LESSONS LEARNED FROM THE SAN DIEGO URBAN SYSTEMIC PROJECT (USP): IMPLICATIONS FOR FUNDERS AND FUTURE PROJECT DESIGNERS

Mark St. John

Barbara Heenan

Jenifer Helms

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INVERNESS RESEARCH ASSOCIATES

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I. INTRODUCTION

The following brief draws upon the five-year evaluation study of the San Diego Urban Systemic Project (USP) that Inverness Research Associates conducted from 2001 to 2006. The intended audiences for this brief are those interested in investing in, supporting, or designing initiatives that aim to improve math and science education in large urban districts.

The San Diego USP was one of approximately 30 projects funded by the National Science Foundation (NSF) through its Urban Systemic Initiative, an initiative which focused on enhancing mathematics and science programs in urban school systems with large numbers of children living in poverty. The NSF encouraged the USP districts to pursue a systemic approach, to work in multiple dimensions of improvement simultaneously, including curricula, assessment, professional development, policy and resources.[1] San Diego Unified School District's USP sought to create system enhancements in each of these dimensions that would yield better teaching, and, as a result, overall improved student learning in mathematics and science Kindergarten through grade 12.

This report looks at San Diego as a particular instantiation of the systemic approach to educational improvement, and offers the reader key lessons learned that can be applied to other similar change efforts.

[1] As part of our study of the San Diego USP we have produced several other reports that document and analyze the work of the San Diego School District along these dimensions. To view these reports, please visit our website: http://www.inverness-research.org.

II. LESSONS LEARNED

In the following section, we briefly describe what we believe are the major lessons learned about fostering improvements in large urban districts based on the case of San Diego. We do not assert that these lessons are entirely transferable to other urban contexts, but we do believe there are elements of the lessons learned in San Diego that can be useful and applicable to the design of future investments made in mathematics and science education improvement in urban settings.

- **Mathematics and science education are separate and distinct endeavors.**

NSF USP grants were awarded to urban districts to address both mathematics and science. In San Diego, it became clear very early in the project that the two subject areas would require very different approaches.

Mathematics and science are two disciplines that are not especially interactive with each other in a large school system. The nature and structure of the actual content matter, the relative priority of the subject, the assessment systems in place, the resources available for improvement, and the readiness of those responsible for their teaching to engage in change – all are very different for mathematics and science. Moreover, different grade levels and grade bands (elementary school, middle school, and high school) also have very different needs and circumstances. Therefore the opportunities for improvement in both mathematics and science vary greatly, not only from subject matter, but also from grade to grade.

By necessity, then, what is theoretically a single K-12 mathematics and science project becomes, in reality, six distinct, but parallel improvement efforts. Although each of the six can learn from and draw upon one another, they remain essentially different. We describe some of the key reasons for the inevitable separation of efforts in what follows:

- o There are ten times as many **elementary** teachers as middle and high school teachers of mathematics and science. At the elementary level there are thousands of teachers potentially involved in a change effort in a large district such as San Diego. Moreover elementary classroom teachers are generalists, all working hard to piece together an instructional day that involves multiple disciplines, meets the needs of a diverse group of students, and fulfills the requirements of both the school and district, as well as of the state.

  Not surprisingly, as a “non-basics” subject science is frequently “lost” in the elementary classroom, ringing in with social studies at the bottom of the instructional priority list. While mathematics generally receives more instructional time and greater professional support than does science, it is also often more constrained. Time-honored traditional teaching methods, long-standing grade level topics in math, and habitual testing practices all resist change. As an overall result, the strategies for supporting instructional improvement at the elementary level are very different in math and science.

- **Middle school** teachers and students also face their own unique issues, which include: the dramatic hormonal changes of preadolescents; the transition for students from self-contained classrooms to multiple teachers, subjects, and classrooms; and the push for teachers to use differentiated instruction. All of these challenges make the middle school teacher's job complex and demanding. In the case of San Diego, prior to the USP, the middle school science program was very haphazard. In the absence of a good, commonly used science curriculum each teacher essentially created his or her own program. By contrast, a centrally mandated decision to introduce algebra at the lower grade levels in the middle school mathematics program proved to be very difficult for many teachers to implement, and even onerous to accept.

- At the **high school level**, there is another, still different set of capacities and constraints at play. High school math and science teachers are, by and large, "content experts." They are steeped in their disciplines, and tend to favor particular approaches or topics of their own choosing in their classroom practice. Their knowledge of and attachment to their discipline creates very different challenges for district-wide improvement than exist at the elementary level. In addition, state and local policies also can play an especially important role. As just one example, the graduation requirement change – from just two to three full years of lab science in San Diego City Schools – has created a whole set of challenges unique to the high school level.

Not only are the conditions different across disciplines and grade levels, but we also found structural separations between the mathematics and science improvement efforts. San Diego may be typical of most large urban districts in that the Mathematics Department and the Science Department are not strongly connected, and in fact rarely work together or collaborate. Physically their staffs are separated, each housed in different buildings separated by several large parking lots. They are separated organizationally as well, each reporting to a different and largely independent curriculum director. Even within each department staffs are organized by and work together in grade band sub-units. For all the above reasons there is not a unitary mathematics and science improvement effort within a district. Rather, as we have described, there are by necessity six different and distinct improvement efforts working in parallel. Each, on its own, is a substantial, challenging and complex undertaking.

While approaches and materials are typically quite different for each of the six efforts, there are ways they can learn from one another, and their strategies for effecting change can overlap. For example, in San Diego the elementary science effort began using Lesson Study as a major focus of their professional development. Due to the success of this strategy with elementary teachers, the leaders of the middle and high school science efforts also began implementing pilot Lesson Study projects. Another example of shared strategy was in the high school science change effort, which began with intensive training of a small team in assessing and selecting quality inquiry-based science materials. Later, the district invested in providing the same experience for a larger middle school team.

In spite of some useful strategies that can be shared, the overall point to be made here is that there is no unitary phenomenon at a district level that can be described as “the mathematics and science reform.” Once the work begins, the differences between subject matter and grade levels quickly demand that the overall reform effort evolve into six large-scale, distinctly different efforts. It is also worth noting that these separate efforts can, and often do vary greatly both in their approach and efficacy. Good progress may be made in one of the six domains, while very little progress might be made in another. Thus, we have learned that it is not sensible to speak in averages about either the work or the success of mathematics and science education improvement in large urban districts.

- **The relative scale of the USP investment greatly influences the nature, scale, quality and longevity of the improvements.**

A sum of 9 million dollars is inarguably a large amount of money for a school system. However, it is important to view the size of that investment relative to the scale of the system and the needs it aims to influence. The $9 million sum is spread over a 5-year period, across 133,000 students who speak 60 different languages and dialects, and approximately 4,500 teachers. The overall annual budget of the San Diego school system exceeds a billion dollars. Thus the two million dollars or so per year provided by the NSF grant is on the order of a tenth of a percent of that billion-dollar figure. Therefore, to effectively implement the improvements in mathematics and science education expected by the USP funding and desired by the district, it is obvious that the NSF contribution alone is not close to sufficient, and that additional funds are required.

- **An outside investment can make the most difference when it adds value to a strong ongoing internal improvement effort.**

The theory of change and strategies adopted by the externally-funded USP effort must be congruent with and be supported by a broader, more inclusive internal reform effort within the district. In other words, it is unlikely that NSF money will effect change unless it is leveraging and complementing a much larger district-driven improvement effort.

When San Diego initially received funds from the NSF, the district was in the midst of a reform effort based on what they called the “*Blueprint for Student Success in a Standards-Based System*,” which was initiated in the year 2000. This effort was centered on the conviction that a system-wide focus on improving instruction would result in greater achievement for all students. According to the *Blueprint*, the district would reorganize itself so that all students would receive “the best pedagogy, the richest learning environment, and sufficient time to meet high standards.”[2] A key characteristic of this effort was a strong district-wide focus on monitoring and improving the quality of classroom instruction.

The USP work in math and science, therefore, was able to readily integrate itself into the larger district plans to improve instruction in all areas, at all grade levels. By the

[2] From the San Diego City Schools Website, www.sandi.net.

time the USP funds were available, the *Blueprint* work was underway, and as the math and science departments used USP funds in their work, they were strongly supported by the district administration.

- **The USP investment in the San Diego schools was an investment in an "improvement infrastructure."**

Based on our experience studying San Diego and other USPs, we have concluded that the primary role for NSF is to fund activities and programs that build the internal capacity of the district. These capacities then empower the district to be better able to engage in its own ongoing improvement efforts. In a large urban district NSF cannot fund all of the activities involved in improving mathematics and science education across the district. Rather the NSF funds are better used to develop and enhance the underlying capacities that make large-scale improvement work possible. We have come to refer to those capacities as an "improvement infrastructure."

As we have described, one of the hallmarks of the San Diego improvement effort as outlined in the *Blueprint* was the focus on the nature and quality of instruction. All districts are worried about student achievement, of course, but San Diego realized that it could not affect student achievement without first affecting what and how students were taught. So the district focused its efforts quite explicitly on making instruction better in classrooms. To accomplish this large-scale improvement in instruction, the district organized itself in radically new ways, changing the roles, responsibilities, and accountability of district and school leaders. The district re-allocated resources and invested a considerable amount of district money in creating more professional development opportunities for teachers.[3] New forms of accountability, coupled with ample support would, the district believed, lead to improved instruction, and ultimately to improved student learning.

Thus, the NSF grant complemented this broader, system-wide focus on instruction. NSF funding allowed the district to develop the key capacities needed to work steadily, in an on-going fashion on the improvement of science and mathematics instruction at all grade levels across the district.

In another document we have produced as a result of our study of the San Diego USP, "Sustaining the San Diego Infrastructure for the Improvement of Mathematics and Science Education," we describe in detail the characteristics of what we call the San Diego "improvement infrastructure" for mathematics and science that was produced through the USP funding.[4] In the following few paragraphs we distill and highlight the lessons learned from the San Diego USP efforts to identify and develop those

[3] We were told that expenditure on professional development increased from less than 1% to more than 6% of the total annual school budget.
[4] *Sustaining the San Diego Infrastructure for the Improvement of Mathematics and Science Education*. Inverness Research Associates, December 2006.

capacities most critical in maintaining ongoing improvement efforts in mathematics and science education.

Leadership

The USP resources allowed for the **development of discipline-specific leadership,** helping to bolster the district's mathematics and science departments. Not only were new staff members hired, but the grant also provided resources for staff development, strategic planning, evaluation, outside consultation and experimentation. The mathematics and science departments became the key interface between the NSF and the district, working to achieve the goals of the USP initiative by designing and implementing improvement strategies appropriate for each grade band and discipline they were addressing. At the same time the department worked to achieve the district's own goals as outlined in the *Blueprint for Success*.

The mathematics and science departments developed strong **centralized leadership** in their own staff, and at the same time, they helped to develop what we call **distributed leadership** in the form of teacher leaders, content administrators, principals and others who worked at school sites. The centralized and distributed leaders worked interactively and collaboratively, sharing information, knowledge and expertise up and down the system, thereby increasing the capacity of both elements and district leadership overall.

The Improvement Community

The cadre of centralized and distributed leaders became the core of the San Diego mathematics and science **improvement community**, a theoretical construct invented by Doug Englebart,[5] and a concept we have used extensively to understand and explain the nature of investments in capacity building. The improvement community that emerged from the USP is the core of the San Diego improvement infrastructure for mathematics and science education.

The community consisted of a group of professionals committed to improving mathematics and science education within the district. They were skilled in areas of curriculum, materials, professional development, assessment and policy. The members of this community designed and delivered workshops and other professional development activities, provided teacher coaching, identified and chose curriculum, and designed assessments. In short, they were the skilled leaders needed to do the actual work of improvement. The members of this community not only worked on improvement, they were also conscious of improving their improvement efforts – always paying attention to what they could do better by deliberately taking time to assess what

[5] Doug Englebart is a professor emeritus at Stanford University, the inventor of the computer "mouse," and a visionary who thinks and writes extensively about the nature of organizations and the improvement of organizations. Englebart distinguishes between a capability (or operational) infrastructure, and an improvement infrastructure. It is this critical distinction we have applied to understanding education and the nature of the educational investments NSF has made in San Diego through the USP.

they were doing and re-designing their work accordingly. They devoted themselves to learning how best they could improve their improvement efforts. Doug Englebart, the creator of the term "improvement community" described this process as "getting better at getting better."

Importantly, one of the key functions of the improvement community is to grow and nurture and thereby maintain itself. That is, its members are constantly identifying people across the system that exhibit expertise, passion and interest in engaging in professional development, coaching, curriculum selection and other improvement efforts. In San Diego multiple opportunities became available for teachers, administrators and others to become active members of the math and science improvement community. The members supported the community at large, and the community supported individual members. The USP supported both individual leaders and the improvement community as a whole.

Instructional Materials

Another key area of capacity development was the **adoption or enhancement of curriculum and instructional materials**. The district found multiple ways to involve teachers, administrators, and math and science staff in improving curriculum and instructional materials. For example, in secondary science, the district formed leadership teams that worked with a national program called the National Academy for Curriculum Leadership (NACL) at BSCS to build their capacity to identify, pilot, and implement new instructional materials.[6] The NACL district leadership teams made sure that the materials they selected met the state adoption requirements, and at the same time were consistent with a higher-order vision represented by the national standards and their own internal district standards.

More broadly, throughout the grant period, the USP helped both math and science leaders to seek out materials that were high quality and educative,[7] and that would help move teachers toward a richer vision of instruction and toward more effective implementation. The USP thus helped the district develop a cadre of curricular leaders – people with the knowledge and skill to select and implement high-quality curricula.

Professional Development

Another key capacity within a school district's improvement infrastructure is the ability to provide large-scale and high-quality **professional development for teachers**. San Diego is the only district we have seen, in our extensive experience with evaluating mathematics and science programs, that consistently spoke of its efforts to not only

[6] See http://inverness-research.org/reports/ab2006-06_Rpt_BSCS-NACL-June2006.htm for more information about the BSCS National Academy for Curriculum Leadership.

[7] Educative instructional materials can be challenging both for students and teachers. However, they allow for and often demand a re-conceptualization of the discipline, as well as a readjustment of the teaching and learning of the discipline. For more, see E.A. Davis & J.S. Krajcik (2005) *Designing Educative Curriculum Materials to Promote Teacher Learning*, Educational Researcher, 34(3), 3 -14.

provide professional development, but also to build a more permanent **“professional development infrastructure.”** This capacity consists of a cadre of skilled professional development leaders, their knowledge of professional development research, their access to new professional development curriculum and strategies, and their ability to respond to and provide a wide range of professional experiences to various constituencies.

Over the years of the grant, the San Diego mathematics and science department leadership found different ways to respond to the emerging needs and new levels of growing sophistication of their audiences, offering an ever-evolving set of challenges for administrators, teachers and students that were cumulative, strategic and “right” for the system. In addition to developing programs “in-house” that were unique to their setting, the department leaders carefully chose, imported and customized programs and models from nationally known projects. Overall then, as a result of the USP investment in professional development capacity, there were ever-increasing opportunities for teachers in San Diego not just to teach, but also to think about, reflect on and try to improve their teaching.

Equity

The ability to address issues of inequity is a capacity that is rarely thought about. But if a district is to take seriously the mandate to “narrow the achievement gap” by providing greater equity and access to opportunities to learn, then progress in this area demands that the district focus on the underlying capacities necessary to ameliorate inequitable instruction and student outcomes.

In its more general reform effort, San Diego took the issue of equity of opportunity to learn very seriously. It believed that the district needed **strong, well-defined district-wide math and science programs at every level and for all students**. In taking this position, they rejected the notion that schools or teachers should “do their own thing,” because such a scatter-shot, arbitrary approach would not lead to equity of opportunity to learn for all students. Instead, they used instructional materials, accompanied by professional development and assessment supports, as deliberately engineered mechanisms “to level the playing field” for students.

In summary, reviewing the preceding dimensions of capacity, one can see that the USP contributed strongly to the development of San Diego’s improvement infrastructure for mathematics and science education. The support for the development of leadership and the growth of an improvement community, the selection of high-quality instructional materials, the design and implementation of professional development, the ability to pay close attention to equity – all of these elements were critical in helping San Diego do the slow, steady work of improving its mathematics and science education. In this way the USP helped San Diego “get better at getting better.”

- **The improvement infrastructure can outlive changes in leadership.**

In the life of the typical school district, administrative turnover and political turbulence often mean that improvement efforts are terminated before they yield results. In our experience such changes seem almost inevitable in large urban districts. Particularly if an improvement effort is simply about pursuing a single strategy or approach, then new leadership can quite easily reject it, and thus the district effort loses any momentum or gains it has made to date. If, however, the improvement process has focused sufficiently on developing underlying capacities, then changes in leadership and even in strategy may not mean that all is lost. Deep-seated capacities such as teacher leadership, professional development staff and practices, and collective knowledge of curriculum and its improvement all can potentially be brought to bear in new ways when new instructional improvement strategies are adopted.

The ability of an improvement infrastructure to outlive the shifts in leadership and direction so typical in today's schools and districts is still another reason for investments such as the USP to deliberately focus on the development of improvement capacity. Producing (often invisible) assets that are flexible and enduring is more likely to yield future returns on investment than simply funding operational activities that can be aborted before they realize results.

- **There are multiple threats to successful improvement efforts.**

While the development and maintenance of a strong improvement infrastructure can increase the likelihood that an ongoing improvement process can be sustained, there are nonetheless multiple threats to the achievement of such system-wide improvements. The following is by no means an exhaustive list of all possible threats, but describes ones that we observed in San Diego in one form or another.

One threat is what is commonly referred to as a **reform overload**, when districts take on too many new and different programs or approaches, all at the same time. The obvious problem here is the burnout of people who are charged with leading and implementing the changes, as well as the overload on teachers who are charged with multiple instructional changes mandated simultaneously. In fact, prior to the USP funding, San Diego had an earlier USI grant from NSF. The district aborted this grant midway, however, because they wanted to strongly focus their efforts on literacy; they felt that the mathematics and science work would provide an overload on both administrators and teachers.

Another threat is **churn**, a term borrowed from the investment world. In the language of investors, churn occurs when assets are bought and sold at such a rate that the costs of trading overwhelm the small returns that come in the short time spans that assets are held. Churn in the schooling world is similar, and occurs when a district changes direction or approach too quickly, moving on to the "next best thing" before the preceding approach or program has gotten a chance to yield results. This situation doesn't provide enough time for the ideas to take hold, to germinate, and to yield long-term sustainable benefits. The work of improving math and science education –

building the requisite capacity and then allowing that increased capacity to play out and accomplish results – requires five to ten years of stable, steady effort. It demands long-term commitment and steady work that evolves and builds upon itself.

Urban systems are particularly vulnerable to the threat of churn, where improvement efforts are typically highly political, episodic and short-term. Urban school superintendents are under great pressure to produce measurable results in a short period of time. San Diego was fortunate in that it enjoyed a period of time that coincided with the early years of the USP, a time when the district had both stable leadership and a stable and coherent improvement effort.

A third threat is to be found in the small window between inertia and backlash. Too little pressure and the system will not move; too much pressure and great resistance can be generated. During the early period of the USP funding, San Diego pursued a strong **top-down design and implementation of improvement efforts**. In the case of San Diego, the top-down approach was both advantageous and disadvantageous to the overall improvement thrust. Because of the size and complexity of the district, and the *Blueprint* work already underway, a mandate from the top was critical in creating a district-wide focus on math and science, establishing the science and math departments, and conferring authority on building-level administrators to push for math and science improvement at their sites. Moreover, the level of "inertia" that existed in the district necessitated a very aggressive, even heavy-handed approach to get things moving.

Although the strong, top-down approach did succeed in starting up and giving the improvement effort momentum, the strategy also created some insurmountable barriers which prevented several specific aspects of the reforms from succeeding. For example, in the case of the high school science change strategy, the top-down nature of the initial and most radical change – a reordering of the traditional high school science sequence placing physics in the 9^{th} grade for all students and using inquiry-based, conceptual instructional materials – met with a great deal of resistance from the teaching staff as well as from parts of the community. After four years, a change in district leadership and a shift in philosophy, this district-wide mandate has relaxed. In fact many schools are opting to return to the traditional high school sequence and materials. In this instance too much pressure from the top, and radical changes made in rapid order could not bring about long-term sustainable improvements.

III. KEY QUESTIONS FOR POTENTIAL FUNDERS

San Diego is a very compelling case of a self-initiated, district-wide instructional reform effort. The USP is a very interesting case of an investment made by an outside agency to help a large urban district engage in its own large-scale improvement work. We believe this particular case suggests more general questions that might be useful for foundations and other outside funders to consider as they plan their investments in mathematics and science initiatives:

1) Can a proposed project add value to a strong, pre-existing, strategic improvement effort? There are two important parts to this question. First, does the district have in place a broader operational strategy for math and science educational improvement? Second, to what extent and in what ways will the proposed project fit into a district's existing improvement effort?

2) What is the existing capacity to do the work that is proposed? What are the working assets that are in place? Are there people in the district's mathematics and science curriculum departments – i.e., teacher leaders, coaches and principals – who can become part of an improvement community?

3) Can the grant focus on capacity building as well as providing more direct services? Will one clearly envision ways that at the end of the grant the capacity for engaging in ongoing improvement in math and science education will be much greater than it was at the beginning?

4) Is the district aware of and does it value its capacity for improving science and mathematics education? Is the capacity that is developed through the grant likely to be appreciated by the district and continue to be supported in the future by the district?

5) Does the district know about and understand its own contextual landscape? Does the district leadership understand the current status and needs of the six different cells that are comprised by elementary, middle and high school science and mathematics programs? Does the district understand where and how it needs to develop its own capacity to pursue strategies that seem most likely to succeed in the district context?

IV. SUMMARY

The USP investment in the San Diego schools provided funding for carrying out the work of improving mathematics and science instruction. Also, importantly, the San Diego USP investment intentionally developed a wide range of capacities for improvement that, if utilized and maintained, will continue to help the district improve its mathematics and science education programs into the foreseeable future. For these reasons we believe the lessons that can be learned from the San Diego USP are particularly important for those who fund mathematics and science initiatives. There is often a gap between foundations – who become frustrated with what they view as a district's bureaucracies and inertia – and the districts, who often feel that foundations have unrealistic expectations for the effects of their funding and lack an understanding of the contextual realities they face.

The interesting aspects of the San Diego USP case include:

- the strength of the leadership capacity that was developed over five years, including both centralized and distributed leadership;
- the strength and sophistication of the curricular and professional development capacity that was developed over the duration of the grant;
- the inclusion of the USP work in a strong district-wide overall reform effort;
- a deliberate and intense focus on the quality of instruction;
- a conscious effort to develop capacity as well as provide services; and
- an evolving, responsive and iterative approach to designing strategies for particular disciplines and particular grade levels.

In summary, the experience of the San Diego USP suggests that foundations should conceptualize their grants to large urban districts as value-added investments, aimed at adding value to existing efforts rather than expecting their funded work to single-handedly produce unrealistic outcomes. The San Diego USP also suggests that a primary focus on capacity building may be a wiser way to conceptualize the purpose of the relatively small funds that are made available by such external investments. If both funders and districts were more conscious of and supportive of investments in capacity building, the gap between foundations and districts might well be lessened or even overcome.