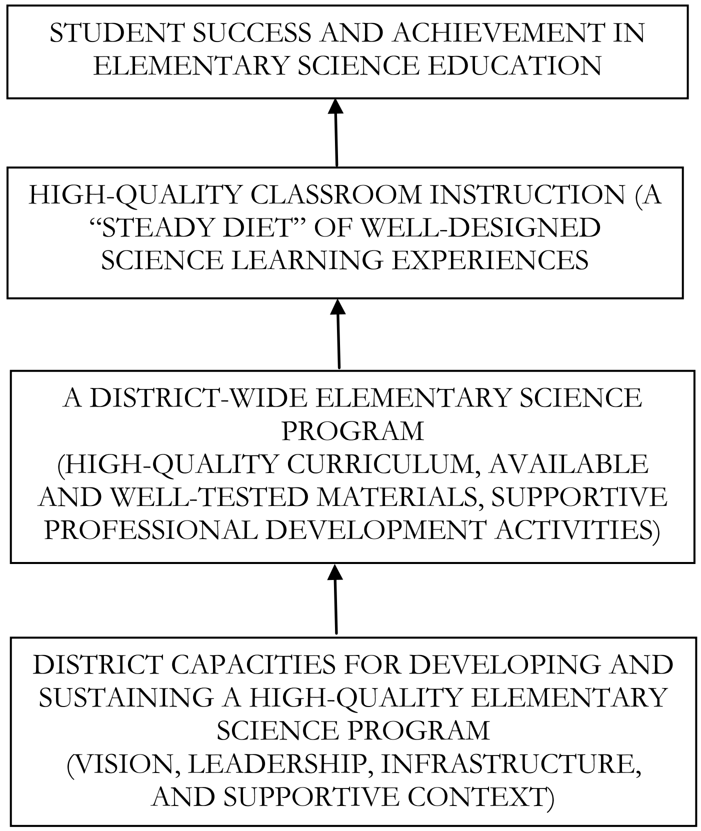
This framework is intended to provide a set of questions that will review the degree to which and the ways in which a school district is developing the capacities and policies that are necessary to develop and sustain a standards-based elementary science education program. The Framework also documents the contextual conditions that most influence the probability that an elementary science improvement effort will succeed. This framework can be used by outside evaluators to monitor the degree to which a district is making progress toward a science program that reflects the national standards. But it can also be used by the district itself, as a self-assessment tool and, perhaps more importantly, as a means to promote a dialogue within the district about the status of its current efforts to improve its elementary science program. Finally, this framework can also be used to provide a longitudinal view of how the district's capacities for reform are changing over time.

The theory that lies behind this framework may be stated very simply as follows:

(1) Student success in elementary science depends upon classrooms that provide a steady and daily diet of high-quality science instruction. (It is well known that in most districts in the United States both the quantity and quality of elementary science instruction is lacking.)

(2) Good classroom instruction that takes place in every classroom in the district depends upon the presence of a solid district-wide elementary science program. Such a program includes good curriculum, readily available and well-designed materials, and supportive professional development activities.

(3) To establish such a program is not easy. Few districts across the United States can boast of a high-quality elementary science program that reaches of all its students. To put such a program in place, and to sustain it, a lot of work must be done. And this work does not happen automatically, but rather it requires a district to develop a set of capacities – each of which is necessary but not sufficient to create a standards-based district-wide elementary science program.



The capacities, policies and conditions outlined in this framework are not mere theoretical constructs (although they are congruent with a vision of systemic reform). They reflect research done by Inverness Research over the past twenty years[1] as well as the research done by others.[2]

[1] See, for example, Inverness Research reports on the Center for Urban Science Education Reform (CUSER), the Appalachian Rural Systemic Initiative (ARSI), and the Portland Urban Systemic Initiative (USP).

[2] See the National Research Council's National Science Education Standards, the National Science Resources Center's LASER Center.

Contents

I. Vision and Reality

1) *A Widely-Shared Common Vision of Good Science Teaching*. The degree to which the district/project[3] has been able to create, articulate and build consensus around an explicit and concrete instructional vision of what good science instruction looks like. (This vision would, for example, outline the range of instructional approaches, the underlying philosophies, as well as the scientific subject matter to be included.)

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

2) *A Widely-Shared Programmatic Vision*. The degree to which the district/project has been able to develop, articulate and build consensus around an explicit and concrete vision of what the desired elementary science program will look like: (This vision would, for example, outline the key program components including specific kits to be used at each grade level, additional activities beyond the kits such as field trips or science fairs, and perhaps the use of additional reading materials.)

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

[3] Throughout this report we refer to the district/project as the agent that is propelling the elementary science education reform effort. What is important is the degree to which the project has helped the targeted district(s) develop their own internal capacities for developing and sustaining a high-quality science program. Thus, ultimately, it is the district that must invest in and come to value the requisite capacities.

3) ***A Plan And Concrete Vision Of The Development And Implementation Process.*** The degree to which project leaders are able to develop agreement about and support for the specific steps of the process that will allow for the implementation of a standards-based science program on a district-wide basis:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

4) ***Knowledge of Classroom Realities.*** The degree to which the district/project is interested in and willing to examine the realities in the field, and the degree to which the project/district has in place multiple mechanisms for assessing the quantity and quality of elementary science instruction that is taking place district-wide: (Such mechanisms generate easily understandable data that can help district leaders understand, for example, which kits and lessons are being taught, the quality of that teaching, and the degree to which program supports, such as professional development and materials distributions, are working.)

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

5) ***A System for Gathering and Using Data.*** The degree to which the project has the capacity to both gather and use data: Data about program implementation, and about the realities of classroom science instruction can be used both for program improvement and for "making the case" for the program to external audiences. (Such data might include a teacher and school database; information about the current status of science teaching; teacher beliefs and attitudes; the success of program implementation; and/or evidence of student success and achievement.)

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

II. Leadership

6) ***An Elementary Science "Point Person."*** The degree to which the district/project has identified, developed, and supported one individual person as a "point person" for elementary science education reform: (An effective point person is an individual working [full time] at the district level who has the mandate, expertise, commitment, energy, knowledge, and position to further elementary science education reform in the district.)

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

7) ***Core Group.*** The degree to which there exists a committed and empowered core group of people (a project-based "leadership team") either formally or informally designated as responsible for furthering the improvement of elementary science education in the district: (An effective core group consists of individuals who share a common vision, are highly motivated, work well together, and bring complementary skills to the reform effort.)

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

8) ***Science Resource Teachers.*** The degree to which the district has established positions for and been able to recruit skilled teachers so that the can serve as "Science Resource Teachers" or "Teachers on Special Assignment:" (Effective Resource Teachers must themselves be good teachers of science, have experience in new curricula and methods, and be good at working in multiple modes of professional development.)

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

9) ***Science Lead Teachers***. The degree to which the district has been able to identify, recruit, train and deploy a cadre of strong science lead teachers. (These are teachers who are still teaching full-time but are willing to assist the reform effort by leading workshops, doing demonstration teaching, working of district task forces or contributing in a multitude of other ways.)

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

10) ***Elementary Science Classroom "Exemplars."*** The degree to which there are available in the district sources of classroom expertise (e.g., classroom teachers who can present visible examples and models of exemplary, inquiry-based science teaching):

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

ADMINISTRATIVE SUPPORT PEOPLE

11) ***District Elementary Science Coordinator or Science Specialist.*** The degree to which the district has designated a permanent position (and accompanying support) for a district administrator who is expected to provide strong and stable leadership for the effort to promote a district-wide standards-based elementary science education reform effort:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

12) ***The Superintendent.*** The degree to which the District Superintendent is interested in the success of the elementary science education program and is willing to assume a proactive role, making elementary science education reform a public priority: Also, the degree to which the Superintendent is able and willing to provide the resources necessary to further the elementary science education reform effort in this district at this time.

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

13) ***Administrative Supporters and Science Advocates***. The degree to which there exists at least a few key upper-level district administrators (e.g., the assistant superintendent of Curriculum and Instruction, Area Superintendents, a key Financial Officer) who are involved in and actively supporting the elementary science education reform:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

14) ***Principals***. The degree to which the district/project has been able to identify, support and draw upon a group of <u>school principals</u> who are leading the science reform effort in their own schools; in addition, they are knowledgeable about, and actively involved in, the effort to improve elementary science education in this district:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

15) ***School Board Members***. The degree to which the <u>School Board</u> is knowledgeable about and supportive of the elementary science education reform effort:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

OTHER SUPPORT PEOPLE

16) ***Scientists and Scientific Expertise***. The degree to which the district/project has developed a relationship with and has working access **to <u>sources of scientific expertise</u>** (e.g., university faculty or graduate students, local industry scientists, high school teachers, local science museum staff); the degree to which the district/project helps design and provide appropriate and useful supportive roles for these people (e.g., enabling them to ensure the content integrity of kits, or teach science content to elementary teachers, etc.):

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

17) ***Partner Organizations***. The degree to which there are symbiotic <u>connections or partnerships between the project/district and other institutions</u>, agencies, and/or program aimed at science education improvement (e.g., Boces, universities, science museums, industry roundtables; other NSF reform projects):

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

18) ***Political Leadership***. The degree to which there is strong external political leadership (individual or group) that is organized and committed so that it is effective in playing an advocacy role for elementary science, both within and outside of the district:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

19) ***National connections and expertise***. The degree to which district leaders are connected with and involved in professional associations, networks, and national projects involving science and math reform (e.g., NSTA, CUSER, NSRC, Exploratorium, Lawrence Hall of Science, California Science Project):

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

III. INSTRUCTIONAL IMPROVEMENT CAPACITIES

CURRICULUM AND MATERIALS

20) ***Curriculum: Well-established Curricular Expectations:*** Overall extent to which the district has defined and shared a clear sense of what is to be taught and how it is to be taught.

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

21) ***Curriculum: Program and Instructional Materials.*** The extent to which the district has adopted and implemented a <u>program</u> with well-designed instructional materials that allow teachers to provide students a wide range of learning experiences.

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

22) ***Curriculum: Instructional Materials Support Systems.*** Overall extent to which the district has the capacity and will to establish, implement and maintain a materials distribution and replenishment system for providing all its teachers with the instructional materials necessary:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

23) ***Curriculum: Curricular Leadership***. Degree to which the district has people with the expertise, position and interest in continuing to shape and refine the district curriculum, the instructional materials, and the materials support systems.

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

PROFESSIONAL DEVELOPMENT

24) ***Professional Development: Use of the materials.*** Overall ability of the district to design and offer workshops and other supports that help teachers with the implementation of materials:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

25) ***Professional Development: Inquiry Based Instruction. .*** Overall extent to which the district has the ability to design and offer workshops and other supports that help teachers with inquiry-based instruction:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

26) ***Professional Development: Knowledge of science.*** Overall extent to which the district has the ability to design and offer workshops and other supports that help teachers better understand the science they are teaching:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

27) ***Professional Development: Language Development and Literacy: for Teachers.*** Overall extent to which the district has the ability to design and offer workshops and other supports that help teachers use science instruction as a context for language development and enhanced literacy skills (reading and writing).

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

28) ***Professional Development: Assessment***. Overall extent to which the district has the ability to offer workshops and other supports that help teachers use assessments to better understand their students thinking and to improve instruction.

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

29) ***Professional Development: For District and Project Leaders.*** The degree to which the district/project has the intention and capacity to provide appropriate ongoing professional development experiences for those who are the key leaders and supporters of the science education reform effort (e.g., District science specialists, TOSAs, principals):

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

30) ***Professional Development Leadership:*** Degree to which the district has people with the expertise, position and interest in continuing to shape and refine the professional development program in elementary science.

	Very Low				Very High	Un- known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

IV. District Policies and Priorities

31) ***District Priority:*** Overall extent to which the district has made the improvement of elementary science a priority and expressed that priority clearly in terms of policies, finances, and supports.

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

32) ***District Science Course of Study***. The degree to which the district has reviewed and addressed its own science standards, science expectations and/or course of study so that it might better support the envisioned elementary science education reform effort:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

33) ***Formal District Science Assessment Policies***. The degree to which the district has reviewed and addressed <u>its own formal testing policies and practices</u> so that they might better support the envisioned elementary science education reform effort:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

34) ***Integration with other District programs and reforms:*** The degree to which the district has integrated the district science program with other key instructional improvement priorities (e.g. mathematics, literacy, writing, ELL…)

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

35) ***Financial Resources***. Overall extent to which the district has the capacity and will to acquire and designate the financial resources necessary to implement a district-wide, standards-based and inquiry-based program in elementary science:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

36) ***A Proactive Stance to Barriers.*** Overall degree to which the district is proactively and deliberately identifying and resolving systemic barriers and blockages that stand in the way of the progress of the elementary science reform program (e.g., finding creative solutions to chronic teacher substitute shortages, organizing time for classroom coaching, etc.):

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

V. Contextual Conditions That Influence The Development of an Elementary Science Program

37) ***Overall State Political and Policy Climate.*** The overall degree to which major state policies (e.g., accountability) and current state political climate are supportive of the district's effort to improve elementary science education:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

38) ***State Science Standards and Testing.*** The overall degree to which state science standards and science tests are supportive of the district's effort to improve elementary science education:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

39) ***District and Local Community Political Climate***. Overall extent to which local district and community political conditions affect the district's effort to develop a plan and process for improving elementary science education in the district:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

40) ***District and Local Community Financial Conditions.*** Overall extent to which local district and community financial conditions affect the district's effort to develop a plan and process for improving elementary science education in the district:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

41) ***District professional culture and climate***. The overall professional "culture" and "climate" in the district (the working conditions, professional culture and overall morale in the district) that influence the willingness of all those working in the district to initiate and sustain reform efforts:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

42) ***District Turbulence and Instability***. Overall extent to which unexpected or rapid changes in the local district or community (e.g., new superintendents, teacher turnover, growth, the number and pace of new reforms) affect the ability and willingness of the district to promote elementary science education:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

VI. Summary Judgments

This section summarizes the previous sections and asks for judgments about the overall status of the capacity of the district to engage in a successful elementary science education reform effort and the probability of its continued success.

43) ***Overall Development of Increased Internal Capacity***. Overall degree to which this district has developed its own internal capacity for initiating and sustaining elementary science education reform (e.g., its leadership, resources, relationships, infrastructure, and implementation progress):

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

44) ***Visible Success in Program Development.*** The overall degree to which the district/project has made visible progress in implementing its elementary science reform program, thereby building a positive reputation for the initiative and showing visible and publicly-recognized evidence of success (e.g., establishing a Materials Center, model classrooms, press releases, test scores, testimonials, etc.) that can buoy and further support additional reform activities:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

45) ***Intentionality.*** The overall "seriousness" and priority that this district places upon elementary science education reform:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

46) ***Signal-to-noise Ratio***. Overall, any district's efforts to reform elementary science education are inevitably a small "signal" in an otherwise noisy district environment. The degree to which the signal-to-noise ratio of elementary science reform in this district is strong enough to be significant:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

47) ***Trajectory.*** The overall trajectory of the elementary science program in this district:

	Very Low				Very High	Un-known
Current Status	1	2	3	4	5	6
Contribution of BaySci to date	1	2	3	4	5	6
Promising Area for Immediate Future growth/work	1	2	3	4	5	6
Promising Area for BaySci Contribution	1	2	3	4	5	6
Need More Information:						

Other summary comments and thoughts:

Appendix E:

2007 - 2010 CA 5TH Grade STAR (CST) Science Test Results for BaySci Districts

Appendix E. 2007 – 2010 CA 5TH Grade STAR (CST) Science Test Results for BaySci Districts

	2007	2008	2009	2010	2011	Delta	Comparison to Statewide Stats 2011
PETALUMA							
Mean score	345.6	361.9	373.5	372.8	374.4	+28.8	+7.1
% Advanced	13%	21%	26%	29%	26%		+1%
% Proficient	34%	38%	32%	37%	39%		+6%
% Basic	33%	25%	33%	19%	23%		-2%
% Below Basic	12%	11%	7%	10%	6%		-5%
% Far Below Basic	8%	5%	2%	5%	6%		-1%
NOVATO							
Mean score	360.1	365.8	374.1	381.5	390.8	+30.7	+23.5
% Advanced	20%	22%	27%	36%	38%		+13%
% Proficient	37%	40%	36%	33%	34%		+1%
% Basic	30%	25%	22%	20%	20%		-5%
% Below Basic	7%	8%	9%	7%	5%		-6%
% Far Below Basic	6%	6%	5%	4%	3%		-4%
NEWARK							
Mean score	335.3	352.8	356.3	358.8	360.8	+25.5	-2.5
% Advanced	8%	13%	16%	18%	19%		-6%
% Proficient	32%	39%	34%	39%	35%		+2%
% Basic	34%	32%	34%	26%	29%		+4%
% Below Basic	15%	12%	10%	10%	12%		+1%
% Far Below Basic	11%	4%	5%	7%	4%		-3%
PALO ALTO							
Mean score	397.6	402.7	418.9	434.4	434.3	+36.7	+67
% Advanced	40%	45%	55%	64%	65%		+40%
% Proficient	44%	40%	30%	27%	25%		-8%
% Basic	12%	11%	12%	6%	7%		-18%
% Below Basic	3%	2%	2%	2%	1%		-10%
% Far Below Basic	2%	1%	1%	1%	1%		-6%

STATEWIDE STATS for 5th grade CST:
2011 Mean Scale Score = 367.3; Advanced = 25%; Proficient = 33%; Basic = 25%; Below Basic = 11%; Far Below Basic = 7%

2007 Mean Scale Score = 334.2; Advanced = 9%; Proficient = 28%; Basic = 37%; Below Basic = 15%; Far Below Basic = 11%

Appendix F:

BaySci Classroom Observation Protocol

Appendix F: BaySci Classroom Observation Protocol

(adapted from the HRI Classroom Observation Protocol 2006)

Project __________ Date of Observation _____________
Time of Observation _____ Start __________ End ___________
Subject Observed ________________
Observer _______________________
Grade Level ____________

SECTION ONE: CONTEXTUAL BACKGROUND AND ACTIVITIES

I. Classroom Demographics and Context

A. What is the total number of students in the class at the time of the observation?

B. What is the approximate percentage of white (not Hispanic origin) students in this class?

□ 15 or fewer
□ 16–20 □ 0–10 percent
□ 21–25 □ 11–25 percent
□ 26–30 □ 26–50 percent
□ 31 or more □ 51–75 percent
□ 76–100 percent

C. Indicate the *teacher's*:

1. Gender □ Male □ Female
2. Race/Ethnicity

□ African-American (not Hispanic origin) □ American Indian or Alaskan Native □ Asian or Pacific Islander
□ Hispanic □ White (not Hispanic origin) □ Other

D. If applicable, indicate the *teacher aide's*:

1. Gender □ Male □ Female
2. Race/Ethnicity

□ African-American (not Hispanic origin) □ American Indian or Alaskan Native □ Asian or Pacific Islander
□ Hispanic □ White (not Hispanic origin) □ Other

E. Rate the adequacy of the physical environment.

1. Classroom resources:

1 2 3 4 5
Sparsely equipped — Rich in resources

2. Classroom Space:

1 2 3 4 5
Crowded — Adequate Space

3. Room arrangement:

1 2 3 4 5
Inhibited interactions among students — Facilitated interactions among students

II. Lesson Description

In a paragraph or two, describe the lesson you observed. Include where this lesson fits in the overall unit of study. Be sure to include enough detail to provide a context for your ratings of this lesson and also to allow you to recall the details of this lesson when needed in future years for longitudinal analysis.

III. Purposes of Lesson

A. Indicate the *major*[4] *content area(s)* of this lesson or activity.

□ 1. Life Science (please specify: __________________)
□ 2. Physical Science (please specify: ________________)
□ 3. Earth/space sciences (please specify: ________________)
□ 4. Engineering and design principles
□ 5. History of science
□ 6. None of the above (please explain)

[4] "Major" means was used or addressed for a substantial portion of the lesson; if you were describing the lesson to someone, this feature would help characterize it.

B. Indicate the *primary intended purpose(s)* of this lesson or activity based on the pre- and/or postobservation interviews with the teacher.

□ 1. Identifying prior student knowledge
□ 2. Introducing new concepts
□ 3. Developing conceptual understanding
□ 4. Reviewing science concepts
□ 5. Developing problem-solving skills
□ 6. Learning science processes or procedures
□ 7. Learning vocabulary/specific facts
□ 8. Practicing skills for mastery
□ 9. Developing appreciation for core ideas in science
□ 10. Developing students' awareness of contributions of scientists of diverse backgrounds
□ 11. Assessing student understanding

IV. Instructional Materials

A. Indicate the instructional materials used during the lesson.

____

B. How closely did the lesson adhere to the instructions provided in the teacher's manual?

□ Exactly, SKIP to Part V below
□ Almost totally □ Mostly □ Somewhat □ A little □ Hardly at all

C. How did the modifications affect the quality of the lesson design?

□ Helped a lot □ Helped a little □ Neutral □ Hurt a little □ Hurt a lot

V. Classroom Instruction

A. Indicate the *major way(s)* in which student activities were structured.

□ As a whole group □ As small groups □ As pairs □ As individuals

B. Describe the *major activities* of students in this lesson.

C. Comments

Please provide any additional information you consider necessary to capture the activities or context of this lesson. Include comments on any feature of the class that is so salient that you need to get it "on the table" right away to help explain your ratings; for example, the class was interrupted by a fire drill, the kids were excited about an upcoming school event, or the teacher's tone was so warm (or so hostile) that it was an overwhelmingly important feature of the lesson.

SECTION TWO: RATINGS

I. Design -- Synthesis Rating

1	2	3	4	5
Design of the lesson not at all reflective of best practice in science education				Design of the lesson extremely reflective of best practice in science education

Supporting Evidence:

II. Implementation -- Synthesis Rating

1	2	3	4	5
Implementation of the lesson not at all reflective of best practice in science education				Implementation of the lesson extremely reflective of best practice in science education

Supporting Evidence:

III. Science Content -- Synthesis Rating

1	2	3	4	5
Science content of lesson not at all reflective of current standards for science education				Science content of lesson extremely reflective of current standards for science education

Supporting Evidence:

IV. Classroom Culture -- Synthesis Rating

1	2	3	4	5
Classroom culture interfered with student learning				Classroom culture facilitated the learning of all students

Supporting Evidence:

Respect for Diversity

Based on the culture of a classroom, observers are generally able to make inferences about the extent to which there is an appreciation of diversity among students (e.g., their gender, race/ethnicity, and/or cultural background). While direct evidence that reflects particular sensitivity or insensitivity toward diversity is not often observed, we would like you to document any examples you do see. If any examples were observed, please check here ☐ and describe below:

V. Overall Ratings of the Lesson

A. Likely Impact of Instruction on Students' Understanding of Mathematics/Science

While the impact of a single lesson may well be limited in scope, it is important to judge whether the lesson is likely to help move students in the desired direction. For this series of ratings, consider all available information (i.e., your previous ratings of design, implementation, content, and classroom culture, and the pre- and post-observation interviews with the teacher) as you assess the likely impact of this lesson. Feel free to elaborate on ratings with comments in the space provided.

Select the response that best describes your overall assessment of the likely effect of this lesson in each of the following areas.

1. Students' understanding of science as a dynamic body of knowledge generated and enriched by investigation.	Negative effect	Mixed or neutral effect	Positive effect
2. Students' understanding of important science concepts.	Negative effect	Mixed or neutral effect	Positive effect
3. Students' capacity to carry out their own inquiries.	Negative effect	Mixed or neutral effect	Positive effect
4. Students' ability to apply or generalize skills and concepts to other areas of science, other disciplines, and/or real-life situations.	Negative effect	Mixed or neutral effect	Positive effect
5. Students' self-confidence in doing science.	Negative effect	Mixed or neutral effect	Positive effect
6. Students' interest in and/or appreciation for the discipline.	Negative effect	Mixed or neutral effect	Positive effect

Comments (optional):

B. Capsule Description of the Quality of the Lesson

In this final rating of the lesson, consider all available information about the lesson, its context and purpose, and your own judgment of the relative importance of the ratings you have made. Select the capsule description that best characterizes the lesson you observed. Keep in mind that this rating is *not* intended to be an average of all the previous ratings, but should encapsulate your overall assessment of the quality and likely impact of the lesson. Please provide a brief rationale for your final capsule description of the lesson in the space provided.

□ **Level 1: Ineffective Instruction**
There is little or no evidence of student thinking or engagement with important ideas of science. Instruction is *highly unlikely* to enhance students' understanding of the discipline or to develop their capacity to successfully "do" science. Lesson was characterized by either (select one below):
□ **Passive "Learning"**
Instruction is pedantic and uninspiring. Students are passive recipients of information from the teacher or textbook; material is presented in a way that is inaccessible to many of the students.
□ **Activity for Activity's Sake**
Students are involved in hands-on activities or other individual or group work, but it appears to be activity for activity's sake. Lesson lacks a clear sense of purpose and/or a clear link to conceptual development.

□ **Level 2: Elements of Effective Instruction**
Instruction contains some elements of effective practice, but there are *serious problems* in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is *very limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" science.

□ **Level 3: Beginning Stages of Effective Instruction** (Select one below.)
□ Low 3 □ Solid 3 □ High 3
Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are *weaknesses*, ranging from substantial to fairly minor, in the design, implementation, or content of instruction. For example, the teacher may short-circuit a planned exploration by telling students what they "should have found"; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is *somewhat limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully "do" science.

□ **Level 4: Accomplished, Effective Instruction**
Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and the teacher implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is *quite likely* to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" science.

□ **Level 5: Exemplary Instruction**
Instruction is purposeful and all students are highly engaged most or all of the time in meaningful work (e.g., investigation, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and artfully implemented, with flexibility and responsiveness to students' needs and interests. Instruction is *highly likely* to enhance most students' understanding of the discipline and to develop their capacity to successfully "do" science.

Please provide your rationale for the capsule rating:

VI. Summary Questions

1. In what ways and to what extent were the FOSS materials used during the lesson?

2. What was the level of fidelity of implementation of the FOSS materials?

3. To what extent were inquiry-based practices used during the lesson?

4. To what extent did the lesson integrate science and literacy?

5. To what extent was science used as a vehicle for language development?

6. To what extent was the lesson appropriate for ELL students?

7. To what extent did the lesson and classroom dynamics promote an inclusive, equitable learning culture for all students?

Appendix G:

References

Appendix G. References

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