Quality Evaluation Designs

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Industry Initiatives in Math & Science Education (IISME):

2013 Evaluation Report

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About This Report

This report summarizes an external evaluation of the Industry Initiatives in Science & Math Education (IISME). The evaluation study was commissioned by IISME in the fall of 2012. Data were collected from January through July 2013. This evaluation sought, in part, to replicate a study submitted in October 2001: *IISME Teacher Retention and Program Impact 1985-2000*, by Kathryn Sloane Weisbaum and Danny Huang. That study focused on IISME effects on teachers' professional development, retention, and attrition. Those themes are echoed in this report, and those findings are largely replicated. The current study, however, takes a more fine-grained view of those areas, is supported with teacher and principal interviews, and also explores impacts on teaching, students, and 21st Century Skills, as well as other variables beyond the scope of the original study.

Quality Evaluation Designs wishes to thank Ms. Jennifer Bruckner, IISME Executive Director, and her amazing staff, including Christina O'Guinn, Tisha Bacigalupi, and Shari Liss, for their contributions to the design of the study and instruments, and who do so much to make IISME successful. Thanks also to Martin L. Tombari, Nicole Dufour, and Tamara Desrosiers for their technical assistance with this report. QED is especially grateful to the IISME teachers who so eagerly accepted our invitations for interviews and survey piloting, principals who gave so generously of their time when they didn't have any, and to the 476 teachers who took the time to respond to the IISME fellowship survey. QED hopes that our efforts will contribute to making an excellent program even better.

Executive Summary

Quality Evaluation Designs (QED) was commissioned to conduct an external evaluation focused on how IISME summer fellowships change teachers' perspectives and behaviors related to their teaching, professional development, understanding of workplace culture and skills, and career decision-making. To address these issues, QED interviewed 25 randomly selected teachers, and 14 school principals who have supervised former IISME fellows within the past 5 years. Based on interviews, QED then designed a comprehensive IISME outcomes survey. A total of 880 teachers were invited to complete the survey and 476 did, for a very respectable response rate of 54%. Findings relate to the three evaluation questions that framed the study.

Overall results reflect excellent success in all of IISME intended outcomes. Because a conventional scale would have understated IISME's value to teachers, QED created a special, 5-point scale, with 5 corresponding to *transformational* impact. Over 15% of respondents rated various impacts of IISME as *transformational*.

The survey and interviews explored the following questions:

1. To what extent do IISME experiences support and/or promote teachers' awareness and integration of 21st Century or Workplace Readiness skills in the classroom?

Ratings were uniformly high on several items pertaining to this area, with overall responses falling in the *moderate* range. Yet for many teachers, the experience of planning and communicating in sponsor settings was *transformational*. Many teachers reported not only that they integrate workplace readiness skills into their instruction, but many have been successful replicating workplace *culture* into their classrooms and schools. Students who experience classrooms where communication and activities mirror those of workplace settings are far better prepared for the world of work than those who have not had such experience.

2. To what extent does IISME support and promote teachers' professional development, especially in the areas of content knowledge, curriculum & instruction, and teaching methods?

Enhanced *Professional Development* as well as *Teaching Knowledge* are among the strongest impacts of the IISME experience. Nearly 20% of teachers rated the *Professional Development* associated with IISME *transformational*. Impact ratings were significantly higher among teachers whose placements align with what they are teaching when they participate in IISME. IISME's current efforts to ensure this alignment are well-conceived. Ratings on all impact variables also rose significantly if fellowship placements aligned with what teachers were seeking when they applied to IISME.

3. How do IISME Fellowships affect teachers' career decision-making, including pursuit of advanced degrees and certifications, leadership positions, and or new opportunities in education? Do IISME fellowships influence teachers' decisions whether to remain in the classroom and in education?

Interviews with teachers and principals provide evidence that IISME participants are often teacher-leaders who seek leadership positions, advanced degrees and certifications, and new opportunities within education. Yet survey ratings for these items were low relative to other impact items. Sections of the survey replicated the 2001 IISME study in exploring whether IISME fellowships deplete education of teachers by exposing them to work environments that lure them away. In this, survey responses were unequivocal. Evidence overwhelmingly shows that IISME does far more to promote and inspire teachers for teaching than it does to provide them a basis for leaving the profession.

Survey results were uniformly high across a range of variables. No meaningful differences were found based on teachers' background, grade level and subject(s) they teach, proportion of students eligible for Free and Reduced Lunch, organization type, work type, and what teachers sought when they applied. While statistical differences emerged on some of these variables, these differences distinguish between impacts that are *moderate* versus *extensive*—the practical implications of which seem negligible. In other words, the impacts of IISME participation affects all teachers in similar ways.

Principal interviews reinforced findings from the teacher interviews and surveys. Principals cited numerous examples of how IISME fellowships energized and inspired teachers, as well as colleagues, students, and even administrators. Principals cited IISME fellows' growth in leadership and professional development, curriculum and instruction, student engagement, and career advancement. Much of what teachers learned from IISME transferred beyond the classroom to the department, school, and sometimes the district. Principals suggested an IISME for principals, which could help replicate workplace culture, not just skills, in schools.

Taken together, these results reflect a highly efficacious program that is consistently well-implemented and strongly valued by teachers and principals.

Table of Contents

About This Report i

Executive Summary ii

I. Evaluation Scope & Methods 1
- Overview 1
- Evaluation Questions & Design 1

II. Survey Findings 3
- A. Description of Impacts 3
- B. Variables That Affect Impact 13
- C. IISME & Career Decisions 17
- D. Summary & Interpretations 19

III. Principal Interviews & Findings 23
- Method 23
- Results 23
- A. Impacts on Curriculum, Instruction, and Students 24
- B. Impact on Professional Development & Career 31
- C. Impact of Sponsor Culture 37
- D. IISME for Principals 38

IV. Conclusions & Implications 40

Appendix A: 2013 IISME Fellowship Survey
Appendix B: Teacher Interview Protocol
Appendix C: Principal Interview Protocol

Tables & Figures
1.1 Professional Development & Teaching Sub-Factors 4
1.2 Ranking of Specific Impact Variables 5
1.3 Highest & Lowest Ratings of 30 Variables Related to Workplace Readiness, Professional Development, Teaching, & Student Impacts 5
1.4 Ratings of *Overall Impact* Items 11
1.5 Mean Ratings on Impact of Sponsor Culture Items 13
1.6 Factors that Affect IISME Impacts 13
1.7 Impacts of *Alignment of Subject Taught* and *What Teachers Seek* on IISME *Impact* Ratings 15
1.8 What were the reasons for your career change? 17
1.9 If you chose "dissatisfaction with job," please note importance of reasons 18

I. Evaluation Scope & Methods

Overview

Industry Initiatives for Science & Math Education (IISME) was founded in 1985. Since then, the organization has been an early leader in providing summer experiences for math and science teachers in industry and academia. The program is intended to infuse real world applications into math and science lessons, motivate teachers in the profession, and inspire students towards majors and careers in science, technology, engineering, and math (STEM). Each summer, 40-50 hosts place between 150-175 math and science as well as English, Social Studies, Computer Science, Special Education and other teachers (elementary through community college). Companies pay fees to host teachers in the lab experiences they provide, which cover teacher stipends and program expenses. Beyond that, companies, universities, their foundations, and non-profit organizations support IISME through donations. IISME enjoys a strong reputation in the Bay Area among school teachers, administrators and participating companies and educational institutions. In 2012, IISME staff approached Quality Evaluation Designs (QED) to request an external evaluation that focuses on how IISME summer fellowships change teachers' perspectives and behaviors related to their teaching, professional development, and career decision-making.

Evaluation Questions & Design

The evaluation focused on three areas:

1) To what extent do IISME experiences support and/or promote teachers' awareness and integration of 21st Century or Workplace Readiness skills in the classroom?
2) To what extent does IISME support and promote teachers' professional development, especially in the areas of content knowledge, curriculum & instruction, and teaching methods?
3) How do IISME Fellowships affect teachers' career decision-making, including pursuit of advanced degrees and certifications, leadership positions, and or new opportunities in education? Do IISME fellowships influence teachers' decisions whether to remain in the classroom and in education?

These questions were pursued using interviews and surveys. First, interviews were conducted with a stratified, random sample of 25 IISME teachers who participated in IISME within the past 5 years (mostly high school, some middle school, elementary school, and community college, with a combination of those who have been fellows two or more times and those who have been fellows just once). Responses were used to design a comprehensive teacher survey, which was piloted by 25 teachers in March 2013. Based on the pilot data, the survey was revised. In mid-April, 2013, IISME staff sent an invitation and a link to the survey, which was posted on a Survey Monkey site hosted by QED. Requests were sent to teachers who held IISME fellowships from 2001-2012. Excluding bounce backs, IISME staff issued 880 invitations. A total of 476

teachers completed the survey, for a very respectable response rate of 54%. Surveys were completed anonymously. The survey was closed at the end of May.

Also, from mid-May to mid-June 2013, 14 school principals were interviewed regarding the effects they have perceived of IISME fellowships on teachers they supervise. Principals were randomly selected from a pool of 35 who currently have teachers in their buildings who participated in IISME within the past five years.

Quantitative and Qualitative data were analyzed by QED. Results and findings are summarized in the following sections.

II. Survey Findings

The IISME survey was comprised of three sections, each including several subsections (see Appendix A).

Section I: Asked teachers about their motivations for participating in IISME, the number of fellowships in which they have participated, and the nature of those fellowships.

Section II: Asked teachers to rate the impacts of their IISME experiences on their teaching, students, and professional development. Questions asked about impacts on subject area knowledge, teaching and advising, awareness of workforce readiness skills, professional development, career, and sponsor culture. This section also probed for the effects of multiple fellowships.

Section III: Asked respondents for various demographic information, including years in education and the effects (if any) of IISME on whether to remain in or leave education. Some of these demographics (e.g., percent students on free and reduced lunch) were asked in Section I on items pertaining to specific internships.

Analyses drew from data across the entire survey. We therefore present results in the following sections:

A. Description of Impact
B. Variables that Affect Impact
C. IISME and Career Decisions
D. Summary & Interpretations

Prior to survey design, QED conducted interviews with a stratified random sample of 25 teachers. Excerpts from those interviews and open-ended survey comments are included to enrich quantitative results (see Appendix B for interview protocol).

A. Description of Impacts

Teachers were asked the extent to which they agreed about IISME fellowship impacts on their teaching, integrating workplace readiness skills in their instruction, understanding workplace culture, perceived impacts on students, as well as their own professional development and careers. Variables related to these concepts vary slightly across the survey. Teachers were asked about these concepts in two ways: *specific impacts* and *overall impacts*. These two approaches are explained in the following sections.

Specific Impact Ratings

First, teachers made separate ratings of 30 items. Impact ratings for these items were on a conventional scale, with response options that included: 1-Strongly Disagree, 2-Disagree, 3-Not Sure, 4-Agree and 5-Strongly Agree.

These 30 items were factor analyzed into six variables. We refer to these as **specific impacts**, since each variable was probed with several specific questions. The variables explored were *Professional Development, Teaching, Integrating Workplace Readiness,* and *Students*. *Professional Development* was found through factor analysis to contain two factors: *inward facing* and *outward facing*. *Teaching* was also found to comprise two distinct factors: *knowledge* and *methods* (see Table 1.1).

The *Professional Development--Inward Facing* factor included not only increased knowledge and understanding but also how teachers *felt* about their profession. *Outward Facing* includes items that have to do with how teachers are perceived by others and activities related to career advancement. For *Teaching*, the *Knowledge* factor included items relating to increased knowledge about their content area and curriculum, but also increased knowledge to incorporate real world examples in instruction and advise students about STEM jobs and careers.

Table 1.1. Professional Development and Teaching Sub-Factors

	Professional Development		**Teaching**	
	Inward Facing	*Outward Facing*	*Knowledge*	*Methods*
Items comprising each variable	Knowledge of Technology	Increased Respect from Colleagues	Content Knowledge	Using Hands-On Instruction
	Technology Skill	Increased Respect from Administrators	Curricular Expertise	Using Inquiry-Based Instruction
	Understanding Workplace Expectations of Students	Increased Respect from Parents	Use of Real World Examples	Using Project-Based Learning
	Professional Confidence	Access to Mentors and Other Resources	Advising Students about STEM jobs and careers	
	Enthusiasm for Teaching	Seeking Additional Degrees/ Certifications		
		Seek New Leadership Roles		
		Seek New Career Options in Education		

Ratings of specific impact variables fell in the *agree* range (3.50-4.50), as shown in Table 1.2, below (*PD-Outward Facing* was only slightly lower at 3.48).

Table 1.2. Ranking of Specific Impact Variables

Overall Variable	**Mean Rating SPECIFIC** **1=Strongly Disagree 2=Disagree, 3=Not Sure, 4=Agree, 5=Strongly Agree**
Professional Development—Inward Facing	4.09
Teaching-Knowledge	3.91
Integration of Workplace Readiness	3.87
Students	3.69
Teaching-Method	3.63
Professional Development—Outward Facing	3.48
Combined Mean for Specific Impacts	*3.78*

As mentioned above, the specific impact variables were comprised of 30 items. Ranking the 30 specific impact items by mean ratings, we see that, of the top one-third items (n=10), 5 variables are related to *Professional Development—Inward Facing*, 5 are related to *Integrating Workplace Readiness*, and 2 are related to *Teaching* (Table 1.3).

Table 1.3. Highest and Lowest Ratings of 30 Variables Related to Workplace Readiness, Professional Development, Teaching, and Student Impacts

Rank (N=30)	**Variable Type**	**Specific Impact**	**Mean Rating (1-5, 5 high)**
Top 10 Ratings			
1	Prof. Development--In	Technology Knowledge	4.14
2	Workplace Readiness	Promotion of Critical Thinking	4.13
3	Prof. Development--In	Professional Confidence	4.12
4	Teaching--Knowledge	Use of Real World Examples	4.12
5	Workplace Readiness	Use of Technology	4.09
6	Prof. Development--In	Enthusiasm for Teaching	4.08
7	Prof. Development--In	Technology Skills	4.05
8	Prof. Development--In	Workplace Expectations of Students	4.03
9	Workplace Readiness	Teamwork/Collaboration	3.97
10	Teaching--Knowledge	Advising Students About STEM jobs	3.95
Bottom 7 Ratings			
24	Teaching--Method	Use of Hands-On Projects	3.58
25	Workplace Readiness	Project Management	3.58
26	Prof. Development--Out	Increased Respect from Parents	3.56
27	Students	Interest Students in STEM Careers	3.56
28	Prof. Development--Out	Take on New Leadership Roles	3.55
29	Prof. Development--Out	Pursue Additional Degree/Certification	3.28
30	Prof. Development--Out	Pursue New Career Opportunities in Ed.	3.05

We find it notable that 3 of the top 10, including the first ranked variable, relate to technology knowledge and skills. Of the bottom 7 ratings, 5 are rated above 3.5, indicating that more teachers responded *agree* than they did *not sure*. As a group, teachers *agreed* that they benefitted in all but two of the thirty specific impact items. Combining the 30 items into grouped variables, ratings reveal the greatest impacts on teachers in the areas of *Integrating Workplace Readiness Skills* and *Professional Development—Inward Facing*.

Impact on Integrating Workplace Readiness Skills into the Classroom
Overall, teachers rated *Integrating Workplace Readiness Skills* as 3.9/5.0.[1] The greatest contributors to this variable were *increased promoting of critical thinking* and *integration of technology into my lessons.* About technology and critical thinking, teachers said:

> *I think that the twenty-first century skills are really important and so I incorporate them in a lot of different ways. We do a lot of [science] projects … I use a lot of… Google apps, applications, like Google Docs and spreadsheets and stuff so they can collaborate at home and work on a document together and see each other's revisions and make suggestions and I can see it as well and sort of help guide it… I also incorporate a lot of technology in other ways; all my students have to learn how to graph on Excel… I try to teach it in that way and then also, even within science, how people are already using it and what are they using it for. Presenting the power of the tool and then letting them sort of run away with it… Working with the computer software itself and then also critical thinking skills. In addition to that they had to read one or two articles that were on the topic and then pull key ideas from those articles that related to what their results were, and how to cite it properly. They worked on it in partner groups and so their ideas may have been discussed, ensuring collaboration and then they would have to discuss the paper but also come up with their own final analysis. FD 157-173, 222-241*

> *I realized how important it was for my students to be able to use Excel, especially if they wanted a job doing what the people I was working with did. So I created a Battleship game where two students would have a laptop facing each other and they would call out cells and the cell that they called would be a math problem and if they get the math problem right it sinks the ship…And then also as an extension, they make their own game board in Excel and so they learn how to input information and I had them make different game boards and different sheets so they learned about that. It was a fun introduction to Excel. MY 101-114*

[1] The 5-point rating scale for this item is 1-Strongly Disagree, 2-Disagree, 3-Not Sure, 4-Agree, 5-Strongly Agree.

Many teachers commented about how their IISME fellowships attuned them to workplace demands and employers' expectations. IISME fellowships gave teachers a better understanding of workplace expectations for students, more real-world examples to share with students and enhance teaching, more teaching of Workplace Readiness skills (particularly critical thinking, technology, and teamwork and collaboration skills), as well as a basis for better advising of students about STEM jobs. Teachers report transferring this valuable knowledge into their classrooms:

> *[At my first fellowship] we had a lot of meetings with people in India and all over the world and so we'd have to talk to them without seeing them and we'd have to explain what was going on, on the computer... So what I did for my ETP is I made a game where the kids couldn't see each other and they had cards and they were in a group of six, and they couldn't show each other the card, and they couldn't see each other. I put up like barriers in between them of manila folders, so they would just have to, almost like they're on the phone, and they had to explain what's on the card and talk together as a group. So that's really what I got out of that: communicating with people that you can't see. MY 122-133*

> *Each fellowship contained different work experiences and cultures. I was able to see what kinds of skills and knowledge were looked for in Industry settings, was able to experience a different type of team work and work culture and bring knowledge and skills back to my school and classroom.*

Impact on Professional Development

Teachers rated *Professional Development—Inward Facing* 4.09/5.0 and *Outward-Facing* 3.48/5.0.[1] So, *Professional Development—Inward Facing* was much more impactful. Top items contributing to this result were *increased technology knowledge, increased professional confidence,* and greater *enthusiasm for teaching*. Teachers spoke of these qualities in their interviews and open-ended survey responses:

> *You know I have to start off with being more comfortable myself before I can expect all my students to do it. I needed to gain the confidence that I knew what I was doing. And I think that this job totally helped me with that… EG 79-89, 102-108)*

> *I am much more confident in using technology in my classroom. 75*

> *Due to my fellowships, I am a more knowledgeable and confident teacher and engage with parents, students, and administrators in new ways. I am pursuing my own professional development plan in ways that link a variety of topics and skills that are improving my students' classroom experience as well as my own. 355*

> *It actually helped me become refreshed for the following school year. Because I was doing something totally different. So whenever I would teach summer school, I wasn't necessarily refreshed the following year. But when you're doing something completely different and then you're kind of excited that you've created this item that you can bring back. So you're really excited to start the school year with something new, something fresh. You feel refreshed; you haven't seen the students in two months, and you're ready to go. It's was a totally refreshing experience for me. EG 324-330*

As mentioned above, the lowest impacts reported by the teachers are those related to *Professional Development-Outward Facing*: *pursuing additional degrees and/or certifications* (3.28/5.0) and *pursuing new career options within education* (3.05/5.0).[1] Means of these two variables are the only two of 30 ratings that were closer to *not sure* than *agree*.

Impact on Teaching

Impact on teaching includes two constructs: *Teaching Knowledg*e and *Teaching Methods*. Teachers report that IISME fellowships strongly impact their *Teaching Knowledge* 3.9/5.0.[1] Items within this construct include *use of real-world examples (4.12), STEM-related student advising (3.95), content knowledge (3.80),* and *curricular expertise* (3.77). Comments include:

> *It's hard to define as a bubbled in slot but the overall experience made me a much better teacher. It's hard to measure how "confidently" you teach a subject but I'm convinced that aspect of my teaching was vastly improved by my IISME experience. 368*

> *I have had two and each one was incredibly beneficial to my teaching. The first one taught me that students need more than just my subject area content to succeed the second one provided awareness of trends that required me to revise what I was teaching to stay current. 384*

> *Sometimes it seemed like a stretch to connect the ETP directly to what the IISME assignment was. Of course, with all the standards you need to cram into your classroom teaching, it can be hard to take time out to implement an ETP if it doesn't align directly with a standard. For me, the impact of my IISME Fellowship was strongest when I could use my experience to start a conversation about engineering/technology careers with a student outside of the classroom.*

> *The fellowship was wonderful for me to do something different and see how one tech company worked. I feel like it didn't directly benefit my students, but it gave me experience that informed my teaching. 264*

Impact on *Teaching Methods* was rated 3.6/5.0[1] overall. Variables comprising this construct include *use of hands-on activities* (3.68), *use of inquiry-based learning* (3.62), and *project-based instruction* (3.58). Although teachers rated *Teaching Knowledge* higher than *Teaching Methods*, most interview and survey comments focused on powerful changes in teachers' teaching methods:

> *I worked with a sociology professor and she helped me infuse one of my mathematics projects with immigration issues as well as naturalization citizenship concerns… Prior to working with her, my students had done research in the different neighborhoods of San Francisco, looking at just education achievement levels, raised incomes, and those sorts of things. She helped me add another layer to that. We started talking about who immigrates to which neighborhoods and who's actually a citizen in these neighborhoods. Who had a green card, who does not? So it really helped to deepen the project and really complexify what we think about when we think about diversity and who's living in what areas. TP 30-45*

> *In [my IISME fellowship] I fell in love again with science…I told the professor, "What I want is, you give me access to your lab so that I can create a hands-on activity for every major concept in the physics curriculum for California high schools." … Because most of low-income students are a) bilingual b) English learners, and c) visual and kinesthetic learners. I knew that I needed to change [my teaching to address these realities]. During the regular school year, I just didn't have the time. I said, I'm going to take this ten weeks and all I'm going to do is, like all the money that I make from IISME, went into buying equipment. I just bought batteries, I bought diodes, I bought transistors, I bought a bunch of stuff. … Every single one [hands-on activity] made it to the classroom. Every single one. You have no idea what it is to show...Are you familiar with Faraday's Law? … When you induce electricity from a magnet and when kids see it, they're like, "What the hell! How do you do that?" And you can just see their brains explode. You know what it is to talk to a low income kid who wants to know more about something like Faraday's Law? I don't think you measure happiness any other way for a science teacher. BR 289-320*

Impact on Students

Questions were included on the survey to explore how teachers perceive the impact of IISME fellowships on their students. Teachers report that their IISME fellowships have an impact on their students (mean = 3.7/5.0).[1] This construct included Increased Engagement in Subject Matter (3.8), and Increased Interest in STEM careers (3.6). Comments include:

- *Students are surprised that there ARE real world applications for subject matter.*
- *They have more buy-in to a project when they learn the project is related to real world goals.*
- *More focused upon gaining skills to enter desired career.*
- *Struggling students who have an interest in science were more motivated to explore what they would need to do to actually seek a career in science.*
- *Interest for computing technology increased*
- *More interest in biotechnology*
- *Student interest in biological research and careers increased*
- *Better attitude overall towards science*

Some teachers felt that bringing what they learned through IISME back to their classrooms altered how students saw them as teachers:

- *Students like to know that their teachers are "students" too--increases your credibility with students/parents*
- *Students sees me an a scientist more than "just a teacher"*
- *Their esteem of me and their perception of my knowledge base increased*

Overall Impact Ratings

After the survey sections pertaining to the specific impact ratings, teachers were asked to provide summative ratings of IISME's overall impact in the areas of *Teaching, Integration of Workforce Readiness Skills, Students, Professional Development, and Career.* A sixth area was added to the overall impact ratings, *Understanding of Workplace Culture,* based on the powerful impact of the sponsor culture that some teachers were reporting in the pre-survey interviews, as described below.

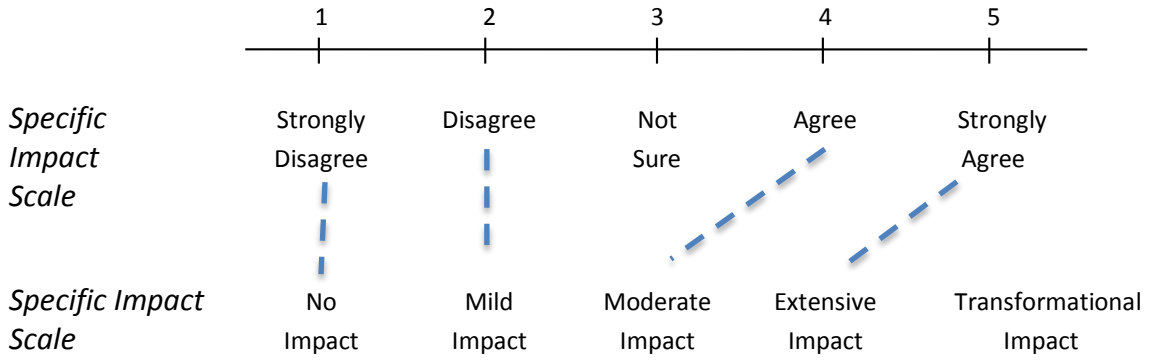
Overall Impact differed from *Specific Impacts* in two ways. First, they were summary assessments, based on a single item asking teachers to reflect on overall impacts in a particular area. Second, *Overall Impact* was rated on a unique scale that differed from ratings of *Specific Impacts*. Whereas *Specific Impacts* were rated on a conventional 5-point scale, QED felt that this scale would be inadequate for IISME participants. In pre-survey teacher interviews, many teachers talked about not merely excellent experiences related to IISME, but *transformational* experiences; that is, life changing, personal and professional impacts. These are the kinds of outcomes reported by people who participate in wilderness trainings such as National Outdoor Leadership School (NOLS) or the Peace Corps. It's very rare to find such effects from an 8-week summer professional development experience. Below are comments from teacher interviews that reflect such effects:

My experience with the IISME Fellowships has been profoundly transformational. From improving my curriculum development skills, to learning and improving my skills in a workplace setting, to allowing me to learn wider applications of technology in and out of the classroom.

Very transformational as a professional development endeavor.

An experience that… really transformed my teaching.

QED created the *Overall Impact* rating scale that included a *transformational* response option in order to capture these extraordinary effects, which would have been downplayed on a conventional scale, the top choice of which might have been *strongly agree* or *excellent*. Thus, a "3" rating on the *Overall Impact* scale denotes a considerably higher impact rating than a 3 on the *Specific Impact* scale, as shown below:



Across all *Overall Impact* variables, respondents chose the *transformational* response option 9-21% of the time (mean = 15%). A *transformational* effect is a most powerful outcome, and it is highly notable that teachers opted for this response so often. Ratings of the *Overall Impact* variables are shown in Table 1.4, below. Impacts for *Professional Development* and *Understanding of Workplace Culture* fell in the *extensive* range (3.5-4.5); the rest of the items fell within the *moderate* range, which is still a strong effect.

Table 1.4. Ratings of Overall Impact Items

Overall Variable	**Mean Rating OVERALL 1=No Impact, 2=Minimal, 3=Moderate, 4=Extensive, 5=Transformational**
Professional Development	3.59
Understanding of Workplace Culture	3.52
Classroom Teaching	3.44
Integration of Workforce Readiness Skills	3.37
Students	3.28
Career	3.27
Combined Impact	*3.41*

Impact of the Sponsor Culture on Teachers

Pre-survey interviews indicated that the means of communicating and getting work done at sponsors' sites influenced—sometimes greatly—how teachers thought about and conducted their own classrooms. Some of the strongest and most passionate responses during the teacher interviews came from those who had been powerfully affected by the culture of the sponsor organization itself – that is, not just the *work* the teacher did there but the *environment* and the *way* the sponsor organization and its people did their work. Examples of teacher interview comments related to this important impact are shown below:

> *I have a better understanding of what it is like to work in a corporate culture; I bring that back to students and am able to promote ethical values and entrepreneurship to students.*

> *Exposure to the corporate culture was the MOST valuable part of the fellowship experience.*

> *It wasn't really the statistics that changed my teaching. It was more the culture and the expectations. Prior to the IISME internship, I had been doing all of my lesson plans on paper…Everything was done on an overhead projector… So when I got to [Company X], the first thing they did was hand me a laptop. Which I never had before. It really changed my way of thinking in terms of how to present information, how to organize information. From that point on, I've only been teaching through electronic media…Every single lesson is Power Point and every single paper I create—they're all electronic. Nothing that I have is paper-based. I think in terms of that I was sort of a pioneer at my school, even though these companies have been doing it for years. PX 112-126*

> *The thing that I guess caught me off guard that summer that connected to my classroom and that really excited me, was just going to the weekly lab meetings. I recognized that there's a pattern of communication that happens in labs and in lab meetings that I had never really made explicit to my students. But it's so critical to doing science. You're like, looking at a question and you're asking for insight. You want people asking you questions. You want people pushing you forward. That communication is so rich. So I was inspired when I tried to bring it into environmental science class. It was fabulous…And so I did a multi-month project at the end of year where the students were in mini lab groups and they each identified their own question that they were going to investigate, and it had to be a question that nobody had ever answered before. And they were going to collect unique data for and then attempt to answer their question. And it was really fun and really inspiring and the kids learned so much and had such a great time. (KW 94-111)*

QED created five survey items under the variable name *Sponsor Culture* in order to quantify these effects.[2] As with the *Overall Impact* variables, the scale for these items was adjusted to avoid a ceiling effect. The mean for each of the five items and the overall variable are shown in Table 1.5, below. All items and the variable overall fell into the *moderate impact* range (2.50-3.50).

Table 1.5. Mean Ratings on Impact of Sponsor Culture Items.

Variable	**Mean Rating** 1=No Impact, 2=Minimal, 3=Moderate 4=Extensive, 5=Transformational
Collaboration/Teamwork	3.34
Communication	3.19
Project management processes	3.18
Values/Ethics	3.10
Training	2.98
Impact of Sponsor Culture (Overall)	*3.16*

Across the sample, 11% of teachers reported *transformational* impacts on these items. Roughly half (49%) reported *extensive* or *transformational* impact on the Collaboration/Teamwork item. Slightly fewer (35% – 45%) reported *extensive* or *transformational* impact on the remaining four variables. Of the 101 open-ended comments related to this item, 88% were positive. Comments included:

B. Variables that Affect Impact

QED wanted to ascertain which variables had the greatest influence on the *Specific Impacts* as well as *Sponsor Culture* variables reported above. Variables explored are listed in Table 1.6, along with the extent to which they were found to influence ratings.

Interestingly, grade level taught did not affect impact outcomes. Number of fellowships was found to have a statistically significant but very weak effect. The greatest effect was found for the first fellowship, with incremental effects for subsequent fellowships. We mention this because it replicates a finding from the 2001 study.

Those whose internships were in *academic/research settings* reported higher impacts on *Teaching Knowledge* and *Impacts on Students* than those in *corporate/industry* settings. *Work Type* also affected *Teaching Knowledge* and *Impacts on Students*. In both cases, those involved with Science Research and Engineering/Electronics rated the highest impact, while those in Web/Sales/HR reported the lowest impact.

[2] *Sponsor Culture* is a stand-alone variable, independent of *Integrating Workplace Readiness* and *Understanding Workplace Culture*.

Table 1.6. Factors that Affect IISME Impacts

Demographic Factors	Levels	Impact Variables Influenced†	Effects (for variables in preceding column)
Subject Taught	• Math • Science • General Elementary • Computer/Techology & Engineering, • English, Social Science, & Special Education	• Teach-Knowl. • Students • WorkPl.Readi. • Sponsor Culture	p=.002: Sci + Comp/Tech/Engr highest; Elem and Engl/SocSci/SpEd lowest. p=.007: Sci + Comp/Tech/Engr highest; Engl/Soc/SpEd lowest. p=.006: Comp/Tech/Engr + Engl/Soc/SpEd hi; Sci+Math lo. p=.034: Engl/SocSci/SpEd high; Sci + Math low.
Organization Type	• Corporate/Industry • Academic/Research	• Teach-Knowl. • Students	P=.000: Acad/Res higher p=.001: Acad/Res higher
Work Type	• Science Research • Curriculum & Instruction • Web & Multimedia • IT • Engineering & Electronics • Business & Production • Statistical, Financial, &Technical Writing • Marketing/Sales/HR	• Teach-Knowl • Students	p=.001: Sci Res & Engr&Elect high, Web & Mkt/Sales/HR low p=.002 Sci Res & Engr&Elect high, Web & Mkt/Sales/HR low
Students Free/ Reduced Lunch	• Less than 50%, • More than 50%	Sponsor Culture	p=.009: More than 50% FRL, report greater impact.
#YRS K-16 Ed	• Continuous, 1-n	PD-Outward	p=-.045: More years, less effect
No. Years in Acad/Research	• 0 • 4-7 • 16+ • 1-3 • 8-15	WorkPl. Readi.	p=.047: More years, greater effect.
No. Years in Corp/ Industry	• 0 • 4-7 • 16+ • 1-3 • 8-15	Teach-Knowl	p=.044: More years, more effect.
No. Fellowships	• 1, 2, 3, 4, 5 or more	None	No effects found for these variables. [3]
Grade Taught	• Elem • MS • HS • CC	None	

† Uses Specific Impact Variables discussed in Section A of this report, plus Sponsor Culture discussed in this section.

The subject that a teacher taught when going through IISME influenced four variables. *Teaching Knowledge* was rated higher by science teachers and computer/technology/ engineering teachers, and lowest by elementary and English/social science/special education teachers. Impact on *Students* was also rated most highly by science teachers

[3] In the 2001 study, effects were found for science compared to math teachers on some variables. The current analyses assess effects on specific impact variables. Analyses by fellowship revealed differences that did not manifest when teachers reflected on their fellowships overall.

and computer/technology/engineering teachers, and lowest by Elementary and English/social science/special education teachers. *Integration of Workplace Readiness Skills* was rated highest by English/social science/special education teachers and by computer/technology/engineering teachers, and lowest by science and math teachers. Impact of *Sponsor Culture* was highest among English/social science/special education teachers and lowest for science and math teachers.

Teaching Knowledge was also affected by the number of years a teacher worked in corporate/industry—the more years in industry, the greater the impact of a fellowship on *Teaching Knowledge*. In addition, the more years a teacher spent working in *academic/research,* the greater the impact experience on *Integrating Workforce Readiness Skills*. Interestingly, teachers who reported serving greater than 50% Free & Reduced Lunch students reported greater impacts of *Sponsor Culture*. Finally, as might be expected intuitively, the more years' experience a teacher has in K-16 education, the less impact an IISME fellowship has on *Professional Development—Outward Focused.*

Significant effects were found in two other areas: the extent to which an IISME placement *aligned with subject taught* and *aligned with what IISME fellows were seeking* when they applied. IISME has always tried to match teachers with fellowships related to the courses they are currently teaching. Between 8% and 28% of the variance of impact ratings can be explained by how well teachers feel their fellowship aligns with what they were teaching at the time of their fellowship, and by how well they felt the fellowship aligned with what they were seeking when they applied. These findings extend across all impact measures – i.e., impact not just on their *Teaching*, but also on their *Students*, their *Sponsor Culture*, *Professional/Career Growth*, and *Integration of Workplace Readiness Skills* (see Table 1.7).

Table 1.7. Impacts of *Alignment of Subject Taught* and *What Teachers Seek* on IISME Impact Ratings.

Impact Variable	*What Subject Teachers are Teaching* Sig/Variance Explained	*What Teachers Were Seeking When they Applied* Sig/Variance Explained
PD-Inward	p<.000/10%	p<.000/17%
PD-Outward	p<.000/12%	p<.000/13%
Teaching Knowledge	p<.000/28%	p<.000/24%
Teaching Method	p<.000/15%	p<.000/17%
Workplace Readiness	p<.000/12%	p<.000/10%
Students	p<.000/22%	p<.000/17%
Sponsor Culture	p<.000/ 8%	p<.000/11%

Taken individually and together, these two factors strongly predict the impacts teachers experience from IISME fellowships. These were the most significant findings in terms of what variables most affect IISME impacts. The strong relationship between *Alignment with Subject Taught* and impact provides quantitative evidence of the high value of IISME's emphasis on matching fellows with fellowships in their teaching subject area. The equally powerful relationship between *Alignment with Seeking* across all impact variables suggests one possible avenue for IISME to heighten the impact of its fellowships even further – by asking teachers what they are seeking when they apply and then incorporating that information in its fellowship-matching process.

Teacher comments from the survey and interviews provide insight into what teachers are seeking when they apply for IISME fellowships, and the passion many of them feel about it. Most teachers are seeking to do something new and different for their own benefit as well as the students' benefit (~80% of the teachers rate these elements as *very important* (3.0/3.0)[4], and ~98% rate them as *somewhat* or *very important*.

> *I love learning! ... I enjoy what I do, and I'm always striving to learn more about my profession both on the science and math side and on the education side, and the technology side now. JL 54-55*

> *It was mostly for personal enrichment. I really like doing things like that! It keeps me excited and energized and it's a really unique opportunity. KW 9-12*

Also, teachers seek real-world experience, to *"learn what the field/workplace is asking of me as a teacher and students as future workforce."* In fact, 60-70% of teachers rate these as *very important*, and ~90% as *somewhat* or *very important*. One teacher said:

> *I want to know what the field is asking of me as a teacher…How do they want me to train my students so that I can get them ready for the field…? … It's almost like there's a disconnect, because I've been in the classroom for so long and I felt isolated on what I'm teaching as to what is it that's really needed from me as a teacher teaching this lesson. … So I said, okay, I need to go into IISME as my way through to enter the technology field. So at least, if I'm talking microchips, I would know how it really works, how it's made, so I would have more knowledge to impart to my kids. AJ 6-34*

Making money is *very important* to about 2/3 of the teachers. Several open-ended comments on the survey—both positive and negative—pertained to the importance of being paid over the summer (negative comments focused on the amount). And about half the teachers are seeking hands-on experience and consider it *very important*. Two other things that teachers are seeking besides those listed in the survey emerged from

[4] This 3-point rating scale, used to rate each individual fellowship, is 1-Not Important, 2-Somewhat important, 3-Very important.

the teachers' open-ended comments in this section: Meet, collaborate with, and network with other teachers, especially those outside their district; and Make a contribution, be useful, do something meaningful:

> *Network with other teacher colleagues to compare experiences in their districts, with their students, etc. Network with the host for future connections for myself professionally and for my students.*

C. IISME and Career Decisions

IISME staff are sensitive to concerns expressed in the past that exposure to the culture and material benefits of industry will lure teachers out of education. In the 2001 survey report, no evidence was found substantiating this concern. At that time, none of the handful of teachers who had left teaching/education attributed their move to their IISME experience. QED included similar items from the earlier survey on the current survey to see if this finding had changed.

Nearly all respondents (91%) are currently employed in teaching. The rest either changed careers (6%, n=26) or are unemployed (3%, n=12). Of those who left education, the most important reasons teachers cited were to pursue a different career and family/personal reasons (see Table 1.8). Almost two-thirds of those teachers (n=15,) said that a different career was *somewhat* or *very important*, and about half (n=12) said that family/personal reasons were *somewhat* or *very important*. The least important reason teachers cited was retirement; only 4 teachers (7%) considered retirement *somewhat* or *very important*. Job dissatisfaction was in the middle; 14 teachers cited it as *somewhat* or *very important*.

Table 1.8. What were the reasons for your career change?

Response Option	Mean
To pursue a totally different career	1.92
Family/personal reasons	1.83
Dissatisfaction with job	1.75
School staffing action	1.57
Retirement	1.29

N = 24; 1=Not Important, 2=Somewhat, 3=Very

Among those teachers who cited job dissatisfaction as their reason for changing careers, the top reasons for their dissatisfaction were low salary and no opportunity for professional advancement (see Table 1.9). The least common reasons cited were poor administrative support and poor student motivation.

Table 1.9. If you chose "dissatisfaction with job" as Very or Somewhat Important, please note the importance of each of the following reasons.

Response	Mean
Low salary	2.53
No opportunity for professional advancement	2.07
Lack of faculty influence and autonomy	2.00
Class sizes too large	2.00
Student discipline problems	1.93
Lack of professional development	1.93
Poor administrative support	1.87
Poor student motivation	1.67

N = 15; 1=Not Important, 2=Somewhat, 3=Very

One teacher reported that the IISME experience encouraged him/her to leave; the other 25 reported that IISME did not affect their decision to leave. The one teacher who said IISME influenced his/her decision cited 4 of the 6 reasons offered in the survey as *very important* in their decision-making, including *gaining the confidence to make a career change*, *making me feel more respected and valued, gave me a view of what another work environment is like*, *showed me that other careers offer better pay/working conditions*.

Of those who are currently employed in teaching, about one-third (36%) reported that the IISME experience caused them to stay in teaching longer; the other two-thirds reported that their IISME experience didn't really affect their decision.[5] One open-ended comment exemplified the concern about IISME leading someone to leave teaching:

> I know you don't want to hear this, but the fellowships made me realize that I wanted to go back into the corporate world. I quit teaching 5 years ago. 244

On the other hand, many more comments reveal that exposure to the corporate world confirmed IISME fellows' commitment to teaching:

> - IISME fellowship re-energized me to continue teaching. I hope we are able to participate in more than 5 fellowships. 100
> - I am grateful for my experiences with IISME. They have helped to make my present employment possible when I could not find another teaching position. 154
> - The added income helped me to purchase my first home. Having a home in the Silicon Valley allowed me to stay in the area and in teaching. 162

[5] The 2001 study reported that "Nearly three-fourths of all respondents (72%) felt the IISME experience increased their commitment to teaching." However, the specific survey items across surveys are not comparable.

- This experience confirmed that I really do enjoy teaching more than research jobs. 174
- I know that I like teaching better than a desk job. 233
- Working in industry was very enjoyable and game me a new perspective but also made me really appreciate teaching.249
- I was experiencing some issues in my teaching assignment right before my fellowship started. The fellowship gave me confidence to face career setbacks and rise above the negativity. Because of the fellowship I was able to reconsider my place in teaching and get back into it and be more energized.282
- If anything, my IISME experience boosted my love for teaching because I was reminded of how much I didn't enjoy the corporate workplace. I loved my fellowship at Lockheed -- I loved that I got to participate in designing a defense missile -- but I knew that I wouldn't be able to spend longer than a few months in a cubicle.291
- My experience at IISME reminded me how exciting teaching is.369
- Got me to appreciate what I had in teaching.

Quantitative and qualitative comments suggest that the risk of exposing teachers to a corporate or research fellowship experience is greatly outweighed by the benefits. The experience re-energizes the vast majority of teachers, and becomes the basis of teachers remaining in teaching more than it does for them leaving the profession.

D. Summary & Interpretations

Before summarizing the specific findings from the survey, we offer a big picture perspective. Overall, survey results are extraordinarily positive across a broad range of variables. Consistently high results on related variables reinforce an over-arching conclusion that the IISME experience is uniformly effective across a broad spectrum of teachers with diverse teaching contexts, years in the field, subject area expertise, and life experience. Variations noted in this section and summarized below show differences across variables that have questionable practical implications. Ratings of specific outcome variables range from 3.48 to 4.08, where "3" means *not sure* and "4" means *agree*. Ratings of overall outcome variables range from 3.27 to 3.59, where "3" equals *moderate*, "4" equals *extensive*, and "5" equals *transformative*. Comments from interviews and open-ended survey items were predominately glowing. The strongest implication of the overall profile of results is that the program model and execution are exceptional. Client satisfaction is extremely high. Benefits accrue regardless of any number of factors that might otherwise be thought to alter experiences of participants who have diverse backgrounds and goals for the experience.

The fact that QED felt that a *transformational* response option was warranted gives some indication of the magnitude of benefit teachers perceive from IISME fellowships. In terms of *Overall Impacts* (assessed on the *transformational* scale), mean ratings nearly all fall within the *moderate* range and *Professional Development* fell in the

extensive range. The effects of *Sponsor Culture* on teachers was an unanticipated outcome of IISME fellowships. Many teachers found that the means by which communication took place and work was planned for and executed in their sponsor organizations differed considerably from conventional classroom and school norms. Many teachers sought to replicate these features within their classrooms. This effort transcends specific skill development. Teachers report that their efforts changed the structure of their own and sometimes even colleagues' classrooms, communication dynamics, and which technologies were used and how they were used for instruction. Teachers' effort to alter their classrooms so they look and feel more like workplace culture is a great leap towards preparing students to meet expectations of future employers.

Of 30 items that probed skills and knowledge associated with specific impacts on *Teaching, Workforce Readiness, Students,* and *Professional Development/Career*, teachers *agreed* or *strongly agreed* that IISME supported and/or promoted 28 of them. Interestingly, although ratings for *specific* and *overall impacts* are on different scales, rankings of the variables are largely the same. The *overall* and *specific impact* data suggest that *Professional Development* is a strong benefit to nearly all teachers. In fact, 20% of teachers reported that their IISME fellowship had a *transformational* impact on their professional development. The greatest proportion of open-ended survey comments related to the value of IISME to teachers' professional development.

In contrast to *Professional Development--Inward Fa*cing being the highest rated *specific impact* variable, *Professional Development-Outward Facing* was the lowest. This was the only *specific impact* variable to earn a rating closer to *not sure* than *agree*. Four of the items on the 7-item variable garnered negative responses, which is unusual for this survey. Between 19%-24% of respondents *strongly disagreed* or *disagreed* that their IISME experience provided them *with increased access to mentors or other resources*, or led them to seek *additional degrees/certifications*, *new leadership roles*, and/or *new career options in education*. These rates of negative responses on these items were 2-4 times greater than rates on any other items throughout the survey.

The survey revealed uniformly strong impacts in nearly every area assessed. Among specific impact variables, *Professional Development—Inward Facing, Teaching (Knowledge), Workforce Readiness, Students,* and *Teaching—Method* all garnered ratings in the range of *agree*. Among *overall impact* variables, the majority of responses for *Professional Development* and *Understanding Sponsor Culture* were in the *extensive* or *transformational* range, with *Teaching* not far behind. Ratings of other variables fell between *moderate* and *extensive*.

The biggest impacts on teachers from IISME fellowships are in *Professional Development, Understanding Workplace Culture and Expectations, Integration of Workplace Readiness Skills* into teaching, and *Impact of Sponsor Organization Culture* on the teachers. Type of sponsor organization, type of work performed for the fellowships,

proportion of students on Free and Reduced Lunch, and subject area taught at the time of the fellowship affect the impact teachers experience from IISME fellowships; grade level did not.

Impacts were least strong in the area of career advancement—*taking on leadership roles*, *seeking advanced certifications and degrees*, and *seeking new options in education*. We know from teacher and principal interviews that many IISME teachers do these things; on the survey, however, they did not necessarily attribute these activities to their IISME experiences.

Teaching Knowledge was found to be affected by Subject Taught, Organization Type, Work Type, and Number of Years' of Corporate/Industry Experience. Reported impacts on *Students* were affected by Organization Type, Work Type, and Subject Taught. Teachers with 50% or greater proportion of students eligible for Free and Reduced Price Lunch reported greater impacts related to *Understanding of Sponsor Culture. Professional Development—Outward Facing* had the greatest impact on teachers with fewer years' experience in K-16 education. The more years' experience a teacher had in K-16 education, the more impact they reported on *Integration of Workplace Readiness Skills* into their teaching.

Survey results confirm the value of IISME attempts to place teachers in settings that align with what they are currently teaching. The more aligned the fellowship is with what the teacher is teaching, the more impact the teacher experiences. The survey also discovered that impacts also depend on the extent to which the IISME experience aligns to what teachers are *seeking* when they apply. In both cases, significant effects were found for both variables on all impact variables: *Professional Development, Teaching, Workplace Readiness, Students, Sponsor Culture*, and *Career*.

In terms of concerns about whether IISME fellowships prompt fellows to leave teaching, survey results reinforce findings from the 2001 survey study. Only one teacher reported leaving teaching as a result of IISME. It was much more the case that the IISME experience prompted teachers to stay in teaching, either because they become re-energized, and/or because they recognize that teaching is a better option for them than a corporate setting.

A relatively large proportion of teachers—29% (140/476)—offered comments or suggestions at the end of the survey. We conclude this section of the report with their voices:

- *IISME offers a creative approach to professional development. I think the program is very successful.*
- *IISME is, hands down, the best professional development I've received in my 20 years of teaching.*

- *I would highly recommend to allow veteran teachers do IISME indefinitely. It helps teachers refresh and be more innovative. Participating in this program is essential to maintain a growth mind set as a teacher.*
- *[IISME] made me realize how important my job is to helping students enter today's highly competitive and demanding jobs.*
- *The IISME organization itself is very organized and well-run. The staff always listens to feedback and incorporates constructive suggestions. The website, orientation, operational procedures, etc. gets better every year. There is authentic collegial respect among IISME fellows and among IISME staff members. We feel valued and important at IISME.*
- *It just provided me with great insight into the corporate world and I really enjoyed being treated like I was important!*
- *I have kept my experiences forefront in my memory as one of the best experiences outside of the classroom that I have had.*
- *I only wish there wasn't a 5 year consecutive limit.*
- *I hope IISME will be able to revisit the 5 year cap rules through input from sponsors and teachers.*
- *It's important to match mentor and candidate closely so that they both benefit from the time working together.*
- *I think that it is very important for me to have a fellowship that aligns to my line of work. I cannot help but emphasize this, as I expect to bring something new to my classroom every time I apply for an IISME fellowship.*
- *The fellowships are grossly underpaid. $22.50/hr is an excuse for large companies to hire intelligent low wage workers. Teachers are also guilty for accepting such low wages. It needs to be somewhere near $35/hour, especially for high visibility projects.*
- *With the furlough days and ongoing attacks on education, unions, middle class and service workers, do what you can to increase the stipend.*
- *If there was a 6-week fellowship, I think you'd get a much larger applicant pool, as I know the 8 week commitment has deterred me in the past."*
- *I loved IISME. At the time it made a big difference. Since then I have moved away from the Bay Area and really miss the opportunity it afforded. I wish something similar existed here in Chicago.*
- *…[B]ring in more humanities based positions*
- *If anything, the fellowship program should be extended to more teachers from other disciplines, English, World Language and Social Studies. Those types of teachers can truly benefit from the exposure to technology and how it has advanced the other disciplines other than Science and Math.*

III. Principal Interviews & Findings

This section summarizes the results of 14 interviews conducted in May-June 2013 with principals whose teachers have participated in IISME fellowships within the past five years. The purpose of these interviews was to determine the principals' perspective on how IISME fellowships impact teachers' pedagogy and career.

Results echo and reinforce the results obtained from the teacher interviews and the teacher survey, reported in the previous section. Principals were very enthusiastic about IISME fellowships, and they report substantial impacts on teachers' teaching, integration of workplace readiness skills, professional development, and career. The results also highlight some additional impacts that include impacts on colleagues' perspectives and practices, and department, school, and district curriculum and culture. Principals also suggested an IISME-like experience for principals.

Method

The interview sample of 14 IISME principals was selected through initial random selection from a pool of 35 principals who had one or more teachers currently on staff who had participated in IISME in the past five years. The pool contained principals from schools with many and few IISME teachers (range = 2-16 teachers); elementary, middle, and high schools; public and private schools; high needs schools and not. The principals who were available for interviews, however, were from predominantly public high schools that were not high needs schools.

Interviews were conducted by telephone between May 13 and June 19, 2013. The interviews lasted approximately 30 minutes each and explored the following topics: principal's background in education and experience with the IISME program; impacts they have observed in IISME teachers related to teaching, professional development, and career; impact on the teachers from the sponsor culture; broader impacts observed beyond the IISME fellow – for example, on the teacher's students, colleagues, departments, or school; impact on STEM teaching and learning; and other comments and suggestions. As interviews proceeded and the idea emerged for an IISME-like experience for principals, a question about this suggestion was included in the interviews (see Appendix C).

Results

All principals were very enthusiastic about the IISME fellowship program. No negatives were reported except one principal commented:

> *It's more of a selfish thing. If they're part of IISME, I can't use them for summer school! FS 133-134*

Otherwise, principals praised the IISME program highly and spoke glowingly about results they've observed in teachers. One principal said:

> *I've never heard a single negative thing coming out of that program at all… and I've talked to almost all these guys about what they did and what they experienced (EZ, 129-130)*

Results are presented in the following four sections:

A. Impacts on Curriculum, Instruction, and Student Experiences
B. Impact on Professional Development and Career
C. Impact of Sponsor Culture
D. Suggestions from Principals

A. IISME Impacts on Curriculum, Instruction, and Student Experiences

Principals were asked: *What effect(s), if any, has participation in IISME by teachers you have supervised influenced curriculum, instruction, and student experiences at your school?*

Impacts clustered in the following areas:

- Teaching
- Workplace Readiness/21st Century Skills
- Students
- Student Choices Related to STEM.

Impact on Teaching

Principals report that IISME fellowships enhance their teachers' teaching, making good teachers even better. They report that IISME fellowships shift teachers' view of their curriculum and teaching, inspiring them to change. Principals have observed that IISME teachers have changed both their content and delivery to make their teaching more relevant to the world of work their students will join and more engaging for a wider range of students. Principals report that the teachers incorporate examples from their IISME experience, are more likely to integrate current research into their instruction, and provide more information about the workplace and careers. They observe teachers doing more project-based learning, collaborative activities, and hands-on work. They often augment their use of technology. Some principals reported dramatic instructional shifts, such as switching to an online approach, for example, or a flipped classroom (lectures online before class, class time used for homework and teacher consultation). Overall, principals echoed the impacts on teaching that the teachers reported in their interviews and surveys. Representative comments include:

Career Awareness

… from their experiences in the private sector, from having the experience of IISME, they were able to really come back and look at their teaching and look at their role as educators in a more holistic way. Really get back to students when they're talking, about not only the content that they teach but also how that relates to their future career choices. XF 43-46

What I tend to see and find, because I came from out there, right, and when I come across teachers who have done nothing but been a teacher, their perspective is very narrow on just the curriculum. So what they miss is the life application piece. I think the value that IISME brings is the life application piece. Because not every student in the class, most, aren't going to leave to become teachers. So teaching them why science is relevant in industry or somewhere else or the careers that are available, I think that's the biggest impact because they now see how different industry works. EV 60-82

So oftentimes in high school there's this kind of bubble that we all inhabit. A bubble that is often devoid of reality in terms of the real world… [IISME] really kind of grounds [teachers'] practice in a much firmer sense of what's happening in the job market right now. PX 50-62

Stronger Curriculum

… [H]e's actually changed his curriculum quite a bit this year… We also are looking at possible new science standards in the fall that are going to be adopted, the common core standards. So he's kind of jumped into that. What he's taken from IISME; he's kind of revamped his whole curriculum with chemistry, to be honest with you. He's actually had Stanford University come out to look at a couple of his lessons. There's a cohort of three people that came to observe him one day, teaching. So he's actually stepped up to the plate quite a bit. FZ 88-95

Enhanced Instruction

[Students] are more engaged in class because the teacher themselves is more excited. But it's not something I can measure. It's not quantitative; it's qualitative. NR 142-143

I think it really has enriched their own curriculum and their instructional strategies. I think what they offer students is a much richer curriculum than it was previously… …So when I say richer, it's usually a great explanation, great detail, because they have the understanding and knowledge behind that to offer that to students. Anytime you DO rather than research or study, it becomes something that's in your repertoire so you're able to express that in a much clearer and a much deeper way to those in front of you. AL 111-118

> *Their classes are enriched because they have been exposed to the latest research. So for one concrete example would be X… where he brought back what he did over the summer into his physics classroom. So in one particular lab, where you're studying Newton's Laws for example. He can talk about some of his experiences that he had in the lab up at Stanford. So he's really excited about that experience and he can relate it to the particular Newton's Laws that they are studying in physics. NR 32-33, 71-80*

> *Why do you need to know this particular thing? Well because if you want to be an engineer here's how engineers use this. I'm thinking about all the things they do in some of those courses… like one of the projects they do, it's some kind of a sling-shot. Something to do with physics. And they get so many things to put together and they've got to use those to propel this object. Another one they do is where they have to build a ship out of materials and they have to race these things across the swimming pool. And it's all about, what was your thinking in terms of the way you built this thing, the way you designed it, the engineering? And it's much more hands on. So there's a lot of thought given to these kinds of projects and how we're going to use this time to move these kids in the right direction. (VA 246-255)*

> *So for M, what he's done, he took his own lessons and units in math and he's put them on the web. So what he does in the classroom is actually work with the kids on problem-based learning, and the kids then do all, actually the homework is being done in the classroom, but the lecture and everything is online for them to do the night before. So you almost reverse from a traditional classroom. But I don't think he would have taken those steps if he hadn't had the whole piece with IISME. He began to develop ways in which he could provide greater learning experiences for the students and I think a lot of that is based on that opportunity from IISME. Because it's just made, it's transcended even beyond what he learned from there to taking teaching even further. AL 36-45*

Impact on Integration of Workplace Readiness/21st Century Skills into the Classroom

By Workplace Readiness Skills we mean the skills that comprise the 21st Century Skills educational framework created by the national Partnership for 21st Century Skills to improve students' readiness for career and workplace. Such skills include:

- skills for working together – such as collaboration, communication (including public speaking and presentation), and project management;
- skills for learning – such as problem solving, critical thinking, innovation, creativity, research and data gathering; and
- technology skills.

As with interviews with teachers, principals commonly referenced IISME impacts on teachers' integration of workplace readiness skills into their teaching. Impacts include increasing student collaboration during instruction, more use of technology, and integration of critical thinking skills. Two other impacts that were mentioned are:

increased differentiated instruction and better understanding of how to teach critical thinking and problem-solving. Several examples are presented below, specifically on critical thinking, differentiated instruction, and multi-faceted integration of workplace readiness skills.

Skills for Working Together

> *K increased the number of group projects that he had. I don't know if it's a term that you're familiar with, but he used differentiated instruction--allowing students to choose between a number of projects or a number of jobs that they could do to learn a particular set of information. They both really stepped it up after their fellowships and had some new ideas. Maybe not that came from the specific job, but certainly it opened their thinking to different ways to have students collaborate with one another, to have them be able to make some choices within what they....how they choose to address different content areas. QD 143-149*

> *They [IISME teachers] also promote leadership. Every single one of these four teachers that I'm thinking of really promotes leadership to the students and really kind of run them like, they're like the supervisor… Like the robotics. The teacher that handles robotics has been a fellow for two years. He did it for two years, and the robotics team itself has grown. The four years that I've been here it's grown exponentially every year. But the kids take on leadership roles. The teacher is there, and I'm guess I'm thinking of it that it is perhaps by the teacher going into the private sector and working, he got to see the model. You know, here's how researchers work. There's a lead, the lead manager or whatever you want to call it, and there's the other engineers so to speak that are working on a problem or a solution, and that's how I see the robotics team… And the science teacher pretty much did the same thing. It's interesting. Because it's not the norm in an educational setting to work that way. XF 218-235*

Skills for Learning

> *The biggest one is critical thinking. When we teach kids how to think, there's a writing component to that, which is one of the focuses of our school. So after the IISME experience, because they've been out in the real world and have some real world applications, they come back and they were able to realize how important problem solving is. Because they were put back into a work environment where they themselves had to be problem solvers. Each one of them was assigned a task at the IISME project that required them to do critical thinking and problem solving. As you're practicing those skills--these are high quality teachers--so they already know how to teach those skills. But to actually have to practice them themselves, again it's like getting a blood transfusion. It was like, oh yeah, I've got to break this down a little bit more. Or, I've got to give kids a real problem that's worthwhile. Or maybe I broke it down too much for this project, and I didn't give them any room to be critical thinkers. So pose them with a problem that doesn't have all the solutions. NR 92-102*

... he's been developing curriculum that is meeting the whole student and having the student to apply their learning to practical applications, whether that it is using a variety of materials that might have been recycled for various projects but certainly neither in the physics in the engineering class. The thing that I really like about the way he works with students is that he lets them discover. Especially through trial and error. They're learning. He implements activities that require students to use critical thinking skills. Beyond teaching them how to solve labs or present projects, he also teaches them the HOW to present. Maybe they're using too many hand movements. So he teaches the professional part of their learning as well as the academic part. SN 32-46

M did this entire unit that was technology-based, and the kids--I mean the learning that was going on, was just tremendous.... [I]t was not lecture based--it was all hands on. For a math teacher that's significant. Usually they're just a very traditional kind of math hour here, and this was totally out of the realm of what most of the traditional math teachers, the way they teach here. Kids were getting, I can't remember exactly what the assignment was, but I know it was all based on what he'd learned from his IISME work. It was on the computer; it was computer based. They had to do some research. They had to respond to questions, mathematical questions, based on the research they did. And then they brought it back. But the beauty of it was from what he did with IISME…Now what he does in his classroom is the backwards lessons… I think it's the beauty of IISME, it allows, it almost gives permission for teachers to take the next steps, to use it as a stepping stone into improved and better teaching. AL 14-35

Technology Skills

Mr. P, the level of technology that he now brings to his work is a direct correlation to his participation in the program.... He's a trained classical artist and yet now he's one of the leaders in the use of technology in the classroom. But it goes well beyond that in terms of him knowing how to create collaborative groups amongst students, which now become these mini-production teams. This is all very much a part of what he does in the classroom as well as his colleague that he works with, that works mainly on video production and then he works on computer animation. The two of them really have that kind of twenty-first century view of education and how then that translates to what the kids will be doing in the future. So that's definitely a very intimate part of what they do. And I think he's been participating in this program for a few years now and he does see that. That this isn't kind of an educational trick, or an educational opportunity to get kids to do things. It's actually a skill that they have to master in order to be part of that twenty-first century economy. PX 145-157

I'll start with H. He teaches social studies, primarily world history. He in particular worked with--now I'm not going to be able to say the particular software program--but it was Microsoft, like a management system. It helped him understand the importance of how much we need to bring in online for our students, even at this age

> *level. So he was one of our big champions in having homework being pulled onto calendars and putting all teacher web pages up for students to be able to access, and having everything coordinated digitally, instead of having the students having paper planners themselves. So his experience in the workplace seeing everything is organized through networking was very helpful and seeing how we need to step it up to incorporate that into how we deal with students. QC 59-68*

> *He [I] came back and completely organized his course to be an online course. So he then used Moodle, which is a software program that manages not only teacher web pages but content and curriculum so his entire curriculum was then put online to where the students could log in and take their tests and it housed all of their homework and their work. So he was one of our pioneers in adopting Moodle, which now we have adopted for the entire campus… He is just a firecracker about technology now. He's one of our lead tech teachers on really pulling that together. QC 85-94*
>
> *… for the students, this is their language--technology is the way that they speak. It's the way that they write. It's how they communicate best, so to speak, whether or not we agree with it, it's their native tongue, so to speak. So the fact that we adopted their communication tool, they're very enthusiastic at this age to use that type of technology…IISEM helped [the IISME teachers] see the vision of why it needs to be done here, why it's important to have a student know how to organize an electronic calendar now and communicate with technology. That's how it's done in the workplace. QC 210-239*

Impact on Students

In discussing impacts on students, principals usually referred to increased student engagement and increased familiarity with STEM careers. One principal reported an increase in test scores from a major technology shift catalyzed by an IISME teacher. Another noted that students had more access to someone who would be willing to support students in activities if they wanted to go beyond the regular class. A third principal reported increased student confidence after the IISME teacher brought in other teachers to view their presentations, and Stanford students to work with them in their physics labs and presentations. One principal mentioned how students' nervousness about interning was reduced when the IISME teacher spoke about what IISME interning was like. Another reported that students in both class and an extracurricular STEM club had learned how to be a team lead and function as a project team. These impacts are detailed in the quotes below.

> *… when I went in and talked to the kids when N [the IISME teacher] invited me in when he was doing the activity that I did see. And he does repeat that every year. The kids were in their element. It was computer based. They were doing it with teams. They really thoroughly enjoyed it. And I think because it broke through the*

> *pattern they were so used to being in in a math class and it was a very positive experience for the kids. They really thoroughly enjoyed it. AL 239-244*

> *… he's helped them to make real world connections to what they're learning. For some students who were indecisive about what majors they wanted to pursue after they graduated, that was helpful. He was instrumental in helping them to narrow down their options, or at least their interests. His students perform very well on the AP exam, the AP physics exam that they take. They all score 3's or higher and there are many 5's. SN 142-146*

> *Through the organization of technology, we've moved to an entirely one-to-one program here … everything that the student has is located on the I-Pad…So to tie that in with what P learned in the software that he used [in IISME], it was critical for him to have that picture ahead of time… Our test scores went up significantly in the area of reading comprehension. QC 210-220*

> *[Students] may have liked a certain science skill or they wanted to investigate or research something, and [the IISME teacher] has allowed them to find a teacher that's willing to sponsor them or sponsor their club to go beyond the school day to do some of these things. (XF 215-218)*

> *… just building the confidence in students so that they're wanting to do more visual and impactful projects. He invites teachers to come and watch the students present their projects. He had never done that prior. And again, working with students from Stanford and bringing them into his classroom...So that connection with Stanford and students who pursued majors that our kids might--it's powerful. SN 64-70*

More Students Choosing STEM

Principals reported increases in AP classes, STEM classes, STEM college majors, and, to a lesser extent, increases in STEM extra-curriculars—all as a result of teachers' participation in IISME. One principal commented on the importance of the humanities in STEM, and thus of having humanities teachers participate in IISME; this comment echoes a similar comment made by at least one of the teachers interviewed as well:

> *This young woman, our student who won her $50,000 award in the International Science and Engineering Foundation competition, she referred to her English teacher. So I think it would be good to recognize the impact of the humanities and their inextricable link to STEM… It would be very good for a literature teacher to be in a math or in an industry kind of environment to be able to bring it in a practical application back to the classroom. BQ 195-214*

Other principal comments related to IISME fellows' impacts on STEM include:

> *… we have two new AP courses that are going to be starting this year, but was it related to IISME? I don't know. Could be. Because C [an IISME teacher] is part of this. It's an AP computer science class and an AP physics calculus-based class. And there was enough student interest to run both of those classes. NR 147-150*

> *As far as AP, we have more students wanting to take our AP computer classes, which is good. That's really trending quite a bit in the media about schools having that AP computer. I can just say, the more engaging a teacher can be, the more students are going to want to be in that class, so this [IISME] helps a lot. LJ 100-103*

> *QED: Is there any evidence that you can see of how IISME fellowships with your teachers might have affected STEM in your school?*
> *QC: Well certainly the technology aspect. …It used to be we even had tier pay for teachers, where based on how much they used technology, as to whether or not it affected their pay. So a teacher could be a Tier 1, 2 or 3 teacher. Three being the most at not only utilizing technology, but being a mentor to other teachers. It's interesting that both teachers stepped up to be Tier 3 teachers after their IISME fellowships. QC 240-252*

> *We have really strong math and science students who were interested in pursuing engineering as a major in college. But they never had a class here beyond calculus they could take that would impel them towards engineering. So by offering that class this year, it really impacted the students who had entry-level interest and really high level interest in pursuing engineering… I know that [the IISME teacher] had students down from Stanford who have assisted him in the classroom. And then informing kids of various professions or careers that they could pursue, or majors that they could pursue through math and science… This was something implemented more through the engineering class that I don't think he did previously. SN 47-60*

> *… More and more students, if you ask them, like we had graduation yesterday, what are you going into? Biology, biology, biology. I think that's on the uptick, [because of our teachers' participation in IISME]. LJ 99-100*

B. IISME Impact on Professional Development and Career

What effect(s), if any, has participation in IISME by teachers you have supervised influenced their professional development?

The impacts principals report center on three areas, summarized in the following sections:

- Impact on Teachers' Professional Development and Career
- Impact on Colleagues, Department, School, District, and Community
- Impact on the Teacher

Impact on Teachers' Professional Development and Career

The interviews asked principals about IISME fellowship impact in these professional development and career areas:

- professional commitment, enthusiasm
- self confidence
- commitment to positive student outcomes
- pursuit of leadership opportunities
- pursuit of other professional development opportunities

The most commonly cited impact of IISME fellowships on teachers' professional development and career was pursuit of leadership and other professional opportunities. Most principals could readily cite one or more leadership examples among their IISME teachers. IISME teachers have gone on to become department chairs, president of the teachers group at the school, dean of students, HR leader, district specialist, associate and vice principals, for example. In a couple cases, teachers undertook an IISME fellowship to help prepare for a promotion they were seeking. Other IISME teachers have pursued professional opportunities such as signing up for Common Core Standards training, joining the leadership group at school, and proposing ideas to the administration to improve professional development. These examples are in contrast to teacher survey responses, in which seeking leadership positions and new opportunities in education—including degrees and certifications—received relatively low ratings.

Did IISME create leaders or support them? Principal interviews provide evidence of both. In most cases, IISME fellows were probably already on a leadership track. Yet a few principals mentioned increased confidence and greater opportunity to work and talk with adults in their IISME fellowship as contributing factors to their teachers' willingness to pursue further opportunities.

> *IISME would be one of a number of experiences that she's had that have developed her leadership capacity. XH160-164*

> *She's now an associate principal. I think she had personal goals and drives. I think she used IISME as a vehicle to give her further insight, to make her a well-rounded individual. EV181-184*

> *He has taken on leadership with the administration and school and has offered some ideas for implementing more professional development time for us as a staff, as teachers… I think IISME probably had something to do with his level of confidence. … He hasn't always been really knocking at my door asking to sit on a leadership team at the school... He came to us and he brought ideas to us and he's participating on a leadership team that's meeting during the summer to implement some changes at school. So I think IISME had a lot to do with that. Just bringing out his confidence as a school leader. SN 120-132*

> *P, who participated a few years ago, her IISME experience she has applied to management. She is now my vice principal. So she has applied many of the group dynamics that she learned from her IISME experience to her new position as vice principal. NR 38-40*

Three principals reported increased commitment to positive student outcomes. One provided the following example:

> *There was one teacher that after her IISME fellowship time, she came back and said, "You know our kids can really do more with the science fair. She really did take on a leadership role and one of her students went to the national science fair this year and it really was directly having to do with coming back and seeing what was out there and saying, "You know, they can do this. XF 134-144*

Two principals mentioned that IISME fellowships can be helpful for teachers who are interested in exploring other career possibilities; it can help teachers gain an appreciation for the job they have. One principal said:

> *I know for one, it was quite interesting for them to go to IISME because the person thought, gee I wonder if I want to go out of education and go into business. It only reinforced that the person wanted to stay in education. XH 129-131*

Impact on Colleagues, Department, School, District, and Community
In the course of asking principals about the impact of IISME fellowships on their teachers' professional development and careers, extensive information emerged about impacts beyond the IISME teacher: impacts on colleagues, department, school, district, and community.

At the department level, several principals reported impacts such as: IISME teachers become better team players and better advocates for innovation and how things could be different. They interest others in IISME by sharing their IISME experiences and inviting teachers to see their students present during their IISME-related lessons. They improve the curriculum, making it more relevant to the workplace, or aligning it with standards such as the Common Core standards, or improving the consistency across teachers. One principal described the IISME impact as *"it opens the door to see careers that are there in the private industry. They're creative and talented teachers anyway, but it lets them expand more."* XF 67-68

At the school level, two principals reported impacts such as:

> *IISME teachers help us all have a better sense of the work world and help our school keep our teaching relevant. Those IISME teachers who serve as peer coaches help improve our professional development program at the school through the adult learning expertise they bring from that experience. NA 50-60*

At the district level, IISME teachers are expanding their impact by serving on curriculum committees and leadership teams, by serving as specialists to help advise other schools.

Two other impacts were mentioned: an impact on the principal himself, and an impact on the larger community. The one principal reported how his IISME teachers' experiences had stimulated his interest in how businesses run organizations, and he has been pursuing that interest actively now. It was during his interview that the suggestion for an IISM-like experience first emerged. The other principal described IISME's impact on the cycle within the community:

> *… We as a community, as a society, we're all responsible for the education, the quality education for our students. These students are then going to go out in that workforce and help make our communities better. So when teachers are supported by community business organizations or by organizations like IISME, it's such a great support for teachers. Because you're giving them fuel for their passion. Without that, they sometimes can become mediocre, when really the potential, if we provide them with the creative-ness and the learning needs that their adult teaching needs, we give back to the teaching profession. We inspire. We provide energy. So it's very important that companies continue to do this for teachers. And I would hope that they have benefitted from having our teachers there. NR 154-162*

<u>*Department impact*</u>

> *I think they are better team players in their departments because they have a different perspective. They have the life-long learner mentality. They are always trying to improve themselves and their craft. And those are who these four individuals are…And they become better advocates or voices in their department of how things could be different, how lessons could be different in their department for kids. So by the fact that they participate in IISME's program, it gives them better insight. EV 127-136*

> *All teachers, when they see someone else doing something, a lot of times they want to do similar activities. So it's always better peer to peer and so I think it has made an impact on their departments to some degree. I do know that our AP teacher has followed along the same lines with M in terms of doing the backward lesson planning. All of the AP chemistry now is online for the kids so that they go in and look at it. And then she spends the day technically working with them with the hands-on, with more lab work, because it frees her up to be able to do that. And so there are pieces like that. Other teachers are saying, oh, I can apply that to my own classroom. I think in that respect, that happened. I think that's happened with P and the chemistry department. She shared almost everything that she created from her internship at IISME and she does share that with her colleagues who teach chemistry. AL 62-71*

[F]our out of six teachers that are listed here are from the science department. Truly our science department is a premier, number one department at this school. They've taken on a lot of innovative, different curriculum paths for our students and done some very innovative things in the last four years especially, when it comes to science....like problem solving would be one of them. Or their method of inquiry or investigation....We went from offering an integrated science program to really focusing and offering biology and physics. They're a department that really has embraced the California Common State Standards… I've heard them talk about their experiences that they've had when they do the [IISME] fellowships and I think that it allows them...it opens the door to see careers that are there in the private industry. They're creative and talented teachers anyway, but it lets them expand more. XF 50-72)

What they bring back to their departments when we're doing department meetings, department planning times, you know their experience is so valuable it's unbelievable…The assessments are the same [across the department], the benchmarks are the same. G has had a huge impact on that, as a matter of fact, he's pretty much planned everything out for the whole department. FZ 110-122

School impact

… I also think [our teacher's experience with IISME] gives us all that much greater sense of where the world is going...When I talked to my computer science teacher and asked him how many of our AP computer science students could go into the workforce now, he said none, in regards to what they need to compete. It's still for the students this kind of this theoretical exercise, whereas when the teachers participate in these programs, whether it's Adobe or Stanford or wherever, they get this greater sense of how they can talk to students about what they need to do to be competitive…So I think it's really important that those fields are represented through IISME and this idea that kids understand that this is the future and it's rigorous and it's going to require a college education and if you don't do these things then chances are you're not going to be living in the San Francisco Bay area. PX 74-89

P is a social studies teacher. She was also the library media teacher so she worked with staff on developing their learning technologies. The technology in the classroom. I know that in addition to doing a regular IISME she was part of leadership group I think [peer coach]… She was developing Power Points on that and doing a lot of, you might call deep thinking about adult learning and the direct correlation between what she was doing in that capacity and what she was doing as the professional development facilitator here at school… Teachers tend to think a lot about the way kids learn. But adult learning is very different and it certainly stimulated quite a few discussions about adult learning… She was thinking about the mentoring she was doing with other teachers and then also obviously translating that to the professional development program at the school. XH 64-73, 114-116

District impact

> *Q is on the [district] curriculum team now. She represents [our school] at the district level. So she's looking to change some of the curriculum, in particular with our special ed students…T is trying to break down all the new science standards that we could present to all the other secondary sites in [our school district]. So I would say yes; they have expanded in more district roles than just staying here at [our school]. FZ 134-143*

> *He has taken on a leadership role with the district and he's here half-time now and the other half of his time is spent with the career technical education department for the district…He helps advise the different schools' best practices. I think that happened as a result of his work with IISME. He started to see the broader picture and how can we do what we're doing at [our school], specifically in his pathway, and how that then informs the work at other schools. PX 165-173*

> *He is significantly working with the physical science teachers …not only in our department but district-wide. They have their own professional leadership team and he's very active in both… He's always collaborated, but again, I think he brings more to the table [since IISME]. SN 134-139*

Impact on the Teacher

In the course of asking principals about the impact of IISME fellowships on their teachers' professional development and careers, considerable examples emerged about the effects on the teachers personally. As in the teacher interviews, principals reported that teachers were rejuvenated and inspired. Also they reported that IISME fellowships satisfy the craving for learning that good teachers have as lifelong learners. Several principals noted the positive impact of increased opportunities for adult collaboration and discussion. One principal commented on how it can be useful for the teacher to have a shift in role from being the "head honcho" to the "new kid on the block." Another principal felt that successfully experiencing an IISME fellowship helps teachers be more willing to take risks in their work and profession.

The responses of the principles were varied and more numerous than those of the teachers in this regard, but they all point to the richness of the impacts these IISME fellowships are having on teachers, personally as well as professionally.

> *The overall impact is that it breathes new air into a teacher. So they're excited. When they get to work outside of the teaching profession it always benefits the classroom because they come back knowing what real scientists do, or what real CEOs, or how companies manage. So it reinvigorates them. It inspires them. They come back with more energy and excitement. So that's the overall. NR 53-56*

The opportunity to interact with other adults in the course of the day, I think is another thing they found unique and exciting. It was part of that rejuvenation process. VA 79-89

If you're a high-quality teacher, you're a life-long learner. That means that you crave to be in situations where you are learning new things. You're open to it and you're willing to take it all in and then process and apply it in ways that are relevant for your classroom. So they're excited after their experience and they talk about it with other teachers. Then that gets other teachers to want to sign up for it. NR 136-140

I'm a believer that change comes out of a conversation. It doesn't come out of taking a university class and I think the fact that teachers have had an opportunity to engage in professional conversations in a business setting I think is a stimulating factor to their own personal growth and learning. XH 83-86

I think it's made him branch out more as an educator… I think he's trying to make more contacts outside of the educational realm to see what is needed for his students to be successful. FZ 45-47

K, again, he was the one who chose to take on physics C. None of the other teachers wanted to touch that one with a ten-foot pole because it's a college level course that is specific to areas of expertise and he was very comfortable doing that. So I would say, definitely, for all three of them, I think IISME was part of it; I can't say that IISME WAS the reason but I certainly believe their experiences as interns allowed them to feel more comfortable about taking those risks in their own teaching careers. AL 172-177

C. Impact of Sponsor Culture

A key finding from the teacher interviews and survey was that, beyond the specific work assignment the sponsor provides, the sponsor culture itself—how the sponsor collaborates, communicates, manages its projects, and uses its values and ethics to guide its practice –is having a substantial impact on many IISME teachers. QED asked principals whether the sponsor's culture had much impact on their IISME teachers. Several principals agreed; one principal said the sponsors' cultures had influenced him personally through his IISME teachers. For two principals, this question led to the suggestion for an IISME-like experience for principals (discussed in the next section).

QED: In your experience has that [sponsor's culture] had an impact on the teachers that you've seen?
VA: Oh yeah, I don't think there's any question… One of the things that I worked at very hard at [my school] was developing a culture that I thought more closely modeled what I thought big businesses were about. As an example, as long as I was there, we eliminated the D grade. So no students in any class there could earn a D

grade and get passing credit…Most of these companies are clearly searching for excellence, which is something we wrote on the side of the walls. We talked about that as a culture. That was part of why I was always excited about sending people out into the business world because I think that's a standard that they have to operate with too just to survive…I think this is one of the greatest things about IISME is it gives you a chance to send people out to some of the greatest companies in the world. Silicon Valley has got some models, and not just around the technology. Around a lot of things. Service, their willingness to compete, their demand for excellence. All those things, you send people out, they bring that attitude back to work with them. VA 138-162

QED: Would you say that the sponsor organization's culture itself had much impact on your teachers?
PX: I think definitely… I think what happens is that these things are done in isolation and so when they're happening at Stanford it's inspiring and it's great but then when you bring it back here it's hard then to say, wow, this is the future…I spent a couple of days this past week at [two internet companies. It was amazing. I would love for every teacher to go there and see what the work environment is like and the fact that it is one of those places, where they feed you…I know that's what IISME does with the teacher fellows, by putting them into these different companies and universities. If we could somehow bring that inspiration …back to the school... One way to do that would be to have more people participate in the program. Including principals. PX 183-202

D. IISME for Principals

Three principals independently raised the suggestion of an IISME for principals, who felt that the benefits to teachers could be realized by administrators as well. The pervasive effects of Sponsor Culture that have influenced teachers might be magnified if school managers—principals—had the opportunity to experience approaches to leadership and management in Silicon Valley companies. QED integrated a question into the protocol to ask principals their thoughts about the idea. Their responses are reflected below. About half of the principals who were asked thought that an IISME for principals was a good idea.

QED: If you had an IISME type of experience available to you as a principal, would that be something of interest to you?
FZ: Oh yes, absolutely. I think that would be very valuable actually for administrators. FZ 181-183

Because the administrator is about managing people and doing things professionally and considering the impact to the whole picture and not just your own classroom or your own school site… When you ask the question, is there a benefit, I think absolutely The parents are sending kids here, trusting us that their product--their

children—are going to turn out better than when they came here. So we're providing the service. That means our employees should be providing the best service in the classroom. So I think the mind-set for an administrator is how is your business providing the best service? And that would be an IISME topic workshop that would benefit an administrator. EV 95-113

Yeah, I remember thinking as a liberal arts teacher and then even as an administrator, wishing there was something along the lines [of IISME] for administrators, or for someone who wasn't in math and science. Because I think just getting out on the outside and doing something other than within the schools is just so helpful… I have lots of training on how to teach and what to teach and all of that but I have very limited training, even twenty years ago in my admin program about how to be a twenty-first century leader, or leadership skills... So on my wish list, in a perfect world, I have always thought what could IISME do for someone who wasn't in science and technology and math? NA 33-45

What does a manager in a large company--what do they do? How do they get a product from here to there in six months? Or how do they train people in their company to do the things they want to do? How do they run meetings? How do they get people to collaborate? Just spending time working with someone else perhaps on their team, just watching what they do… It doesn't necessarily have to relate to what you do day to day, but someone who is just a manager and has to get a team of people moving in a certain direction. HR 127-189

IV. Conclusions & Implications

As mentioned in the summary of Section II, Survey Findings, results are uniformly high regardless of teacher background, grade level and subject(s) they teach, proportion of students eligible for Free and Reduced Lunch, organization type, work type, subject area taught, and what teachers sought when they applied. Statistical differences observed mostly distinguish *moderate impacts* from *extensive impacts.* Impacts across a broad range of variables are *moderate* to *extensive*, which is a notable accomplishment for any program. Strongest impacts are in the areas of *Professional Development, Teaching,* and *Understanding and Integration of Workplace Culture*. Lesser impact is in the area of *Career* advancement. We now revisit the evaluation questions from Section I.

1. To what extent do IISME experiences support and/or promote teachers' awareness and integration of 21st Century or Workplace Readiness skills in the classroom?

Awareness and integration of workplace readiness was a strong finding throughout the study. Ratings were uniformly high on several items pertaining to this area. In addition, based on pre-survey interviews, QED included survey items that asked teachers to rate the extent to which facets of sponsors' culture influenced them back at their classrooms and schools. The fact that this happened so often, combined with the fact that we used a scale that topped out at *transformational*, indicates how powerful an impression these experiences made on teachers. IISME staff would have hoped that teachers' experiences would promote awareness and integration of workplace *skills* in classroom instruction, and teachers report this happens regularly. Beyond that, many teachers are trying to replicate the *culture* of the organizations in which they have worked. To the extent that they are successful, this would be the ultimate success in preparing students for the workforce they will enter after high school, or even before. Teachers' self-reports are reinforced by comments from school principals, many of whom could cite specific ways IISME fellows had altered instruction as well as culture in the classroom, department to better emulate how business is planned and managed in Silicon Valley businesses and academic settings.

2. To what extent does IISME support and promote teachers' professional development, especially in the areas of content knowledge, curriculum & instruction, and teaching methods?

Enhanced *Professional Development* as well as *Teaching Knowledge* are among the strongest impacts of the IISME experience. *Teaching Methods* were not rated as highly, yet interviews with teachers and principals, as well as open-ended survey items, suggest that improved teaching methods is a common outcome of IISME participation. Ratings for *Professional Development* were consistently high and in the area of *Overall Impacts* nearly 20% of teachers marked *transformational*. Ratings on all impacts rise significantly if what teachers are seeking from IISME aligns with their IISME placements, so teachers are certainly intentional when they apply for this program. Yet the data suggest that

even without making an extra effort to do so, most IISME placements meet the hopes and expectations teachers have for the experience. Alignment of teachers' content area to their summer placement also significantly increases the impact of the IISME experience. In this, IISME has been intentional and the data indicate that the effort to make these matches pays off.

3. How do IISME Fellowships affect teachers' career decision-making, including pursuit of advanced degrees and certifications, leadership positions, and or new opportunities in education? Do IISME fellowships influence teachers' decisions whether to remain in the classroom and in education?

Interviews with teachers and principals provide evidence that many IISME teachers do seek leadership positions, advanced degrees and certifications, and new opportunities within education. Yet survey ratings for these items were low relative to other impact items, with two of these falling closer to *not sure* than *agree*. Survey respondents did not seem to connect their IISME experiences to survey items that probed for these activities.

Sections of the survey replicated the 2001 IISME study in exploring whether IISME fellowships deplete education of teachers by exposing them to work environments that lure them away. In this, survey responses were unequivocal. Of 25 teachers who had left teaching 24 reported that IISME had no impact on their decision. One former teacher reported that his IISME experience did lead to his leaving teaching. Yet this experience was offset by over 30% of teachers who reported that IISME re-energized them and increased their commitment to teaching. Several teachers reported that the corporate environments in which they worked made them appreciate teaching even more. Evidence overwhelmingly shows that IISME does far more to promote and inspire teachers for teaching than it does to provide them a basis for leaving the profession.

In addition to addressing the evaluation questions that framed the study, some auxiliary findings emerged worth highlighting. First, the alignment of IISME fellowships with what teachers are seeking from the experience may be a promising matching characteristic. This finding is discussed above.

The emergence of the powerful effects of sponsor culture on IISME fellows was unexpected. Typically, calls to prepare students for the demands of the workplace focus on teaching skills of collaboration, communication, technology, etc. The moniker *21st Century Skills* encompasses the body of expertise that students need to succeed in today's workforce. Yet many teachers were persuaded that replicating workplace *culture* was a powerful and expansive means by which to integrate the demands as well as the skills they found they needed during their fellowships. Teachers in this study provided several examples of efforts they made to replicate sponsor culture in their classrooms. Can IISME support teachers in replicating sponsor culture in their schools? Partnering with willing teachers and sponsors might present exciting possibilities.

Principal interviews raised the idea of an IISME for principals—an idea that IISME staff have no doubt considered. Principals we interviewed were excited by the idea of learning innovative leadership and management strategies that they could import into school settings. Obviously this idea links tightly to replicating sponsor culture in IISME teachers' classrooms and schools. In order for teachers to successfully replicate sponsor culture, they need a willing and supportive principal. Were principals to have experiences in industry and academia similar to those of IISME fellows, the chances might increase that the profound changes reported in this study could manifest more quickly in more schools.

This concludes the second thorough evaluation of the IISME fellowship program. Both studies are based heavily on teachers' self-reports, although interviews with principals reinforce the enthusiasm and benefits reflected in teachers' comments and survey ratings. Were IISME to explore new directions on the effects of its program, fruitful inquiry might focus on the extent to which ETP's—or more important, concepts underlying those ETP's—are carried into daily classroom instruction. To what extent are students internalizing the lessons that IISME teachers have learned? Teachers report that students are doing project-based work more often, collaborating more, and relying on technology more. What does this look like in classrooms? Are students learning more? Are they learning more about collaboration, inquiry skills, and technology? Are these skills assessed? Do they need to be? These are higher order issues, yet they do align with the IISME mission. With the program model being implemented so successfully year after year, some energy and resources might be made available to explore these dimensions of IISME impacts.