

THE EXPLORATORIUM'S INSTITUTE FOR INQUIRY

FOUR CORNERSTONE CLAIMS:

A SUMMARY OF EVALUATION FINDINGS

(1996-2000)

I. INTRODUCTION

The Investment in the Institute for Inquiry

The Institute for Inquiry (IFI) is, in part, a research effort, working to generate knowledge about scientific inquiry, as well as about how scientific inquiry can be best promoted in elementary school settings. But, mostly the Institute for Inquiry is focused on practical work — assisting education leaders across the nation who are implementing elementary science education reforms in their home schools and districts. Through its professional development offerings and its curricular resources, IFI is seeking to help these leaders make inquiry a central feature of their elementary science education programs.

The Logic of the Investment

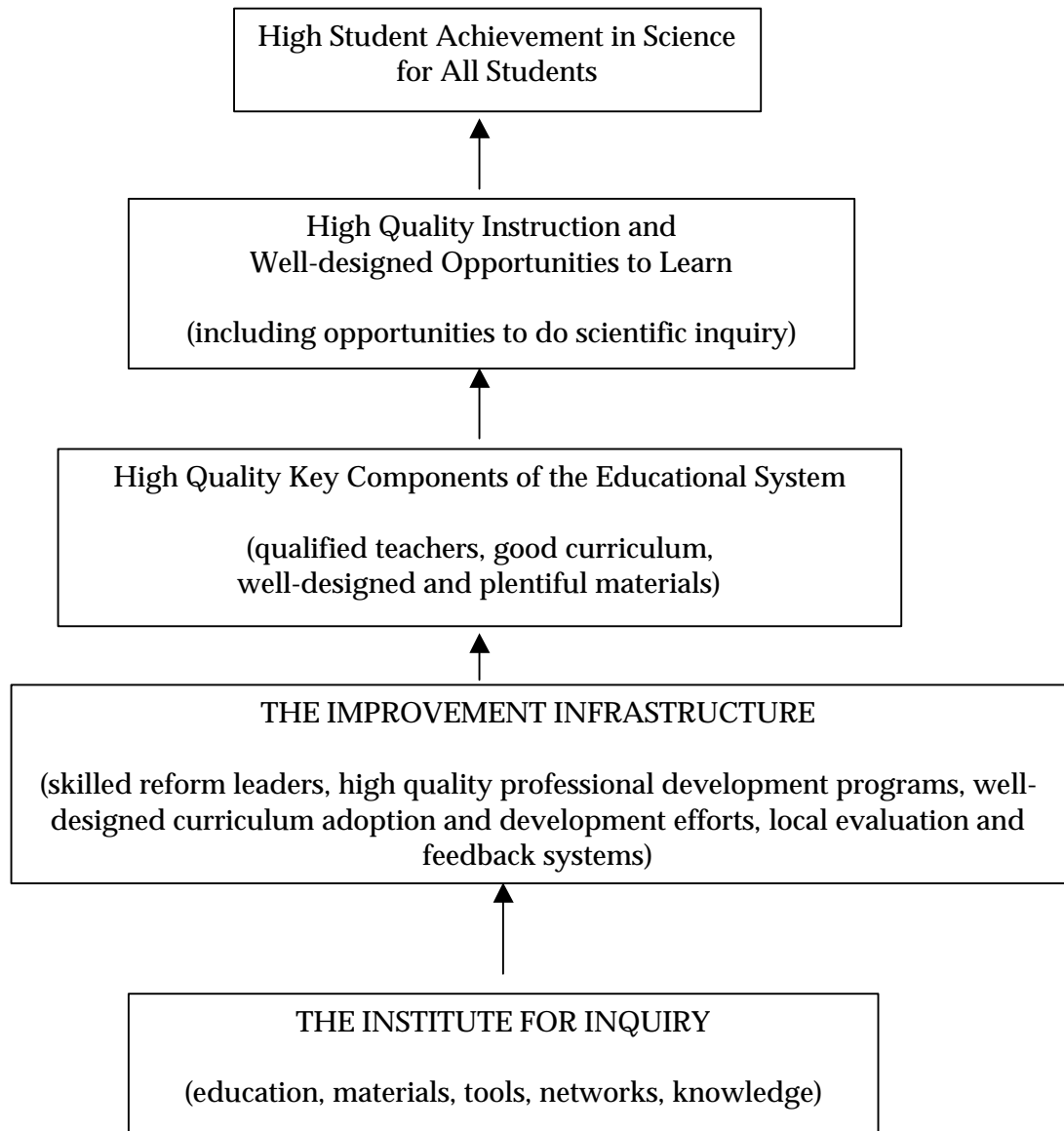
Because the broadest goal of the Institute for Inquiry is to serve teachers across the country, by increasing their ability to provide their students with a rich, inquiry-based science education, IFI must by necessity find ways to “leverage” its work. Clearly, it is not possible for IFI to work directly with the more than one million elementary school teachers in the United States. Nor is it feasible for them to engage individually with the over 16,000 school districts in the country. Moreover, the Institute for Inquiry does not address all aspects of science education reform, but instead focuses its efforts on its

unique strength and area of expertise — inquiry. Consequently, the Institute for Inquiry’s fundamental change strategy is to use its relatively scarce resources to strengthen — and add value to — existing elementary science education reform efforts.

To do this, IFI seeks to design programs, materials and tools that will empower the leaders of local elementary science education reform projects. IFI has worked with many NSF-funded projects including Local Systemic Change Initiatives (LSCs); State Systemic Initiatives (SSIs), Rural Systemic Initiatives (RSIs) and Urban Systemic Initiatives (USIs). In addition, IFI has worked with other projects funded by local foundations (for example, the Hewlett-Packard Foundation, Marin Community Foundation, etc.). In this way IFI focuses its work on leadership development. IFI does, for the most part, not attempt to work with students or classroom teachers directly, but rather its programs focus on those key individuals who have the authority and resources to improve elementary science education in their local schools and districts.

More specifically, IFI programs and tools are designed for those individuals who are responsible for professional development at a district level. Professional development providers in their local settings have influence over hundreds of classroom teachers, who in turn are directly responsible for providing science instruction to thousands of children. In addition, IFI works with those key administrators who serve as “gatekeepers” in their schools and districts. The Institute provides these strategically-placed district leaders with workshops, seminars and institutes centered on inquiry. They also provide these science leaders with access to professional development tools and strategies, publications, and resources — all of which are directed toward helping people understand inquiry and helping them to teach science inquiry to others. The aim of the Institute then is to enhance the capacity of these key people, so that, in turn, they will serve as more effective teachers and leaders of inquiry in their local science education improvement efforts.

The rationale for the approach and work of the Institute for Inquiry is shown in the diagram that follows.



In simple language the diagram tells us this: Student achievement in science depends, in part, on what students learn in classrooms. And what they learn in classrooms depends, in part, on the nature and quality of instruction they encounter there. And the quality of that instruction is itself highly dependent upon multiple critical system components — such as the quality of the teacher, and the soundness of the curriculum, etc. In turn, the strength of these system components depends, in part, upon the degree to which there exists a local “improvement infrastructure” that is capable of providing continuing resources and processes that can upgrade the quality and effectiveness of the key system components that are needed for good instruction. Hence, good inquiry-based science education depends upon the existence and efficacy of the local district

improvement infrastructure, and it is this infrastructure that the Institute for Inquiry seeks to support. Specifically, the Institute has focused on three key leverage points: (1) leadership development, (2) professional development design, and (3) professional development tools and curriculum. Through this three-pronged approach IFI is working to make the local improvement infrastructures capable of promoting both greater quantity and quality of inquiry-based science instruction.

Why the Focus on Inquiry?

Critical to an understanding of the overall reform strategy of IFI is their singular focus on inquiry. At IFI, inquiry is defined as the personal process by which one questions into something they realize is unknown to them. Inquiry is the process that generates new knowledge and new understandings. It is the means by which individuals become conversant with, and confident in, both what they know — and, equally important, what they do not know. Personal understanding and inquiry are inextricably linked, at the Institute.¹

Inquiry is also the process that underlies all of science. It is inquiry that yields the evidence and insights that result in new collective understandings of how nature works. Inquiry is the process that creates the ever-growing body of scientific knowledge. Inquiry is thus at the very heart of science as a discipline. And yet when “science” is taught in schools, all too often it is presented only as a body of knowledge to be learned, a *fait accompli*. The products of others’ inquiries are presented, but rarely do students ever have the opportunity to experience the process of scientific inquiry for themselves.²

For these reasons inquiry is the *raison d’être* of the Exploratorium and its Institute for Inquiry. The museum is dedicated to the proposition that inquiry is not only fundamental to science, but is actually an integral part of the human experience. The power to ask questions for oneself, to learn firsthand by making conjectures, by observing closely and trying things out, is held as a fundamental human right by those who work at the Exploratorium.

In 1995, in response to the growing national interest in using inquiry approaches to teaching science, due in large part to the publication of the National Science Education

¹ *Wait, Wait! Don’t Tell Me! The Anatomy and Politics of Inquiry*. The 1998 Catherine Molony Memorial Lecture booklet based on a lecture by Mark St. John for The City College Workshop Center (New York: 1999).

² The opposite perspective on science as a means of personal investigation is well-presented in the book of the Nobel prize winning physicist Richard Feynman: *The Pleasure of Finding Things Out*. Perseus Publishing (Cambridge: 1999).

Standards,³ the Exploratorium launched the Institute for Inquiry. The ultimate mission of the Institute is to promote opportunities for inquiry science learning for elementary students all across the country. The Exploratorium has learned that, in order to help students, one first has to help teachers understand and experience inquiry. And to do this, the Institute has further learned, one must first work with those who educate and guide the work of teachers. That is, it is the teacher educators and the administrators who must deeply understand and value inquiry if, ultimately, teachers and students are to be able to successfully pursue inquiry-based science programs.

Hence, the work of IFI is about providing a foundation for inquiry-based science programs through enhancing the “improvement infrastructure” of local districts. IFI programs provide science educators from across the United States — lead teachers, administrators, and professional development providers — with experiences designed to increase their leadership capacity to promote inquiry-based science education in their own local schools, districts and reform efforts.

³ *National Science Education Standards*. The National Research Council; National Academy Press (Washington, DC: 1996).

II. THE EVALUATION

The Role of the Evaluation: Gathering Evidence to Support the Program's Cornerstone Claims

Inverness Research is an independent educational research and evaluation group which has served as the evaluator to the Institute for Inquiry and its antecedent programs⁴ for almost two decades. For the purposes of this summary evaluation report we at Inverness Research have thought about our work as a kind of audit of the NSF investment made in IFI. IFI makes the argument to NSF (and to other funders) that their investment in the Institute is a sound one.

IFI's argument rests on four cornerstone "claims" that the program has made and has worked to achieve. These claims collectively form the logic and rationale for IFI's work. When taken together these claims collectively bolster the argument that IFI is making a significant contribution to the capacity of the nation to improve inquiry-based science education at the elementary level. The claims are:

- 1) The Institute for Inquiry is able to create and offer very high quality professional development programs and tools.
- 2) IFI professional development programs and curriculum tools are valued by and benefit key reform leaders in multiple and important ways — with the end result that these leaders are empowered to improve their local elementary science reform efforts.
- 3) IFI is able to serve directly hundreds of key leaders of elementary science education reform efforts. These leaders, in turn, through an important "multiplier effect" then are able to help thousands of elementary school teachers across the country improve their science teaching.
- 4) IFI makes a significant and visible difference. That is, the reform projects and districts that IFI works with are clearly distinguishable from otherwise similar districts and projects.

⁴ IFI's antecedent program was the School in the Exploratorium (SITE) which served elementary teachers between 1972 and the spring of 1995. Its mission was to offer formal training programs, and help design and disseminate curricula. SITE's workshops provided teachers with approaches to science that were grounded in the observations of natural phenomena. It also offered intensive program workshops to develop teacher leadership. A regional impact study by Inverness Research Associates conducted in 1994-95 ([The Exploratorium: A Regional Science Resource Center. A Study of Long-term Regional Impacts](#)) found that the program had reached over 650 teachers during the preceding 10 years. SITE was funded by the National Science Foundation, corporate and foundation funds, and the State of California.

The following then is a summary evaluation report, which draws on many years of previous research and evaluation we have conducted on IFI's behalf. It is not intended as a comprehensive evaluation of the project. We do not, for example, describe the program in full, or discuss relevant issues. Rather, this report is the result of our "auditing process." We have gathered and organized evidence that exists to help frame and buttress IFI's cornerstone claims, and now present a kind of "closing argument" intended to review those major claims and the evidence we have found that supports them.

The Data Sources

The evidence and findings that we summarize in this brief "auditor's report" are based on the data sources we have listed below.

- **Surveys of Participants**
We have conducted two extensive participant surveys for IFI: the first in 1997, and the second in spring of 1999.
- **Focus Groups with Participants**
Following IFI institutes and seminars we routinely conducted small focus group interviews with participants.
- **Project Director Interviews**
We have conducted three rounds of interviews with Project Directors who have attended IFI events or whose staff members have attended.
- **A "Triple Blind" Study of Projects and IFI Influence**
We conducted a "triple blind" study comparing districts and projects, half of which had multiple and long-term experiences with IFI, and half of which did not. They were rated according to key dimensions; for example, the importance they placed on inquiry, their understanding of inquiry, the level and quality of the inquiry the projects had infused into their professional development offerings, etc.
- **An Outside Review of IFI's Core Professional Development Offering**
A nationally recognized independent evaluator of science initiatives attended several sessions of IFI's flagship workshop, the Professional Development Design Workshop, in the spring of 1999, rating the quality of the professional development using a NSF-mandated protocol. This evaluator wrote a summative report based on and addressing the components in the protocol.
- **The Development of an IFI Database**
We have assisted IFI in developing a database which helps identify and track IFI participants and events, providing important quantitative information to us, to the funders and to the Institute.

- **Field Work**

In the past two years we have visited projects in their home settings. We have tried to understand the role and function of inquiry in typical (often kit-based) school science programs, as well as the particular strategies projects have used to infuse inquiry into their professional development offerings. We have monitored and assessed the quality of workshops offered by local professional developers as they seek to replicate what they learned at the IFI workshops.

The Organization of This Report

This report is organized around each of the four major cornerstone claims. These four claims focus on the quality, the benefits, the scope, and the impact of IFI respectively. For each of these cornerstone claims we first explicate the importance and significance of the claim IFI has made. We then present the evidence we have gathered that supports each claim. It is important to understand that the claims are IFI's, whereas the independent assessment of the evidence for those claims is ours.

III. THE CORNERSTONE CLAIMS

CLAIM 1

THE QUALITY OF THE IFI PROGRAM

- ***The Institute for Inquiry is able to create and offer very high quality professional development programs and tools.***

The value of the investment made in the Institute for Inquiry depends heavily on the claim that it is able to offer exemplary professional development experiences and tools to the science leaders it serves. There are several reasons why quality excellence is a key underpinning to the overall high-leverage strategy IFI is employing.

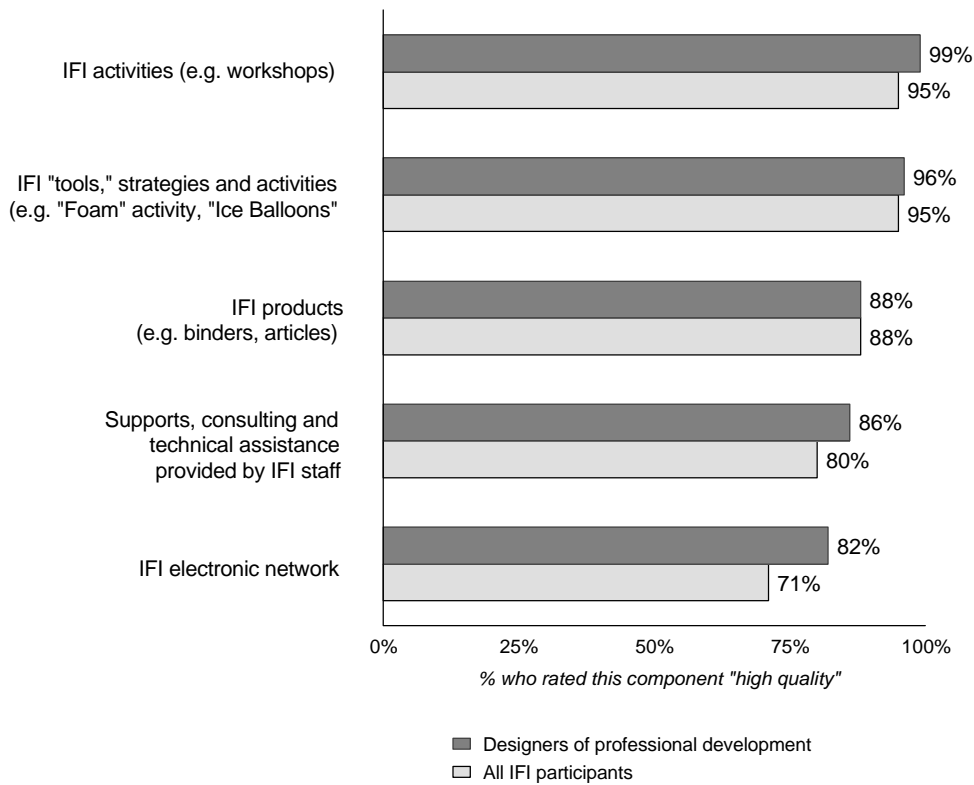
First, as the Institute works with local professional development providers, the initial IFI experiences become the referents, defining the model that professional development providers will seek to emulate back home. Secondly, it is necessary that IFI offerings are of sufficiently high quality that participants are both motivated and enabled to recreate the same high quality professional development activities in their own settings. In other words, the professional development provider must leave IFI with enthusiasm for and a commitment to infusing their own reform activities with inquiry. Third, and more concretely, participants need to take home with them well-designed, accessible, and ready-to-use professional development activities. This clearly cannot happen with a mediocre or weak initial experience, or with poorly designed tools and technologies.

Our research data shows that the participants in the Institute for Inquiry find that the programs, materials and supports are, in fact, of superior quality. We ourselves through our work across the country over the past two decades have had the opportunity to observe many different professional development events, and we, too, find the IFI events to be well-designed, appropriate, and intellectually challenging for the intended audience.

Findings from a survey of participants. In our most recent survey participants rated the quality of the IFI programs very highly. (See Figure 1 on page 10.) Participants who are themselves professional development providers in Local Systemic Change initiatives (LSCs) and other National Science Foundation (NSF)-funded projects — and who have major responsibility for translating what they receive at IFI to their local settings — are particularly positive in their assessments of the quality of the resources and supports provided by the IFI program:

- Professional development providers gave the very highest rating (99%)⁵ to workshops and seminars where they have participated directly in intensive instruction in inquiry at the Exploratorium.
- The second highest rating (96%) was given to IFI tools and strategies. These are professional development tools and strategies designed to illuminate the inquiry process, which participants themselves experience at an IFI event, and which IFI has documented and published, in order for participants to use in their own professional development settings.
- Finally, it is important to note that the highest ratings have been given by participants on those items that are most critical to the overall leverage strategy (for example, the quality of their own professional development experience, and professional development tools and strategies).

⁵ The survey asked participants to what extent they agree with statements made by other IFI participants in focus groups and interviews. Percentages throughout this section refer to the percentage of survey respondents who agree strongly or very strongly with each statement (i.e., they marked “4” or “5” on a 5-point rating scale where “1” = strongly disagree and “5” = strongly agree).

Figure 1. Participant ratings of the quality of major components of the IFI program

An independent assessment of the quality of IFI. We know that self-reporting by participants on surveys or in interviews can reflect a “halo effect,” and can, as a result, be dismissed as overly positive. For this reason we also asked an independent evaluator⁶ to judge the quality of the Institute’s flagship workshop, the Professional Development Design Workshop (PDDW) in the summer of 1998. Using the same protocol and instrument developed by Horizon Research Inc., used to judge the quality of NSF’s LSC professional development programs, he wrote:

Overall, the PDDW reflects high quality in its design and implementation. The staff are knowledgeable and experienced facilitators who create an inviting environment for professional growth. Individual sessions are themselves well-designed and also show thoughtful planning in how they are woven together through the week to create the overall PDDW experience. On the HRI protocol, most sessions rated at Level 4 (Accomplished, Effective Professional Development) or Level 5 (Exemplary Professional Development). The PDDW as a whole would be rated at Level 4.

⁶ Michael Howard, a nationally-recognized science education leader and LSC evaluator, was contracted for this work.

Rated most highly in his report were the following:

- Participants' understanding of science as a dynamic body of knowledge generated and enriched by investigation
- Leaders' knowledge and understanding of effective classroom practice
- Leaders' ability to convey to others a vision of effective science classrooms

The Howard report concludes:

The Professional Development Design Workshop represents a clear example of a high quality professional development experience. Its design is carefully planned and articulated, and for the most part is skillfully implemented. The culture of the workshop fosters individual growth within a climate of respect, collaboration, and energy.... The "likely impact" ratings...indicate the evaluator's assessment that the PDDW has strong likelihood to affect participants' practice. This prediction is supported by comments from the follow-up interviews....

Our observations and ratings. Our researchers are also trained as LSC observers. We have attended and observed many different IFI offerings. We would concur with the Howard report, that comparatively, the IFI events rate at the highest levels of the HRI scale. In contrast to the great majority of professional development events we observe IFI workshops are meticulously and thoughtfully designed.

Focus groups and follow-up interviews. We have conducted focus groups and follow-up phone interviews every year that reaffirm the very strong consensus that the activities and tools offered by IFI are of the highest quality.

Summary of Our Findings

Our survey data, an independent assessment by an outside evaluator, and our own observations, focus groups and interviews — particularly when contrasted to other programs we evaluate — all indicate that the quality of the professional development events, interactions and tools the Institute for Inquiry offers is very high. Consequently, validated by repeated and multiple measures, we believe the claim to quality made by IFI is legitimate. The high quality of their programs serves as a strong foundation for the rest of the IFI program, and ensures that participants are highly likely to sow the seeds of inquiry in their own home science reform efforts.

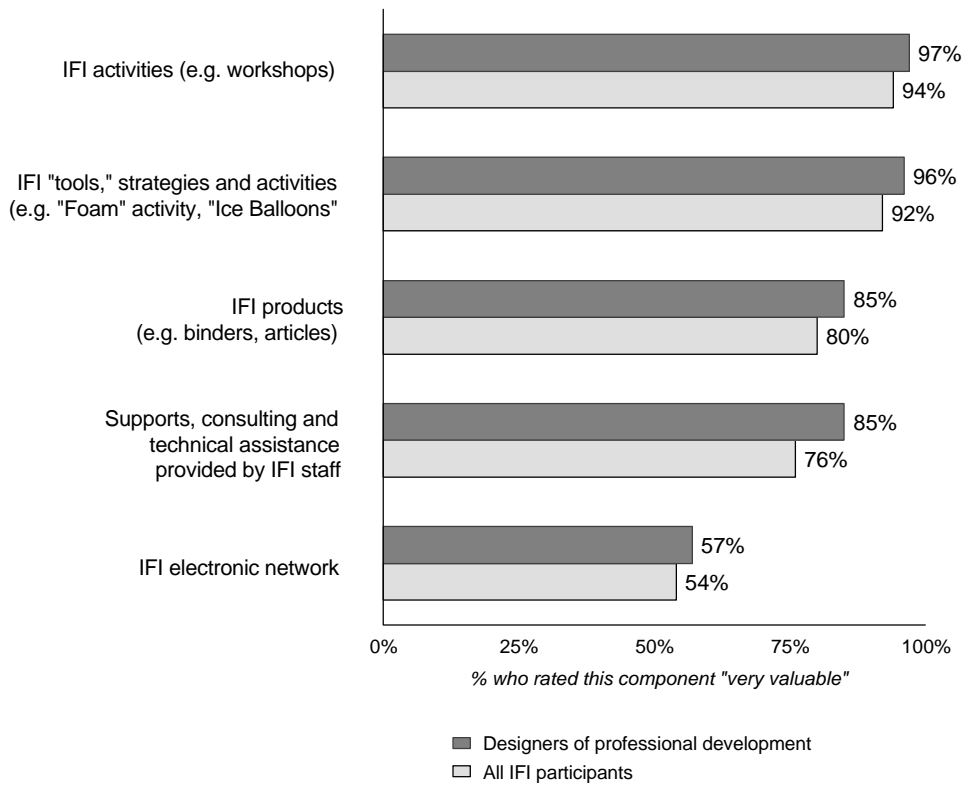
CLAIM 2**THE BENEFITS AND VALUE OF THE IFI PROGRAM TO ITS PARTICIPANTS AND ITS PARTICIPATING DISTRICTS**

- ***IFI professional development programs and curriculum tools are valued by and benefit key reform leaders in multiple and important ways – with the end result that these leaders are empowered to improve their local elementary science reform efforts.***

The Institute for Inquiry’s claim that it is valued by — and benefits — the participants in multiple ways is another of the cornerstone claims that justify the NSF investment in a national center devoted to inquiry-based science education. It is important to understand that although inquiry is the central tenet of the National Science Education Standards, and although many educators easily espouse its importance, too often inquiry is not a central part of elementary science instruction. Often teachers and even professional development providers lack concrete and comprehensive images of science inquiry; many do not have the personal, firsthand experiences of doing inquiry so that it remains an abstract ideal for them. Consequently, IFI argues that there is a largely unmet need for science reform leaders themselves to have the opportunity to learn about inquiry. Substantiating IFI’s claim for its value and benefits to participants involves demonstrating both a clear “need” and “market” for the kinds of tools and services IFI offers, as well as a high level of “customer satisfaction.”

VALUE TO THE PARTICIPANTS

Our interviews and surveys show that participants rate highly the value of the IFI programs. (See Figure 2 on page 13.) They find the programs valuable not only in terms of their own personal learning, but also in terms of the degree to which it empowers their work. In particular those participants who are professional development providers in LSCs and other NSF-funded projects are especially positive in their assessment of the usefulness of IFI’s professional development tools and strategies.

Figure 2. Participant ratings of the value of major components of the IFI program

We learned that currently there is no place in the country except for the Exploratorium's Institute for Inquiry where educators can go to learn about and focus solely on inquiry-based science education. Although there are occasional small, local resources the Institute has no "critical competitors" serving a national audience. The overwhelming majority of IFI participants report that *"IFI's strong and central focus on inquiry meets a significant educational need"* (97%). Moreover, every IFI participant (100%) who responded to the survey believes that *"there is a need and a demand in my district or project for more teachers to have the kinds of science inquiry learning experiences and activities that IFI offers teachers."*

On our 1999 survey participants agreed overwhelmingly with other statements attesting to the uniqueness of IFI:

- *"I believe that IFI's strong focus on science inquiry meets a significant educational need."* (97%)
- *"Activities and products offered by IFI are unique, available from few if any other sources."* (94%)

- *"While inquiry is a central tenet of the National Standards, it is very hard to find concrete help or ways to do science inquiry, and IFI has been very helpful in that respect." (72%)*

I really appreciate that there is a place where inquiry is there, full-time, every day. I think it is really important that there be a place that can be an experimental laboratory for learning more about inquiry and finding real ways that it can fit into the practicalities of real science classrooms.

LSC Project Director

BENEFITS FOR THE PARTICIPANTS

Not only is IFI valuable and useful to participants who recognize it is a unique national resource, but IFI experiences also provide multiple, specific benefits to those science leaders who attend IFI events and activities.

IFI's contribution to participants' own understanding of inquiry. First and foremost, IFI helps professional development providers and other science reform leaders personally understand the process of inquiry more fully and more deeply. In our interviews we learned that the Institute provides most participants with their first intense introduction to inquiry. Even for those participants who considered themselves familiar with inquiry prior to an IFI workshop, the experience intensified and deepened their understanding of it.

In addition, we learned that participants' firsthand, personal experience of inquiry is frequently "transformational" in nature. *"Most workshops you go to, you get something to take home but you are the same. Here I also got something to take home... but mostly it was me that changed... Now I see everything differently... Now I am able to see the world through an inquiry lens. ..."* The inquiry experience alters profoundly the way many participants perceive science and science teaching and learning. Many of those we interviewed voiced sentiments similar to the following: *"I had read a lot about inquiry, but it's not until you experience inquiry yourself that you really understand it. I need to do things in order to understand them well, and as a result the Exploratorium was a real paradigm shift for me."*

IFI's contribution to participants' understanding of the National Science Education Standards. Survey respondents also told us that one of the greatest benefits of IFI is its contribution to helping them better understand the nature and importance of science inquiry, as well as its place in the Standards and in science education.

- *"I'm now convinced more than ever that a deep understanding of science inquiry is an essential cornerstone of a good science education reform effort." (95%)*
- *"Because I better understand science inquiry, I am better able to implement the National Science Education Standards within my project." (82%)*
- *"I have been involved with science education for many years; I thought I understood science inquiry, but after my experience at IFI I understand much more about it now." (73%)*
- *"The work at IFI has shown me the importance of science inquiry and the need to make it a priority in our science reform effort. I used to give science inquiry lip service, but now I really see the need to make it a priority." (59%)*

Fully half of the survey respondents credited IFI with helping them understand the Standards for the first time.

- *"I had read about science inquiry in the National Science Standards but I didn't really understand what it meant until I experienced it for myself at IFI." (49%)*

IFI's contribution to the participants' understanding of the relationship between science inquiry and content. Another key benefit is IFI's contribution to participants' understanding of the interplay between, and the symmetry of, science content knowledge and the process of science inquiry.

- *"IFI helped me understand how knowing science content can contribute to the process of science inquiry." (85%)*
- *"IFI helped me understand how science inquiry contributes to the development of science content learning." (84%)*

IFI's contribution to the professional development design of local science reform efforts. Not only do elementary science reform projects have a need for assistance in understanding inquiry more fully, but they also need help in the area of professional development design. Our work with many other projects, as well as with IFI, has shown us that most projects engage in a kind of ad hoc design process, if any. They frequently offer a pot pourri approach, selecting professional development activities based on their immediate interests and skills, rather than on a coherent approach to achieving an overarching purpose. Reform projects have few if any resources other than IFI to assist them in designing effective and coherent professional development aimed at explicating inquiry in their home settings.

We have learned that a key benefit of IFI to its participants has been to give them tools and activities that allow them to recreate for others the inquiry experiences and understandings they themselves had at the Institute at the Exploratorium. Moreover, IFI has helped participants understand the goals and rationale of these activities, and to link them together in purposeful ways. Our survey results bear out the claim that IFI helps develop the capacity of participants to engineer inquiry-infused professional development back home.

- *“A valuable feature of IFI is the explicit attention it gives to the design of professional development – the concrete and practical ways to create and organize professional development experiences back home.” (96%)*
- *“I am at least reasonably well-prepared to facilitate in-depth learning experiences of the kind that I have had at IFI.” (88%)*
- *“What I have experienced made science inquiry very concrete and 'translatable' back home.” (81%)*

IFI has given us a tool. The professional development component gives us what you might call the “decoding” of inquiry. We know that people don’t always understand inquiry by osmosis just because they do it. A good analogy is the relationship between phonics and reading. Some children will learn to read if you just simply let them read. The majority of children however need the decoding pieces to make sense of the whole, and that is what we have received and our districts have received at the Exploratorium. Finally, this is letting people understand the decoding of inquiry. They have a whole new understanding when you can show them the parts that lead to the whole. We have been able to use that here in our summer institutes. We have gone back and just replicated that whole Professional Development Design Workshop now I see our Pilot School Coordinators doing those same pieces in their districts.

NSF-funded Center Director

IFI’s contributions to the overall capacity of local reform efforts. Our data show that IFI participants apply what they learn in multiple ways when they return to their home districts and projects. They report that they use what they have learned at IFI to improve the quality of their work in their own home settings. In particular, survey respondents representing the leaders directly responsible for professional development in their districts and projects — agree that *“IFI has made a substantial contribution to the*

capacity of our reform effort to provide high quality and inquiry-based professional development in science to elementary teachers.” (90% of the 193 PDDW participants)

On the same survey:

- 82% of the professional developers report that *“IFI has made a substantial or major contribution to the capacity of our local reform effort to provide high quality and science inquiry-based professional development in science to elementary teachers.” (82%)*
- 62% agree that *“IFI has already been a significant help to me in making the case for science inquiry-based instruction to administrators, parents, colleagues and others.”*
- 66% say that *“IFI has been very helpful in showing me how to move teachers beyond mechanical usage of the kits.”*

IFI participants’ enhanced capacity propels them into action. They make what they have learned about inquiry and professional development design operational, providing a myriad of activities and events in their local settings. The following are only a few examples of the many which IFI has inspired and supported:

- BASEE (Bay Area Schools for Excellence), an LSC consisting of a consortium of seven school districts in the Bay Area, has offered an intensive inquiry institute for its teacher leaders for the past four years.
- Science leaders from the South Carolina “Hubs,” an outgrowth of that state’s SSI work, have offered a variety of inquiry-based professional development events, including intensive, firsthand inquiries, to teacher leaders from each of the state regions served by the “hubs.”
- As part of a second level of professional development offerings aimed at rounding out their overall professional development program for teachers the VIPS (Valle Imperial Project in Science) LSC based in California’s Imperial Valley offers a menu of events based on IFI activities; for example “Tops” which illuminates the differences between inquiry and other kinds of hands-on science teaching approaches; “Process Skills Circus,” which focuses on the cognitive process necessary to inquiry; etc.
- An LSC based in Anchorage, Alaska offered an intensive inquiry focused on pin-holes to its teachers who had been involved with kit-based science teaching for many years, and who, the leaders judged, were “ready to open their kits to inquiry.”
- With support and technical assistance from the Institute for Inquiry, the Fort Worth Museum of Science and History and the Dana Center, have collaborated to begin to develop a Texas-based inquiry effort, the Texas Center for Inquiry.

They plan to organize a series of workshops and institutes for science educators throughout the state focused on inquiry.

Finally, the IFI strategy of supporting science leadership at multiple levels results in an overall gain in reform capacity within the district. When IFI works extensively with the administrators, science specialists and teachers who reside in a single district, the program adds to the propensity and ability of the district to pursue elementary science education reform. About two-thirds of all survey respondents report that their districts have benefited because IFI has *"Increased the attention given to inquiry-based science" (69%).* And 67% agree that *"Involving many different people at many different levels in IFI has had a real payoff in our district/project."*

IFI's contribution to local leadership development. We think the evidence shows that the Institute for Inquiry has turned out to be a powerful leadership development program. Participants, who by design include administrators as well as professional development leaders, report in both the interviews and surveys how their IFI experiences have enabled them to be more articulate in promoting elementary science education reform. In particular, participants find that leadership for elementary science education reform, and an in-depth understanding of science inquiry, are inseparably intertwined:

Somehow there is some magic at the Institute for Inquiry; I can't quite put my hand on it. But people go out there and they come back with a clear vision of what kind of leadership role they can take, and how they can affect other people.

LSC Project Director

Most participants report that IFI has made a major contribution to their own leadership in elementary science at the district/project level. (73%)

In addition they say that:

- *"IFI has contributed to my capacity and ability (97%) as well as to my willingness (96%) to assume increased responsibility for elementary science education."*
- *"A good understanding of science inquiry contributes to strong leaders for science education." (95%)*
- *"Knowledge of science inquiry and effective science education leadership are closely tied." (95%)*
- *"Our project leadership has definitely evolved both a more sophisticated understanding of inquiry and a larger repertoire of inquiry-based professional development tools." (79%)*

The Institute has changed the way 99% of the people in our project looked at inquiry. It made us make a major shift from hands-on to inquiry. We didn't have that before. It was something we all talked about, but ask us to define it, and really be able to articulate that to somebody else, no. So, IFI helped us with the communication and articulation of what was meant by science inquiry, and the fact that inquiry is not just putting materials in front of kids and letting them rip at it. Real, good inquiry has a structure underneath it, it is extraordinarily structured.

LSC Project Director

We have also learned that IFI experiences, especially successive experiences that occur over the long term, are important in helping develop the leadership abilities of participants, enabling them in becoming more knowledgeable, articulate and skillful leaders of their local science reform efforts. Thus IFI's value as a leadership development program increases when participants attend more than one IFI program. IFI respondents who have themselves attended IFI more than once (18%) report that the benefits that they have received from IFI have grown exponentially as a result of attending multiple events. Eighty-seven percent of those who have attended multiple times agree with the following statement: *"I am strongly convinced that it takes several years and multiple experiences with IFI or something similar to become very skilled at infusing science inquiry into a science education reform effort."*

Summary of Our Findings

In summary, then, the Institute for Inquiry is highly valued by professional development providers and other science reform leaders because it provides them with a unique and needed service and a wide range of benefits. In other words, the Institute For Inquiry not only successfully identified a need and has filled a "market niche," but also created a high level of "customer satisfaction." Specifically, IFI provides science leaders with a successful personal experience of inquiry, which serves as an important and foundational reference point or vision, strengthening both their understanding of and commitment to inquiry-based science education. In addition, IFI then also offers participants a range of other kinds of professional development interactions which further bolsters their relationship with inquiry, as well as practical tools which they can then use on their own to teach others.

CLAIM 3**THE SCOPE OF THE IFI PROGRAM**

- ***IFI is able to serve directly hundreds of key leaders of elementary science education reform efforts. These leaders, in turn, through an important “multiplier effect” then are able to help thousands of elementary school teachers across the country improve their science teaching.***

Another underpinning to the success of the investment made in the Institute for Inquiry is found in the number of people served. The Institute must be able to serve a sufficient number of participants, directly or indirectly, in order for its work to have a national impact. If IFI served only a few districts, and helped only a few teachers, then one could argue that no matter how high the quality, the investment in IFI would not be justified.

Also, in order to achieve long-term viability and self-sustainability, IFI must establish its reputation as a national center for science inquiry. It must convince projects and districts across the country that it offers programs, materials and tools that can add real value to their reform efforts. IFI must, in short, generate market demand on a national scale for its services. If IFI is able to build a kind of momentum through ever-increasing numbers of participants, and through the ongoing development of new tools and workshops, then as an institution it will survive, and it will continue to increase the national capacity for improving inquiry-based elementary science education. If, on the other hand, IFI is able only to serve a few districts and projects, and if it does not succeed in building market recognition and demand, then the long-term national impact of IFI will be minimal.

Our findings, based on data gleaned from participant interviews, surveys and IFI program records, show that IFI is succeeding in growing itself and in generating a large market for its services. Indeed, at the time this report is written, IFI is serving substantial numbers of leaders in science education; these leaders, in turn, are serving and influencing thousands of teachers and administrators in their own local settings. And IFI is continuing to grow the numbers of people served, both directly and indirectly.

Program Records. According to records kept in a program database more than 1106 participants representing 81 science education reform projects, 288 districts in 34 states, and several dozen universities and museums across the country have participated in Institute programming.⁷

⁷ These data reflect program totals as of May 1999.

Survey data. According to our own independent survey data collected in 1999, we also conclude that the Institute is influencing the work of many local professional development projects. More specifically, as of the time of the survey we estimated that about 45 teams and 340 individuals had both attended IFI and were using IFI ideas and activities in their own professional development projects.⁸ From our data we were able to make the following estimates:

- Through May of 1999 IFI participants presented or facilitated at about 3,015 “IFI-influenced” local events and activities after they returned to their own projects and districts.
- The typical Professional Development Design Workshop participant responding to our survey tells us that she or he used what they learned at IFI to enhance the quality of the work they do in their own professional development activities. Thus far, the typical participant reports that she or he has used Institute ideas to enhance the professional development experiences of about 75 teachers, lead teachers and other workshop leaders, in addition to another 6 administrators.
- Based on these data we estimate that the number of teachers, administrators and others served by IFI participants in their own local settings is on the order of 20,000.⁹

We have taken some of the professional development activities that we have learned at IFI, and because we have to do teacher trainings, we have been able to take programs there and come back and implement that to use in the 100 hours of local training that we offer... That is what has been helpful to us. We didn't have to re-invent the wheel or dig up something new to do all that — IFI gave us high quality things to use — the program is already there. We have of course changed it to meet our needs, but the basis, the core, the meat of the whole thing was there, ready for us to use.

LSC Project Director

⁸ We surveyed the 462 participants representing NSF-funded reform projects who attended IFI between 1996 and Spring 1999. Fifty percent of those surveyed responded. To calculate these estimates of IFI-influenced activities and IFI's secondary audiences we added the actual figures reported by the 231 survey respondents to calculated estimates for those who did not respond (based on median values reported by respondents).

⁹ If 340 IFI participants reach on average 75 teachers and 6 administrators through professional development, the calculated total of people who have benefited from participants' experience is 27,540. To be more conservative and take into account cases where more than one IFI participant works with the same individual, we reduced our estimate of individuals benefiting by about a third and rounded off to our very rough estimate of 20,000.

Summary of our findings

Our evaluation has found that the Institute for Inquiry has established a scope and reach that has made itself strongly felt among science education leaders across the country. IFI has been able to serve directly many NSF-funded systemic initiatives and hundreds of key leaders in science education. These individuals have taken IFI ideas and activities and incorporated them into their own professional development programs. As a result there is a “second tier” of IFI work that has contributed to thousands of elementary teachers across the country.

CLAIM 4**IFI MAKES A SIGNIFICANT DIFFERENCE TO THOSE IT WORKS WITH**

- ***IFI makes a significant and visible difference. That is, the reform projects and districts that IFI works with are clearly distinguishable from other otherwise similar districts and projects.***

The goal of the Institute for Inquiry is to empower local reform projects and districts to improve the quality of their local elementary science reform efforts, especially in terms of promoting a practice of inquiry-based science education. The work of the Institute, then, is about increasing local capacity for improvement; however the measurement of such capacity is not easy. Hence, we at Inverness Research found a difficult challenge facing us as we sought to find ways to assess the degree to which the IFI work was making a significant difference to or impact on the “improvement infrastructure” of the projects and districts it worked with.

Survey findings. Our survey data have shown that the Institute for Inquiry has in fact made a visible and significant difference in the projects and districts with which it has worked. This statement is particularly true for those districts and projects with whom IFI has a long-term, sustained relationship. First, IFI's contributions to participants' understanding of science inquiry are visible to their colleagues.

- Administrators who have attended report that “*teachers with whom I work have become significantly more knowledgeable about and supportive of inquiry since their involvement with IFI.*” (74%)
- Most participating teachers have seen similar changes in their district administrators who have attended IFI. (69%)

At the Institute for Inquiry the (school) administrators who attend come away with a greater understanding of the value of inquiry-based science education... because by allowing those administrators to participate in a personal science inquiry, to fully understand it experientially, makes a deep impression. Any administrator from our districts who has gone there has come back convinced and a friend of the program in a new way.

– NSF-funded Center Director

A “Triple Blind” Study of the Impact of IFI’s Work

As we addressed the challenge of how to measure growth in capacity we reasoned that, while “capacity” is not easily measured in absolute terms, it is clearly discernible to a trained observer and even to those who work within the system. We believed it was reasonable, then, that if IFI made the claim that it was making an impact on system capacity that such an impact would be clearly visible — both to those who are part of the system, and to outsiders who have no knowledge of the work of IFI.

If the impact of the Institute for Inquiry on the districts and projects with which it works were insignificant, then the districts and projects that IFI has worked with would not be distinguishable from other similar districts and projects. And if there are no noticeable differences between “IFI districts” and “non-IFI districts,”¹⁰ then it would be sensible to question the efficacy of the Institute, as well as the overall value of the investment in the IFI project.

Hence the fourth cornerstone claim of IFI could be stated in the following way: “As a result of our work, there will be significant and obvious differences between an IFI district and a non-IFI district in important dimensions such as the conceptualization and understanding of inquiry, leadership capacity, and professional development design. These differences should be quite evident to a knowledgeable and objective outside observer.” In other words, an IFI project must be distinguishable from a non-IFI project in the ways the project leadership talks and thinks about inquiry, in their commitment to the promotion of inquiry-based teaching and learning, or in the way they have engineered their professional development programs to include inquiry.

¹⁰ IFI districts refer to those districts and projects that have participated with the Institute for Inquiry for multiple years and with multiple teams. Non-IFI districts refer to other districts and projects, who are also engaged in elementary science education reform, but who have not had any direct interaction with the Institute for Inquiry.

To assess this cornerstone claim we asked the following more specific research question:

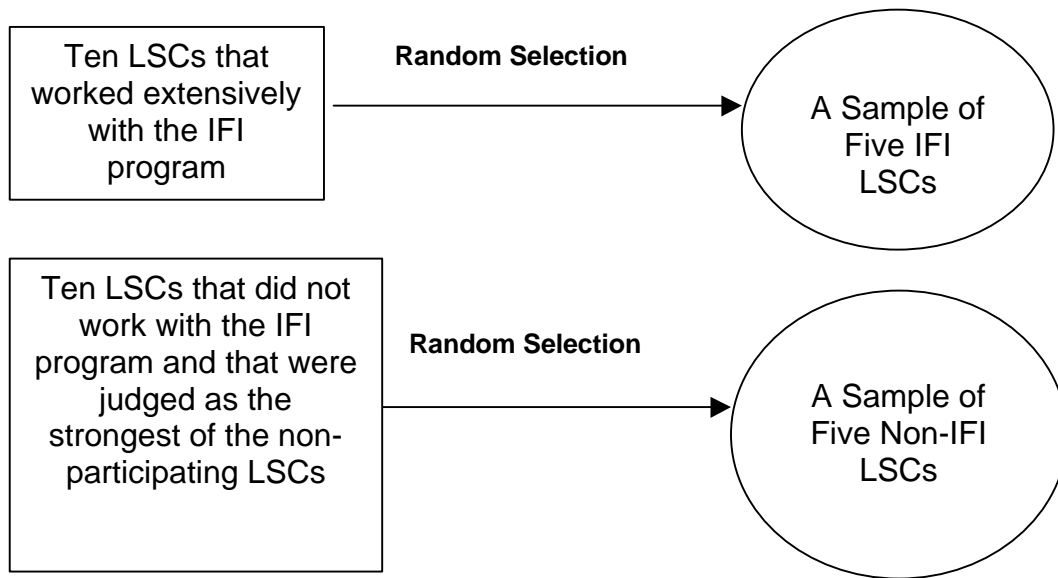
In what ways — and to what extent — are the Local Systemic Change Initiatives (LSCs) that IFI has worked with distinguishable from the LSCs that IFI has not worked with? Would a “blind observer” see significant differences in the IFI and non-IFI LSCs, especially in those dimensions that are centered around inquiry and that are most important to the IFI program?

The IFI program over the past few years has worked with over a dozen Local Systemic Change Initiatives. Funded by NSF, their mission is to provide professional development to all teachers in a district with the ultimate goal of helping them implement standards-based curriculum in a high quality fashion throughout the district. And in elementary science one key element of being “standards-based” is “inquiry-based,” so that all districts involved in LSCs are faced with the challenge of helping their teachers move toward inquiry-based instruction. Hence, there is a clear need and opportunity for IFI to contribute to the capacity of these projects, and to help them be better able to help their teachers understand and use inquiry in their teaching.

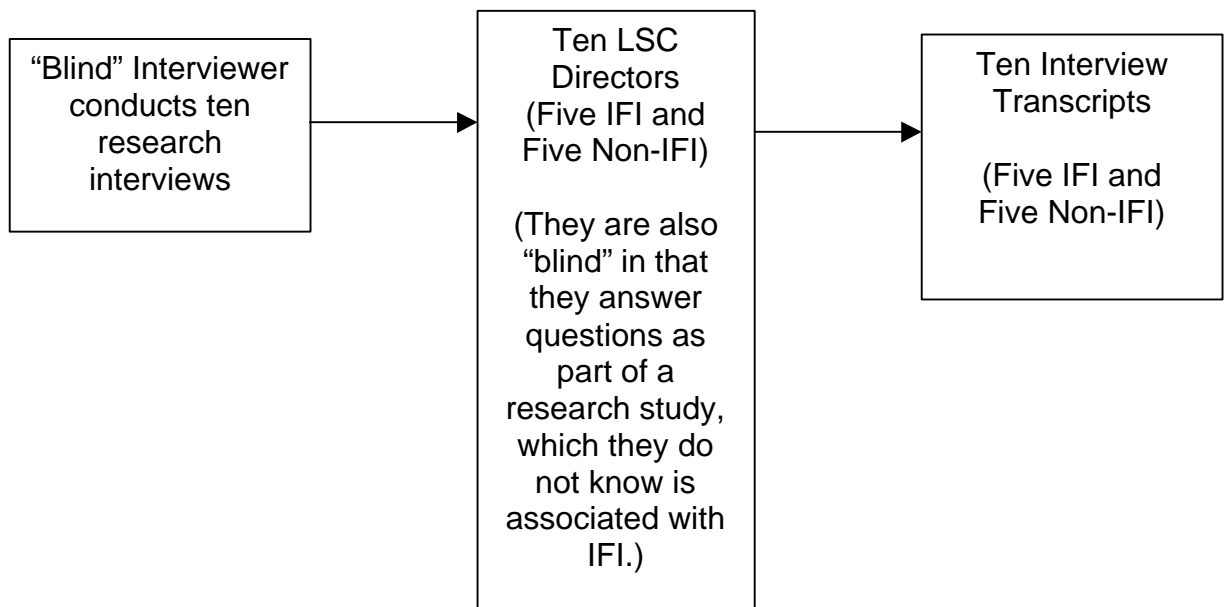
Consequently, we were led to a concrete research question about the degree to which — and the ways in which — the IFI-supported LSCs would, in practice, be distinguishable from the non-IFI LSCs. We asked the question whether or not outside expert observers could find any differences between the two types of LSCs. If the LSCs with which IFI worked were in no way distinguishable to “blind” observers, then, as we said, it would be hard to justify the NSF investment made in the IFI program.

The procedure. Since it is not possible for outside reviewers to visit large numbers of projects all over the country, we used the following method to select a sample of LSC projects for our comparative test:

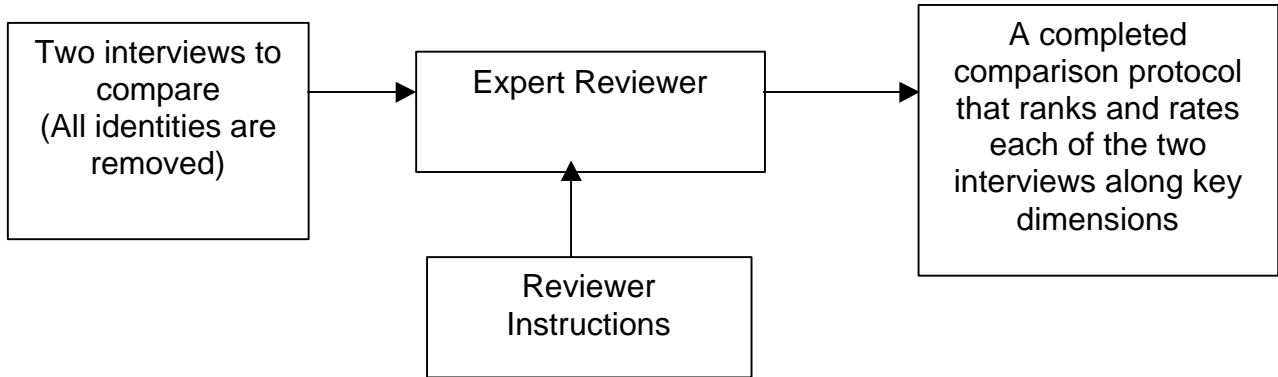
- 1) We selected two samples of LSCs — one was a group of IFI clients, and another a group of LSCs not involved with IFI. All LSCs were focused on improving elementary science education.
- 2) We asked IFI to identify the “top ten” of its clients and from that sample we randomly selected five to be included in our comparison test. Similarly, we identified what we believed to be the ten strongest and most mature of the non-IFI LSCs, and we randomly selected five from that group.



- 3) We created a protocol that was designed to be used for interviewing the leader of each of the LSCs. This interview protocol asked about certain dimensions of the work of the LSC, including its stance toward inquiry and its approach to designing professional development. The questions were selected to maximize the probability of finding differences between the two samples, but in no way did the interview protocol use language or terms that would be a “tip off” or “code” to the IFI LSC participants.
- 4) We trained a “blind” interviewer to ask the questions on the protocol. She was told that the interviews were part of a research project that was investigating the ways in which different LSCs thought about their work and designed their activities. She did not know that the interviews in any way involved the Exploratorium or the Institute for Inquiry, and, of course, she did not know that there was any difference between any of the ten LSCs that were part of the study. She conducted an interview with the leader of each LSC included in the sample. The interviews were tape recorded and transcribed.



- 5) The transcribed interviews were then assembled and matched randomly in pairs — with one IFI LSC paired with one non-IFI LSC in each pair. In all we set up 15 matched pairs.
- 6) We created a comparison protocol by which outside and “blind” reviewers could compare and contrast two interview transcripts and rank the two along critical dimensions and according to established criteria. The comparison protocol asked reviewers to make inferences and judgments about each project, and the leadership of the project — all based on the responses of the interviewees contained in the transcript. Like the initial interview protocol, this comparison protocol made no mention or hint of IFI.
- 7) We then identified and recruited ten expert reviewers. These reviewers were skilled in science education, professional development, and inquiry-based teaching and learning. We sent them each a pair of interviews and asked them, using the protocol, to compare the two interviews along certain dimensions. The LSC projects and interviewees were not known to the reviewers and all reference to identifying names were deleted from the transcripts. The reviewers were not aware that they were part of any kind of evaluation; rather, they understood that they were involved in a blind study of some sort that involved the LSCs. The comparison asked interviewers not only to judge which interview was superior on a given question, but also to assign an overall rank or grade on a 5-point scale to each interview. (Some reviewers ranked two sets of interviews.)



- 8) Finally, we collected and compared the completed interview comparison protocols. This provided us with 15 different cases where an IFI-involved LSC was compared against a non-IFI involved LSC.

It is important to reiterate that this is, in essence, a “triple blind” study:

- The interviewer did not know which LSC was which, or even that this was an evaluation effort involving IFI and the Exploratorium. Hence, this eliminates the natural tendency to probe certain answers and seek for more information that would illuminate the work of the Institute for Inquiry or the issue of inquiry more generally.
- The interviewees did not know that this study was connected with or part of any evaluation. Rather they answered the questions in the belief that they were involved in a more general research study, and as part of that they tried to inform the interviewer as candidly as possible about their thinking, their program design, and their practices.
- The reviewers similarly did not know that they were part of any specific evaluation study. Rather they simply knew that they were hired to judge in a blind fashion interviews with different LSC leaders.

Results: looking at “winners and losers.” One way to decide whether the LSCs that IFI has worked with are distinguishable from those that it has not assisted is to compare the “winning” of individual pairs of matched interviews.¹¹ For each question on the comparison protocol we asked reviewers to “choose a winner,” deciding between the two different interviews they read for a number of specific questions.

In the chart below we compare the number of times that the IFI-involved LSC was judged to be superior to the non-IFI supported LSC.

¹¹ Perhaps an analogy might be helpful here. What if you wanted to determine which of two racing stables did a better job of training racehorses? This is tricky since individual racehorses vary considerably and conditions also are not uniform. One way to make the comparison would be to draw randomly a sample of five horses from each stable — and then race them in pairs. You might think of the comparison of these 15 matched pairs of interviews as 15 horse races. The goal of these races is to see whether one stable is better than another stable at producing fast racehorses. The 15 horse races involve a total of five horses from one stable, and five horses from another stable. They then race each other one at a time, with each horse racing three other horses from the other stable.

Figure 3. Comparative judgments of 15 pairs¹² of LSCs on five key comparison questions

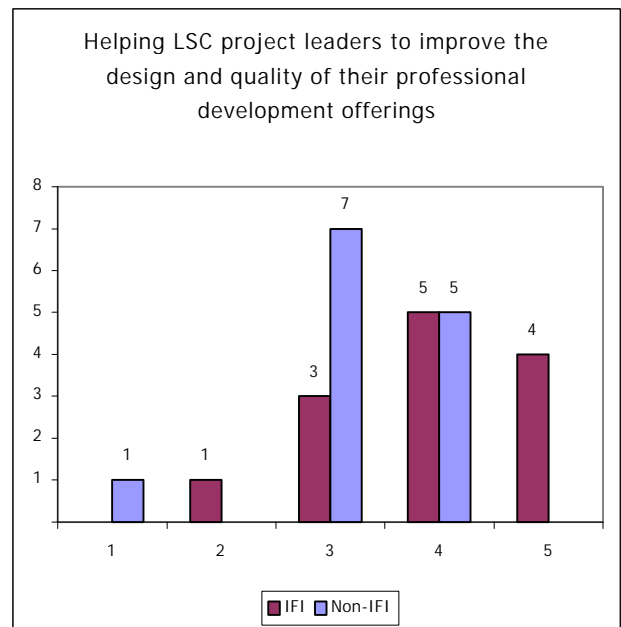
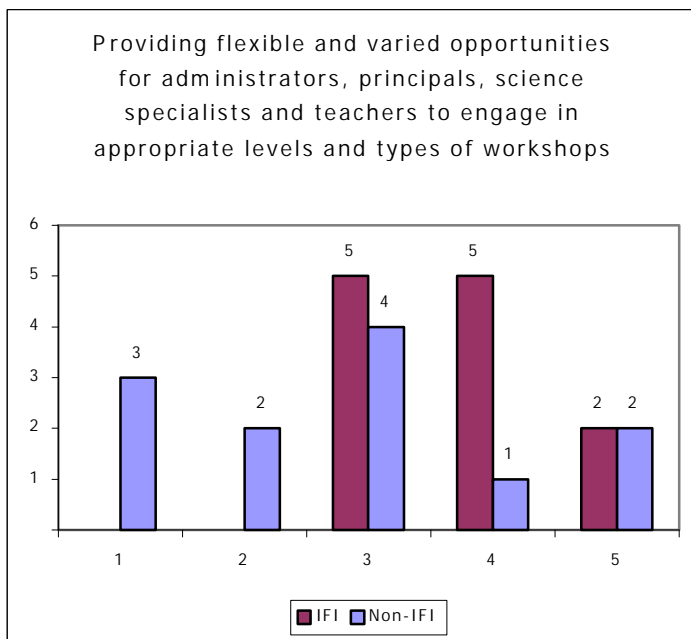
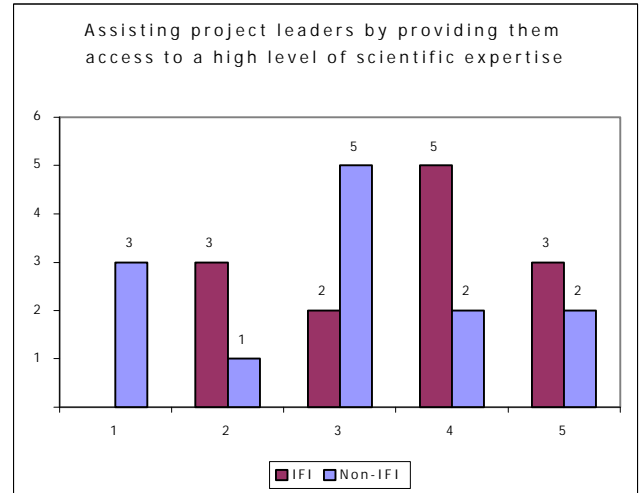
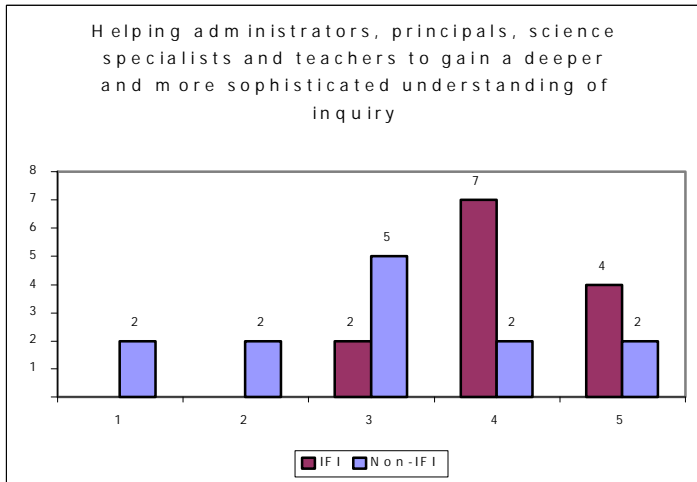
Comparison questions	# of pairs in which the LSC was judged to be superior		Total ratings
	<i>IFI-Involved LSC</i>	<i>Non-IFI LSC</i>	
1) Overall, which project would you say has most benefited from sources of outside support?	13	2	15
2) Overall, which project do you feel has the deepest understanding of and commitment to inquiry?	10	4	14
3) Overall, which project do you feel has the deepest understanding of and commitment to leadership development?	10	4	14
4) Overall, which project do you feel has the deepest understanding of and commitment to professional development design?	10	4	14
5) Overall, which project do you believe has the strongest vision for science teaching and learning?	10	5	15
Grand total	53	19	72

It is clear that the IFI-involved LSCs are distinguishable from the non-IFI LSCs — at least along these questions. They win the match-ups at a ratio of more than two to one. Collectively, along these key questions, the IFI LSCs “win” 53 out of the 72 comparisons.

Comparing ratings. We also asked reviewers to rate each interview they read using scales that measured multiple dimensions of capacity. For each questions asked, they responded using a 5-point rating scale. The comparisons of the reviewer ratings are shown in the graphs that follow.

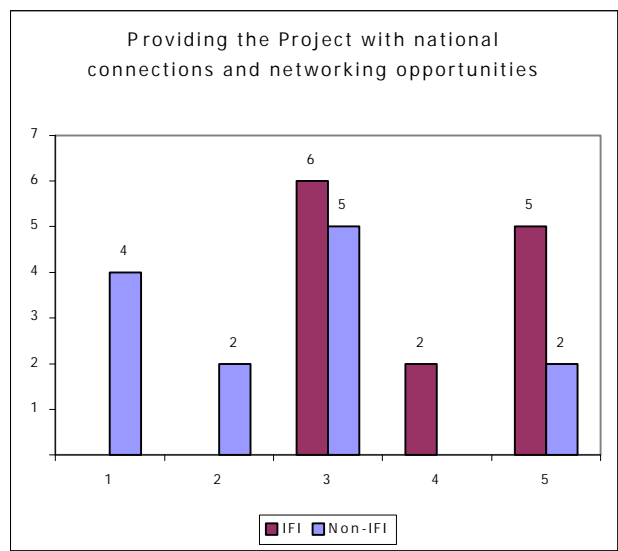
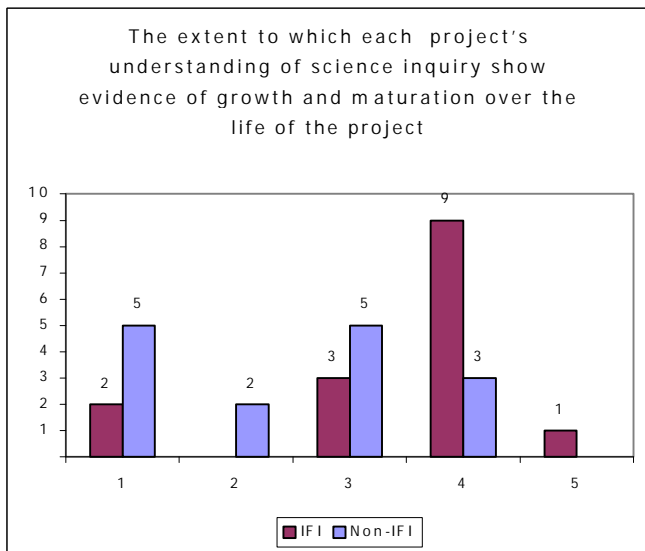
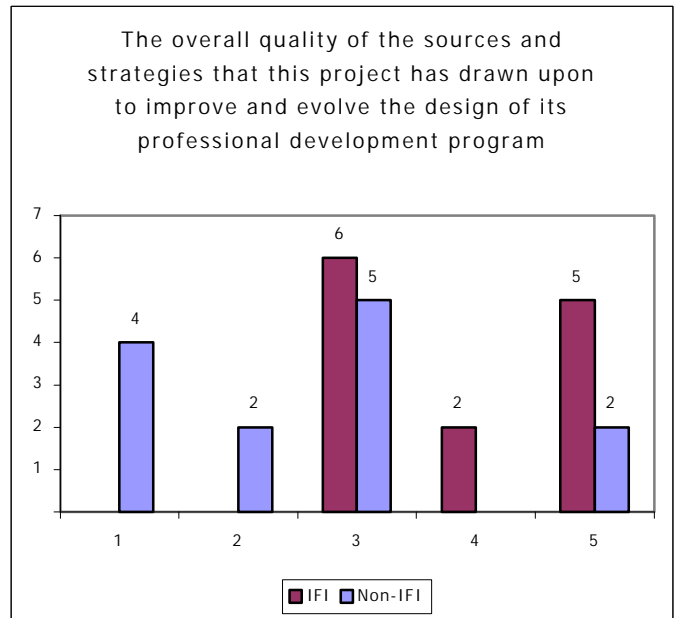
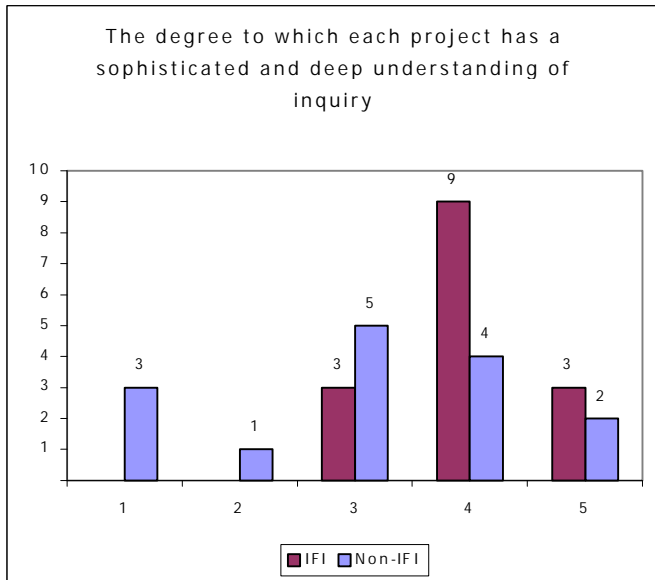
¹² Note in some cases the reviewer was unable to rank one above the other; hence, the total number of comparisons shown is sometimes 14 — not always 15.

Figure 4. Ratings assigned by 10 experts to IFI and Non-IFI LSCs¹³



¹³ These graphs depict the ratings of 15 expert reviewers as they compared the transcripts of interviews with LSC project directors, half of whom were involved with the Institute for Inquiry and half who were not. The vertical scale represents the number of raters assigning the project a given rating. The horizontal scale refers to the quality of the project's work. The labels on the horizontal scales vary in their descriptions but in all cases "1" represents the low end of the scale, while "5" represents the high end of the scale.

Figure 4 (continued). Ratings assigned by 10 experts to IFI and Non-IFI LSCs



These results from our “triple blind” study show that the projects that IFI works with become, after a period of time, significantly different and distinguishable from projects that have not worked with IFI. Most importantly these differences are to be found in the capacities of projects to provide professional development to teachers in the area of inquiry-based science instruction. We believe that this triple blind study constitutes a rigorous test of IFI’s fourth claim: that its work makes a significant impact on the districts and the leaders it serves, so that a distinguishable difference is discernable.

IV. SUMMARY AND CONCLUSIONS

This evaluation report summarizes the evidence we have gathered and the conclusions we have drawn around the four “cornerstone claims” the Institute for Inquiry program makes. These claims underlie the theory of change the program espouses, and provide justification for the investment that is made by NSF and others in its work. The four claims are:

- 1) The Institute for Inquiry is able to create and offer very high quality professional development programs and tools.
- 2) IFI professional development programs and curriculum tools are valued by and benefit key reform leaders in multiple and important ways — with the end result that these leaders are empowered to improve their local elementary science reform efforts.
- 3) IFI is able to serve directly hundreds of key leaders of elementary science education reform efforts. These leaders, in turn, through an important “multiplier effect” then are able to help thousands of elementary school teachers across the country improve their science teaching.
- 4) IFI makes a significant and visible impact. That is, the reform projects and districts that IFI works with are clearly distinguishable from otherwise similar districts and projects.

In studying these claims, we have learned about the quality and quantities of IFI professional development based not only on our own observations, but also on those of other independent evaluators as well as on participants’ reports. Second, we have learned about the extent to which and the ways in which participants benefit from their IFI experiences, and how they have used what they learned to improve their own local professional development activities. Third, we have documented how many people and projects IFI has served, how often and for how long. Finally, we have conducted a rigorous triple blind study that documents the ways in which the projects IFI works with gain capacities that make them distinguishable from other similar reform efforts.

The results of all this work suggest that IFI is an investment that is highly leveraged. The work of IFI is intended to “add value” to existing reform efforts. We believe that there is considerable evidence that, in fact, it does assist many different elementary science education reform initiatives in improving their work. Drawing on the unique character and strengths of the Exploratorium, and on their own history of over two decades of experience teaching inquiry to teachers, the Institute for Inquiry is able to assist many existing elementary science education reform efforts do a better job of helping teachers understand and pursue an inquiry approach in their classrooms. We

think that there is solid evidence drawn from multiple measures to show that the contribution of IFI in the area of inquiry to each of these efforts is needed, appreciated and utilized in a way that could ultimately benefit thousands of teachers and students.