Going to Scale: A Case Study of the Valle Imperial Project

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The Valle Imperial Project in Science began in 1996–97 as a collaborative partnership among the 14 Imperial County school districts, San Diego State University, Imperial Valley Campus, and Imperial Valley College. Funded as a Local Systemic Change Initiative (LSC) through 1999–2000, the project served approximately 22,500 K–6 students and 1,100 teachers. It was preceded by a three year pilot effort in the El Centro Elementary School District, the largest district in the county, with 6,500 students. Three schools participated in the pilot, a fully functioning materials resource center was set up, and a cadre of lead teachers was selected and prepared. The pilot project was the result of the district's participation in the Pasadena Center Program at the California Institute of Technology, which was also funded by the National Science Foundation (NSF). Technical assistance and support were provided by the Pasadena Center to build the capacity within the district to support future district-wide and countywide expansion of the program. The NSF Local Systemic Change grant supported the expansion. The scale-up was successful, and the program became self-sustaining, celebrating ten years of activity in 2006. This case study shares reflections on the LSC experience in Imperial County, attempting to identify the factors and strategies that contributed to the successful scaling up of the program.

Background

Imperial County, located in the extreme southeast corner of California along the United States border with Mexico, is one of the largest (4,597 sq. mi.) and most sparsely populated (130,000) counties in California. The county lacks a large metropolitan area and residents must travel to San Diego (120+ miles) or Los Angeles (200+ miles) to reach an urban center.

Many Imperial County residents live in extreme poverty, and household incomes have declined in real dollars over the last decade. Imperial County ranks highest in poverty of all 58 counties in California, with a mean per capita income of $17,353 in 2000. The county's unemployment rate increased from 17 percent in 1991 to 23 percent in 1999, while statewide unemployment rates remained about 5 percent.

Most Imperial County residents have strong cultural and linguistic ties to Mexico. Of the 22,500, K–6 students attending the 43 schools and 14 districts serving the Imperial County, 81 percent are Hispanic. White (11 percent), African-Americans (5 percent), Asians (1 percent) and Native Americans (1 percent) make up the rest of the population. More than 50 percent of the students in the county have been identified as Limited English Proficient, and 10 percent of the students are children of migrant workers. Nearly all of the county's schools qualify for Title I. Countywide, more than 70 percent of all students are eligible for free and reduced lunches.

The isolation of the county also affects the composition of the school staffs. San Diego State University produces 94 percent of all teachers hired in the 14 school districts in Imperial County. The majority of these teachers also attended elementary and secondary school in Imperial County. Due to its location, the development of human resources for the schools is almost a

closed system, where improvements in one part of the enterprise are likely to lead to improvements in other parts as well.

Program Design and Implementation

The model for science education reform adopted by the Valle Imperial Project LSC was based on the National Science Resources Center's LASER Model. This model identifies five critical interrelated elements necessary for effective systemic reform (National Academy of Sciences, 1997). These are: (1) high quality curriculum; (2) sustained professional development and support for teachers and school administrators; (3) materials support; (4) community and top level administrative support; and (5) program assessment and evaluation. The strong connection to the LASER model was present from the beginning of the project as the Valle Imperial Project's Principal Investigator was one of the contributing authors for the National Science Resource Center's book *Science for All Children.* Interaction with the other contributing authors provided the Valle Imperial Project leader with important insights into the development of an effective implementation plan for the LASER model in the Imperial Valley.

A planning team consisting of representatives of key stakeholder groups (superintendents, principals, teachers, business representatives, scientists, and university staff) attended a National Science Resources Center Strategic Planning Institute. During the institute a strategic plan was developed, which guided the implementation of the Valle Imperial Project over the four years of LSC funding. All five elements of the LASER model were implemented simultaneously, with attention given to each element each year.

A committee consisting of representatives of all stakeholder groups reviewed and selected the student curriculum materials that would be the focus of the Valle Imperial Project. Planners selected commercially available inquiry-based instructional materials that were developed under the National Science Foundation's Materials Development Program and had been approved for adoption by the state of California. A curriculum matrix was developed, addressing earth, physical, and life science topics each year in grades K–6, and appropriate modules were selected from Full Option Science Systems (FOSS), Science and Technology for Children (STC) and Insights. The matrix was later extended to include grades 7 and 8, using materials available from FOSS and STC, selected because of their alignment with the California Science Framework.

Two important aspects of the LSC were carefully crafted to increase the likelihood that the reforms would have a strong impact on student achievement. One critical decision was to focus on professional development in science for all of the LSC teachers over the four years of scale-up (Klentschy & Molina-De La Torre, 2003). The Valle Imperial Project team believed that this intense focus would provide teachers with the sustained and in-depth experiences necessary to support full implementation of the new science curriculum. This decision and commitment was made by the superintendents of the participating school districts based upon a recommendation from the Valle Imperial Project staff. The recommendation was based on the conviction that sustained learning experiences were needed for elementary teachers to move along the novice to expert continuum identified by Berliner (1994). And the team believed that this kind of growth was needed for teachers to attain the instructional capacity required to alter student achievement

The professional development focused on science content, pedagogical strategies, and student learning. This strategy enabled the professional development designers to address a second critical need in the Valley schools; they embedded English language development strategies and literacy skills such as expository writing through the use of science notebooks into the professional development design. It was believed that integrating literacy strategies into science instruction would enhance student learning and provide opportunities for students to make meaning from their classroom science experiences (Klentschy, 2005, 2006; Klentschy & Molina-De La Torre, 2004). The project team believed that the focus on science over an extended period of time would provide a content platform for strengthening student application of reading, writing, language, and mathematics skills.

The implementation of the professional development was based on a concept of stages of teacher growth. At the first stage (Initial Use), the design called for teachers to receive training in the content and use of the designated instructional materials. This training took place through required pre-school year and mid-year training. In the second stage (In-depth Focus), 40-hour summer institutes were offered focusing on content, pedagogical strategies, and student learning. Teachers self-selected the institutes that best meet their perceived needs. Following the institutes, Science Resource Teachers provided in-classroom support through coaching during the school year. In subsequent years, the model expanded to cover other skill areas including leadership training, lesson study, in-depth language and writing pedagogical strategies, integration of technology through LessonLab, and examination of student work.

Professional development sessions were provided both centrally and at individual schools during the school year as the LSC grew to scale. The ultimate goal of the LSC was for each K–6 teacher to receive at least 100 hours of sustained professional development during the four-year scale-up of the project. Initially, the program provided common training for all teachers at each grade level, focused on grade-level science content standards and the designated instructional materials. Later, alternative pathways were provided, with multiple entry points for teachers to deepen their science content knowledge, expand their pedagogical strategies, and increase their understanding of student learning.

In order to take the reforms to scale, the 14 districts formed a strong partnership through which time, resources, and support were provided by the central offices and building principals. The professional development was supported by the school districts through the commitment of contractual days to make the professional development mandatory. In addition, teacher stipends for summer institute attendees were provided through a combination of NSF and school district funds.

A cadre of science professionals was recruited from the local university, community college and the business sector to assist with the professional development implementation. Science Resource Teachers (SRTs) were recruited, hired and trained as coaches and professional development leaders. The initial group of resource teachers was recruited from the three pilot schools; these teachers already had three years of training and experience in the use of the new instructional materials. They received additional training through programs at the Exploratorium, job shadowed other Science Resource Teachers in the Pasadena Unified School

District, attended National Science Resource Center Institutes, and visited other Local Systemic Change Projects. All of the Science Resource Teachers were under the supervision of both the Principal Investigator and the Science Director for the El Centro School District.

In later years, new Science Resource Teachers were recruited from the participating school districts. Several had completed a Master's Program in Curriculum and Instruction from San Diego State University that was established to provide a deeper experience for classroom teachers. The new Science Resource Teachers also attended professional development provided by the Exploratorium and job shadowed existing SRTs. Over time, it became clear that the Science Resource Teachers not only needed deep understanding of the science content in the materials, pedagogical strategies, and student learning, but also facilitation skills and adult learning strategies. These additional skills were attained through professional development provided by the Principal Investigator and San Diego State University staff.

Teacher Engagement

Three different teacher engagement strategies were utilized to provide strong incentives for teachers to participate and to ensure appropriate support for implementation of the instructional reforms and new curriculum materials by teachers. The three were: (1) policy decisions made by school districts to maximize the time available for teacher training during "contract days"; (2) leadership development for teachers; and (3) payment of stipends and/or university credits for participation in summer institutes and follow-up activities.

Policy decisions made collectively by the 14 school districts to optimize the use of contract days made two days of training before the opening of school and two days of training at mid-year available to the LSC. With this supportive policy context, LSC staff was able to plan and provide four days of training a year for four years. It was not surprising, then, that all of the targeted teachers who were employed in the participating districts over the entire four years completed at least 80 hours of training. The availability and coordination of these four days also allowed the project professional developers to establish a county-wide culture for science education, and to provide opportunities for teachers to work in grade level teams with their district and school peers as well as cross district teams. This approach also avoided duplication of services and encouraged the efficient use of LSC funds. The policy decision providing for the county-wide allocation of time also reduced the problems that other projects had experienced with reluctant or resistant teachers. Evidence that this was the case can be found in reports on classroom implementation from the Science Resource Teachers, the level of use of the instructional materials when they were returned to the Science Resource Center for refurbishment, and from an examination of randomly selected student work samples.

The development of teacher leaders was envisioned by the Valle Imperial Project LSC team as a means of providing built-in project sustainability. The project's theory of action held that if the districts were left with a strong cadre of highly trained teacher leaders when the LSC funding ended, then there would be a higher potential for sustainability. Each year during Years Two–Four, a new cohort of teacher leaders was identified and recruited by the LSC staff. The teacher leaders needed the support of their principals, who were asked to assure that LSC activities

would be implemented in their schools. Each teacher leader received an additional 70 hours of specialized training in facilitation skills, science content, pedagogical strategies, and the interpretation and analysis of student work. Each was also video taped periodically by the LSC staff and participated in discussions regarding fidelity of implementation of the designated instructional materials.

A second pathway for the development of teacher leaders resulted from the project's partnership with San Diego State University. The University established a Master's in Education Program in Curriculum and Instruction with a Specialization in Science Education. Over the years, more than 100 teacher leaders and teachers from the San Diego State University Master's program have served as trainers and Science Resource Teachers in the LSC.

The third engagement strategy was to provide stipends or university credit for summer institute participation. The content of the summer institutes fell into three categories: (1) standards-based science content institutes led by university professors supported by teacher leaders; (2) special theme institutes such as English Language Development or Immersion in Inquiry led by LSC staff and teacher leaders; and (3) assessment institutes focusing on the use of science notebooks and the analysis of student work led by university professors and LSC staff. Each is described in more detail below.

Content Institutes

The content covered in the summer institutes was directly connected to the California Science Content Standards in Grades 4–8. The institutes were held at San Diego State University – Imperial Valley Campus and/or the Science/Mathematics Resource Center in the El Centro School District. Teacher surveys were given at the end of each institute and the results utilized during spring planning sessions to assist planners in the development of the upcoming summer courses. For example, as a result of teacher feedback collected during the previous summers, institute activities were explicitly aligned to the most challenging science content standards taught in grades 4–8.

Content institutes were team-taught, with the requirement that each team have the expertise needed to address all of the elements necessary for effective instruction. Content was usually addressed by faculty from San Diego State University, Cal Tech, or the Imperial Valley Campus. Pedagogy was typically addressed by an experienced Science Resource Teacher, and classroom practice by a teacher leader. The model is cyclical in that each presenter builds on the work of the others to further enhance the experience for the participants.

Special Theme Summer Institutes

Three Special Theme Summer Institutes were offered to meet the unique needs of the local teachers and students. The Immersion in Inquiry Institute was designed to engage teachers in the inquiry learning experiences they would be expected to practice with their students. Inquiry-based science investigations were offered as summer institutes, led by Exploratorium-trained LSC staff focusing on "Balances," "Pinholes," (light) and "Ice Balloons" (changes of state). Additional sessions of the same units were offered quarterly for teachers unable to attend the Inquiry Institute during the summer. In addition, shorter awareness professional development sessions such as "Three Kinds of Science" (dealing with tops) were provided for novice teachers. These inquiry-based institutes focused on pedagogical issues such as appropriate questioning strategies, designing investigable questions, assessment of student learning, and providing appropriate feedback.

The content of the second Special Theme Institute—English Language Development/Academic Language Development Institutes—was drawn from the science content standards, and cut across all of the science disciplines. The evaluation of student work was a central focus of these Institutes, using materials gathered from area classrooms. These institutes provided an intensive look at the literacy components that had been infused into the content institutes; they were designed to help teachers further their understanding of how English learners can best develop language and academic skills through science.

The third Special Theme Institute, focused on assessment, introduced teachers to student science notebooks and the analysis of student work to help them reflect on the effectiveness of their instruction. The development of a "student voice" or a "knowledge transforming" form of expository writing through student science notebooks was a significant part of the LSC (Klentschy & Molina-Del La Torre, 2004). The Assessment Institutes also helped teachers understand current accountability standards, as well as the impact of their feedback on student achievement.

The Valle Imperial Project LSC documented the gains in expository writing by students who experienced science notebooks as an integral part of their science program (Amaral, Garrison, & Klentschy, 2002). The project also worked with researchers from Tennessee State University in a pilot project to refine the analytical strategies used by teachers to assess the science notebooks.

Each of these institutes offered 40 hours of professional development. Teachers could earn a $500 stipend for attending an institute or alternatively earn two university credits toward salary advancement or reauthorizing credentials. Their choice was usually based on where they were on the salary schedule and how many credits they needed for advancement or credential renewal.

In retrospect, each of these engagement strategies provided some teachers with an entry point into professional development; the design provided some common experiences for all and in-depth experiences in a variety of domains based upon their interests and needs. Recently, as teachers were certified by local districts for "highly qualified" status as defined in the No Child Left Behind legislation, most used their extensive training in science to meet the requirements for this certification.

School Level Support

The Valle Imperial Project LSC staff shared a strong belief that school principals play an important role in supporting high quality science instruction in classrooms. They also believed that school site administrators needed a well-designed professional development program to prepare them to provide the formative feedback to teachers necessary to strengthen the fidelity of implementation of the designated instructional materials. Support for the principals came in two forms: a coherent program of science instruction provided by the district and a professional development program especially designed for principals. The Valle Imperial Project in Science designed a professional development program for principals and other school administrators. Known as "Hand Lenses on Science" (which shares many features of the mathematics-focused Lenses on Learning program developed at the Education Development Center [Grant, Nelson, Davidson, Sassi, Weinberg, & Bleiman, 2002]), the program consists of a series of half-day segments, focusing on:

- State-required science content standards;
- Science content associated with the state content standards;
- Literacy connections through writing in science and ELD strategies;
- Video study;
- Teacher feedback;
- Analysis of student work;
- Fidelity of classroom implementation;
- Administrative support; and
- Media and community relations.

The sessions were designed to strengthen principals' capacity to provide formative feedback to their teachers. The major goal of this formative feedback process was to move teachers along three distinct, but inter-related, pathways in their development of teaching expertise. These three pathways are described by Berliner (1994) in terms of knowledge of content, knowledge of pedagogy, and knowledge of student understanding. Berliner believes that as teachers grow as professionals, they move along these three distinct pathways and progress in stages from novice to competent to expert. Expert teachers have a great deal of knowledge in each of these three domains (National Research Council, 1999). A major responsibility of the principal is to observe teachers and provide them with formative feedback intended to help them develop expertise and to strengthen the fidelity of their implementation of the designated science curriculum.

In addition to the professional development program provided for the 43 elementary principals, Valle Imperial Project teacher leaders offered school-level support through professional development on each campus. These programs covered such topics as student science notebooks, embedding English Language Development strategies into science lessons, and analysis of student work.

A third form of on-site support came from the project Science Resource Teachers. Each SRT was assigned to a group of schools and made weekly visits to each campus to support classroom

science instruction through a process of coaching and feedback, demonstration lessons, and informal discussions with teachers. The typical case load for a Science Resource Teacher was about 80 teachers from 3–5 schools. The roles of the SRTs were discussed at the beginning of each year at each of the participating schools at a staff meeting led by the principal. The principal made it clear that the Science Resource Teacher's role was to provide support, coaching, and demonstration, and was not to evaluate teachers. Over the course of the first year, the experience of having another teacher visit and provide feedback became less stressful for most teachers and many came to appreciate the support that they received from the Science Resource Teachers. The role of the Science Resource Teacher as a coach and mentor for support has become part of the culture of the schools in the participating districts.

All three of these school-level support strategies have worked exceptionally well. The "tipping point" in the scale-up process came when the support of the principals was secured through their participation in the "Hand Lenses on Science" training. The subsequent strong support provided for the reforms in science teaching by principals, offered considerable comfort to teacher leaders at the school level and made the visits of the Science Resource Teachers more effective.

The greatest challenge was getting the principals to attend the training sessions due to the competing priorities facing them in their schools. This challenge was overcome in part when two of the participating districts' superintendents became trainers for the program. Superintendent participations helped in recruiting the principals and contributed significantly to the scale-up effort. In addition, several of the superintendents from the participating districts met individually with each principal in their districts three times a year to discuss and analyze student work from the principal's school. These discussions also added to the momentum behind the program as they made it clear that the science program was a priority and had the personal support of the superintendents.

LSC Adaptations

Over the last decade, several adaptations have been made to the project design. Intended to improve the quality of curriculum implementation, the adaptations included the redesign of pivotal lessons to make the science content goals more explicit. In addition, English Language Development strategies were embedded into the lessons to strengthen student opportunities to learn and draw teachers' attention to the importance of teaching for understanding rather than simply for "coverage."

Classroom observations made by principals and Science Resource Teachers indicated that implementation was uneven across the project, with some teachers at each grade level having considerable difficulty in providing students with opportunities to learn important science content. The greatest area of concern was the need for more attention to student "sense making." A project analysis of student work indicated that many students, especially English Language Learners, were not able to draw conclusions from their science instruction, or were not linking claims to evidence. To address this issue, Valle Imperial Project LSC staff redesigned the lessons from the adopted commercial curricular materials (FOSS, STC, and Insights) to make the science content goals more explicit. The lessons were also redesigned to embed English

Language Development strategies to provide English Learners with enhanced opportunities to develop the academic content language necessary to make meaning from the activity.

The time allocations for lessons were also analyzed. Through this analysis, the project staff concluded that many of the key lessons could not be taught in one day. These lessons were expanded to two or three days and specific "scaffolded inquiry" strategies were incorporated into each lesson. These scaffolded inquiry strategies provided students with writing stems and discussion time though a "making meaning" conference in which they were asked to link claims to evidence and draw conclusions from the activity. These adaptations emphasized the students' science notebooks as a means for recording their science experiences in a more organized and focused manner, and were generally well received by teachers across the project.

The adaptations were further refined by groups of teachers participating in lesson study groups. Over a five-year period, more than 100 teachers participated in lesson study grade-level groups (Amaral & Garrison, 2004; Klentschy, 2005). The lesson study process strengthened the alignment between the lessons and standards; it also provided a different form of professional development for teachers at the school sites by establishing a culture of common planning, observing colleagues teach, providing feedback on the lesson based upon student learning, and providing feedback to the Valle Imperial Project that could be used in summer institutes and as coaching strategies by the Science Resource Teachers.

Achievement in Science

Of course, the ultimate goal of the Valle Imperial Project was to improve student understanding. The fact that the Principal Investigator of the project was the superintendent of one of the participating districts provided important opportunities to assess progress toward that goal. All 4^{th} and 6^{th} grade students in the El Centro School District were assessed annually with the Science Section of the Stanford Achievement Test, Ninth Edition, Form T in addition to the Reading, Mathematics, Language and Spelling sections. To examine the impact of the LSC, these data were first disaggregated to form a group that included only students who had attended an El Centro Elementary School District School continuously for the previous four years (92 percent of all students in the district). This group was then further disaggregated into groups according to the number of years each student had been taught by a teacher who had participated in the district science program during the scale-up years.

In the El Centro Elementary School District, all student cumulative records are electronically stored, making it possible to retrieve individual student demographic information, achievement data, and their teacher for each of the previous four years. A sub-file for teachers was established which referenced the year they began participating in the professional development program and whether they had implemented the district science program in their individual classroom. The number of years each student had participated in inquiry-based science was computed by matching students with teacher implementation information.

The results of this study showed that the longer students in El Centro were exposed to a high-quality program of instruction in science supported by sustained professional development of

teachers, the better they achieved. (Amaral et al, 2002; Jorgenson & Vanosdall, 2002; Saul, Reardon, Pearce, Dieckman, & Nentze, 2002; Klentschy & Molina-De La Torre, 2003, 2004). The results also indicated that achievement gaps between English speakers and English Learners were closed though the lesson adaptations made by the project staff (Amaral et al, 2002). Since the student demographics and patterns of implementation were similar for all participating districts, these initial results contributed to the sustainability of the reforms; once local education leaders learned that student achievement improved through the implementation of the science program, it was almost universally accepted county-wide.

On-going Challenges

Change is a constant in any school system. Teachers retire, move to other careers, or change districts, schools, and grade levels. This situation is the norm rather than the exception. The process of change is even more complex when 14 districts are involved in a county-wide partnership. The Valle Imperial Project staff anticipated that there would be teacher turnover, school and grade level changes, and that new teachers would be hired into the participating school districts. Consequently, the professional development design of the LSC addressed these issues of teacher mobility. During each of the four summers of the scale-up years, initial training for each of the instructional units was conducted during the week preceding the start of school by a cadre of teacher leaders, Science Resource Teachers, and volunteer science professionals. This approach provided both an introduction for new teachers and a seamless transition for teachers moving from one grade level to another, regardless of whether they changed schools or districts. The impact of teacher mobility was further reduced because all school districts in the county were using the same instructional materials. Only new teachers and those who changed grade levels needed to receive the initial training each year. (The principles of pedagogy and learning involved in using oral discourse and students writing to make meaning through the use science notebooks and the acquisition of Academic Content Language were core to all grade levels.)

The establishment of new leadership roles for teachers, and the recruitment of Science Resource Teachers provided unique career pathways for teachers. Teacher leaders and teachers who completed the San Diego State University Master's program with the Specialization in Science Education became a natural pool of candidates for the Science Resource Teacher positions. A Science Resource Teacher moved into the position of Project Director during the second year of scale-up. Over time, the Valle Imperial Project LSC contributed to the development of a strong cadre of teacher leaders across the county and within the schools. As a result, a significant amount of informal mentoring now takes place within schools between new teachers, teachers new to grade levels, and established teacher leaders.

The Valle Imperial Project in Science was established as a partnership of the 14 school districts of Imperial County, Imperial Valley College, and San Diego State University. As noted earlier, one unique feature of the partnership is that San Diego State University produces 94 percent of all teachers hired in the 14 school districts in Imperial County, and the majority of these teachers also attended school K–12 in Imperial County. Due to its geographic isolation, the development of human capacity within the region is almost a closed system. Still, prior to the LSC, the linkage between what was taught in the teacher education program at San Diego State University

and what was actually being taught in Imperial County Schools was weak. In order to institutionalize the new vision of instruction and sustain the reforms that had been introduced, the Valle Imperial Project staff and members of the Teacher Education Department at San Diego State University revised the pre-service program to align the science methods courses, student teaching, and other pre-service experiences with the curriculum and instructional practices of the 14 Imperial County school districts. The Chair of the Teacher Education Department at San Diego State University was Co-Principal Investigator for the LSC and spearheaded the change at the university, and the science methods course was taught by the Director of the Valle Imperial Project in Science. The changes at San Diego State University were important, and demonstrated the power of collaboration. Pre-service teachers entering their student teaching year were invited to the summer training sessions along with the regular classroom teachers to receive training on the unit that they would teach that fall during student teaching. This same approach was used at the mid-semester training for the second semester of student teaching. Thus all newly hired teachers who were from San Diego State University had already taught two units of the designated instructional materials by the time they graduated, and in most cases could be treated as a teacher changing grade levels in their induction training. The resulting pipeline ensured that new teachers came into the workforce with content and pedagogical skills directly aligned to the needs of the LSC.

The Benefits of Partnership

The partnership established by the Valle Imperial Project in Science also was cost effective for the participating districts. Eight of the 14 participating school districts are single school rural districts, and could not possibly have designed and delivered the institutes for teachers and principals on their own, nor could they have hired the Science Resource Teachers and provided on-site support for teachers. The partnership allowed them to provide high quality, sustained professional development for their staff.

Another advantage of the partnership has been the acquisition and refurbishment of instructional materials. The Valle Imperial Project in Science established a materials resource center in the El Centro School District, with the cost of material acquisition and refurbishment prorated among the 14 districts based on student enrollment. A centralized purchasing system was established and billing for the materials also prorated. The instructional materials were bar coded and a computerized scheduling system supported their rotation and delivery. This system greatly reduced the cost of purchasing materials. For example, the acquisition of a single instructional unit for Grade 4 is $400. Three instructional units of study are required for each year. In a non-rotational system, the acquisition of the materials would cost $1,200 per teacher and this cost would be extrapolated for scale-up. By using a rotational system, the materials center could purchase three instructional units for $1,200 and distribute them to three teachers. The instructional units could then be collected, refurbished for $180 ($60 per unit), rotated, and redelivered to a second group of three teachers. This process was repeated during the third trimester of the year for $180. The total cost for the year would be approximately $1,580 for the three teachers as opposed to the $3,600 cost if the materials were not shared and rotated. Although each district owned their own materials, all materials were shared by the consortium. At the end of each trimester, the kits were collected, refurbished at the materials resource center,

and then redelivered to another school in a rotation. The rotation was between schools, not classrooms within a school. Follow-up support was also efficient, as all teachers at School A would be teaching Physical Science, School B Earth Science, and School C Biological Science, allowing the teacher leaders and Science Resource Teachers to focus their efforts accordingly.

After four years of scale-up and then sustaining the program for a number of additional years, the 14 districts now own all of the instructional materials and pay only for refurbishment and some replacement of non-consumable materials. This system of cost-sharing has proven to be extremely cost effective and has been part of the county culture for more than a decade.

Sustaining the Reforms

In the post LSC era of standards, assessment, and accountability as part of the No Child Left Behind legislation, there is a tremendous press to improve reading and mathematics scores in most districts, and science is being neglected in some districts. However, these competing demands for time and resources have not adversely affected the amount of time devoted to science instruction in Imperial County schools. The factors contributing to this continued emphasis on science have their roots in the design of the Valle Imperial Project LSC. The teacher leaders developed by the LSC have become strong advocates for science in their individual schools; and the professional development program for principals has contributed to the development of cultures in which the importance of science education is recognized. There is also strong community support from the science professionals who were mobilized and activated by the LSC. And finally, local decision-makers have been influenced by the persuasive evidence, stemming from the evaluation of the Valle Imperial Project, that a strong program of instruction in science has positive effects on achievement in other disciplines as well.

The teacher leadership cadre has become a sustaining force within each school. To date, more than 200 teachers have participated in the leadership training, providing multiple leaders in almost every participating school. The teaching of science on a daily basis has become part of the professional culture within the county. This culture has been reinforced by the strong support of the central office and school level principals. Over the last decade, five new superintendents appointed in the county were formerly principals trained by the Valle Imperial Project LSC. Eight of the current 43 principals were at one time either LSC Science Resource Teachers or members of the teacher leadership cadre. All of the newly-hired teachers from San Diego State University are already trained in the use of the designated instructional materials. Many of the volunteer science professionals who assist with training are also parents of students within the county schools and serve as strong advocates for a high quality program of instruction in science. Finally, the research evidence drawn from the project over the last decade has provided the documentation that the science program is enhancing reading and mathematics achievement, especially in grades 4–8.

The Valle Imperial Project in Science LSC has served as a powerful catalyst for instructional improvement and systemic change within an isolated rural area. The systemic change has resulted in a number of significant policy decisions by the school districts and the local university. The catalyst of the LSC has produced important changes in the culture and climate of

the schools in the region. It has provided teachers with high quality instructional materials coupled with a program of sustained professional development. In combination, these supports for improved science teaching have led to high levels of classroom implementation and ultimately improved student achievement. Teachers are receiving strong district, school level and community support for this program of instruction improvement. This change in culture has been the strongest force for sustainability.

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