Bringing Technology Professional Development to Scale:

Lessons learned from Intel Teach to the Future

by

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Abstract

This paper presents findings from a three year evaluation of Intel Teach to the Future, a large-scale technology professional development program. In describing the impact that this program has had on the teachers, schools and districts it reached, we use a conceptual framework developed by Coburn (2003) for examining the outcomes of large scale school reform efforts across four dimensions: depth, spread, sustainability and shift in ownership. We argue that Intel Teach to the Future was largely successful in achieving positive outcomes across these four dimensions of scale, in part because local adaptation and teacher creation of instructional materials were key design elements of the program, and in part because the scaling model focused on creating large cohorts of trained teachers within schools and developing district leaders to support technology integration.

Introduction

K-12 teachers' need for effective professional development related to educational technology has been stressed for decades, and the need to deliver high-quality training in this domain to large numbers of teachers continues to be urgent (CEO Forum on Education and Technology, 1999; Dickard, 2003; National Commission on Mathematics and Science Teaching for the 21st Century, 2000; Office of Technology Assessment, 1988; U.S. Department of Education, 2000a; Web-based Education Commission, 2000). No longer are isolated incidences of exemplary technology use by those Rogers (1995) calls the "early adopters" enough to satisfy policy-makers and the public (ESEA, 2001; Fishman & Peek-Brown, 2003). Districts, states and the Federal government are all now requiring that educators meet technology standards in order to ensure that their students acquire the 21st century skills they will need to function in an increasingly sophisticated, global, knowledge-based civilization (Partnership for 21st Century Skills, 2003, SRI, 2002; U.S. Department of Education, 2002). The establishment of these teaching standards and requirements by policy-makers sends a clear message to the education community that technology use can no longer be perceived as an add-on for special projects, but rather must become part of the fabric of schooling.

What these burgeoning technology standards do not articulate, however, is the mechanisms that might most effectively deliver needed training to large numbers of teachers. There are approximately three million K-12 public school teachers in the United States (U.S. Department of Education, 2002), and the most recent survey data available (U.S. Department of Education, 2000b) demonstrates that only 33% of them consider themselves to be "well prepared" or "very well prepared" to integrate technology into their teaching. Although this proportion has likely increased since this survey was conducted in 1999, an enormous population of teachers is still in need of opportunities to learn how to use technology effectively to support their students' learning. In addition, the rapid pace of technological change means that even those educators who felt "well prepared" in the survey described above require continued staff development in order to remain so. Therefore, broad, ongoing access to high quality training is necessary if teachers are to become skilled adopters of educational technology, capable not only of using hardware and software, but of making good pedagogical decisions about how and when to use these resources with their students. While consensus has been reached regarding the characteristics of high quality professional development for teachers (Corcoran, 1995, 1997; NSDC, 2001; U.S. Department of

Education, 1995), much less is known about whether and how promising practices and programs can be brought to scale in order to meet the existing need.

The difficulty of effectively bringing educational initiatives to scale is well-documented (Bodilly, 1998; Cuban, 1990; Elmore, 1996; Stringfield & Datnow, 1998) and holds true for professional development programs as well as other initiatives such as whole-school reform models (Coburn, 2003) and innovative curricula (Blumenfeld, Fishman, Krajcik, Marx, & Soloway, 2000). The characteristics of small-scale programs that are often central to their local success, such as relevance to local needs and priorities, often become attenuated or eliminated when an initiative is brought to scale (Culp, Honey, & Spielvogel, 2003). More specifically, research on small-scale educational technology integration and technology training initiatives (such as single-school or single-district programs) suggests these programs are vulnerable to losing their impact when introduced on a larger scale because the "conditions for success" of these initiatives (such as strong administrative leadership, adequate technical support and reliable access to resources) is often dependent on local contextual factors difficult to generalize as part of scaling up (Culp, Hawkins & Honey, 1999; Zhao, Pugh, Shelden & Byers, 2002). Collectively, this literature suggests that simply achieving scale (delivering training to large numbers of teachers) is difficult and insufficient, and that achieving intended outcomes (such as changing teacher practice) at a large scale is even more difficult.

Recent work by educational researchers and researchers studying the related field of non-profit management has begun to address the challenges of achieving scale for innovative programs (Coburn, 2003; Dees, Anderson, & Wei-Skillern, 2003; Sabelli & Dede, 2001). These researchers are articulating frameworks that can be used to support systematic description and analysis of the processes and potential outcomes associated with scaling educational programs in general.

Dees, Anderson & Wei-Skillern (2002) suggest that both scaling program delivery and achieving desired program outcomes depend in large part on program developers consciously reviewing their options regarding both *what* elements of a program are going to be brought to scale and *how* program scale is achieved. Dees et al. argue that by making careful choices about what and how to scale, program managers can create and deliver experiences that reach large numbers of people, maintain core program characteristics, and are locally relevant and useful.

This framework is relevant to the program theory of Intel Teach to the Future, an ambitious professional development program that began with two goals: to reach 100,000 teachers in the U.S. in three years, and to improve the quality of technology integration in U.S. K-12 schools.[1] This program is an important case of how deliberate choices regarding *how* to scale an educational technology professional development program can interact with choices about *what* content to deliver via the program to produce a range of positive and potentially long-lasting outcomes at the level of the individual teacher participant, the school and the district.

Since early 2000, the [evaluation team] has been conducting an evaluation of Intel Teach to the Future in the United States. This paper draws on that research to reflect on the lessons we have learned from the program. We examine how the interaction of two

[1] Intel Teach to the Future reached a million teachers worldwide as of June, 2003. The program had equally important, parallel goal statements concerning its international implementation (which reaches thirty countries including the U.S.). However, this paper considers issues of scale only within the confines of this U.S. program. The findings presented here are derived from evaluations of the United States implementation of the program. These evaluations have been conducted for the past three years by the authors. To access full reports on the evaluation, please visit our web site at [omitted for peer review].

critical elements—the implementation model (the "how" of scaling") and the curricular content (the "what" of scaling)—have affected both the extent and the character of the program's impact. Our review of the evaluation is organized using a conceptual framework developed by Coburn (2003), which defines scalability not as the number of participants or sites reached, but as the quality, extensiveness and sustainability of program impact on the participants and sites. We argue that the developers of Intel Teach to the Future were in many ways successful in bringing their program to scale as conceptualized by Coburn for two key reasons: a. they designed into the training curriculum opportunities for teachers to create locally relevant materials, and b. they focused their scaling strategies on training high concentrations of teachers within schools and districts and developing district capacity to support educational technology integration. In articulating this argument, we hope to contribute a new perspective on the relationships between content and implementation, and between scale and sustainability, that will inform the efforts of others seeking to preserve the value of their programs while disseminating them to ever-larger audiences of practitioners.

About Intel Teach to the Future

Intel Teach to the Future was conceived as a large-scale program from the beginning. It sought to reach teachers at every grade level, in every subject area, and in districts ranging from the smallest rural schoolhouse to the largest urban communities. The program was designed to achieve its goals through a highly structured train-the-trainer dissemination model that involved rigorous accountability measures and specific numerical targets.

In a presentation about the program (Hawkins, 2003), the director of Intel's

Innovation in Education initiatives articulated five factors that she believed were essential to bringing this program to scale. These included:

- Maintaining a long-term *focus* on clearly defined goals;
- *Building alliances* with the educational, non-profit and corporate entities that could help to create and deliver a large scale program;
- Establishing *effective leadership networks* in the regions and districts where the program was implemented;
- Maintaining a willingness to *adapt to local circumstances*;
- Recognizing that the *timing* was right for a program that could meet the need among teachers for training in how to use technology to support instruction.

These factors capture the rationales behind the programmatic decisions of *how* to scale the program (a highly structured train-the-trainer model with extensive administrative support and well-defined incentives and quality control). The *what* or the content of the program is a curriculum that helps teachers understand how to support students' learning of core content by using commonly available software (Microsoft PowerPoint and Publisher, the Internet) in the context of project-based teaching and learning. The training addresses many of the most common challenges teachers face when beginning to use computers with students, including classroom management, supporting effective student research on the Internet, and understanding intellectual property issues. The training also provides teachers with time and resources to support the creation of curricular materials aligned to standards. The central activity of the training is the creation of a unit plan, including student work samples, support materials, and an implementation plan. Teachers are encouraged to select a unit that they already use in their teaching that might be enhanced with an infusion of technology. By designating a large amount of time in the workshops for the creation of instructionally relevant materials, the curriculum enables teachers to walk away from the training with a usable product. (For more information about Intel Teach to the Future, see www.intel.com/education/teach.)

Origins of the program. The program has its roots in an earlier professional development effort, Intel ACE (Applying Computers in Education). Between 1998 and 2000, Intel ACE trained 4,200 K-12 teachers, with a goal of giving teachers the skills, experience and materials they needed to integrate technology into the classroom. The program trained ten professional development providers (called Master Teachers), in each of eight participating geographic areas (Arizona, Massachusetts, New Mexico, Northern California, Oregon, Texas, Washington, and Washington, DC).

Building upon the Intel ACE experience, Intel Teach to the Future was designed to maintain the core goal of preparing teachers to use technology with their students while also involving larger numbers and greater geographic concentrations of teachers in the program. To achieve the desired scale, program managers created an implementation model that included an extensively piloted curriculum, a train-the-trainer dissemination model, and a highly structured process of delivery and administration, in which tiered networks of regional and local coordinators administered the program in accordance with Intel's guidelines for recruitment of participants, distribution of incentives, and certification of program completion. , The train-the-trainer model involved senior trainers training Master Teachers from local districts or consortia of districts, who were then expected to train three groups of twenty teachers each over the next three years.

Incentives (stipends and laptops) were provided to Master Teachers who met their numerical goals for training. All program participants were given copies of Microsoft Office and curriculum binders, and districts were given opportunities to purchase discounted computers for those teachers who participated in the program.

Below, we describe in greater detail how Hawkins' scaling criteria are reflected in the program design.

Sustained focus on clear goals. Intel's education staff had a clear set of goals and expectations for this program and they did not change over time. Specifically, they committed themselves to reaching target numbers for teacher participation (achieving scale), and to delivering a specific curriculum to all teachers participating in the program (providing consistent content). Adherence to these core program goals made it possible to replicate the program across diverse contexts without losing the core components that the program staff felt distinguished Intel Teach to the Future from other technology professional development programs. These included the train-the-trainer dissemination structure, the delivery of the entire forty-hour curriculum to groups of approximately twenty teachers at a time, and the consistent emphasis in the training itself on modeling technology use to support project-based classroom instruction.

Building alliances with educational, non-profit and corporate entities. Program staff at Intel established close, long-term relationships with other organizations that supported a range of program elements. These organizations included: the Institute for Computer Technology (ICT: www.ict.org), which developed the curriculum in 2000 in collaboration with Intel staff, and hired and trained the senior trainers; Microsoft, which donated the software for program participants; and Education Development

Center/Center for Children and Technology, which conducted the evaluation of the program.

Establishing effective leadership networks. Intel Teach to the Future was piloted in 2000 in five regions (Arizona, northern California, northern and southern Texas, and Oregon), and then scaled in 2001 to fourteen other states (a non-incentive version of the program is now available to school districts nationwide). Intel established administrative networks in each of these regions, by creating Regional Training Agencies, housed in universities and non-profit educational organizations, which were responsible for recruiting and supporting participating districts. Regional Training Agencies, in turn, supported the train-the-trainer dissemination model at the heart of the program.

Adapting to local circumstances. Without compromising the larger program focus, the Intel team identified areas of flexibility that local administrators could modify in order to meet the specific needs of their communities. These included choosing whether or not to take advantage of discounted computer purchasing programs offered by Intel; choosing the number of Master Teachers the district wanted to have trained and selecting the Master Teachers; and choosing to form consortia with other local districts, rather than participating in the program alone (which made participation viable for very small districts that could not support the scale of training required by the program model).

Adaptability was also built into the Intel Teach to the Future curriculum itself. The unit planning process at the heart of the training was guided by the teachers' own selection of what topics to emphasize and what questions to ask. Making room within the program for teachers to address their immediate needs and the districts' curricular objectives ensured that the program would remain locally relevant despite highly structured and largely external administrative requirements.

Recognizing the importance of timing and the presence of the need. Intel Teach to the Future began in 2000, when teachers all over the country had become familiar with many technology tools, but few had yet thought carefully about whether and how they might integrate those tools into their students' work. Intel Teach to the Future is not, as many educational technology programs are, focused on the most cutting edge technologies. Rather, this program sought to help teachers take familiar software applications and think through how to bring these tools into their students' everyday learning activities.

Intel Teach to the Future was designed to address a critical need, lack of professional development in technology. By the late 1990's, school districts across the country were making significant investments in technology. However, in many cases, the technology infrastructure had outpaced teachers' technical skills. Intel created the Intel Teach to the Future program as a response to the professional development gap.

Relating scaling strategies and program outcomes

This description of the structural and administrative characteristics of this program is consistent with what Dees et al. (2002) calls an *affiliation* approach to choosing how to bring a program to scale. He distinguishes "affiliation" from "dissemination," simply making materials available to a broader audience, and from "branching," establishing new, freestanding organizations that replicate all the characteristics of the original. The affiliation approach strikes a balance between monitoring and documenting how program replication occurs, while also condoning and to a limited extent supporting local adaptation of the program to meet local needs.

From our perspective as program evaluators, what was most important to learn about the scale of this program was whether and how it was influencing processes that we knew to be central to successful professional development: creating sustained shifts in teacher practice and/or in the nature of the learning environment, establishing clear links between the program and teachers' immediate classroom-level needs and interests, and creating resources that facilitate sustained follow-up and collegial interaction around core program ideas. This paper presents relevant data from our evaluation that describe what we learned about how specific elements of both the "what" and the "how" of this program interacted to facilitate these kinds of processes. First we will review the relevant literature on the relationship between programmatic scale and capacity to support the local processes that are essential to producing meaningful project outcomes.

Theoretical framework

Reaching teachers, schools or districts on a large scale is often a central goal of educational programs. However, the difficulty of achieving substantive educational outcomes through a single uniform intervention spread across large numbers of schools or classrooms is familiar to program developers, funders, and educators in general (Bodilly, 1998; Coburn, 2003; Cuban, 1990, Elmore, 1996; Stringfield & Datnow, 1998). Coburn (2003) argues that in much of the literature, the concept of scale is understood mainly as a process of delivering a specific experience or resource to large numbers of people, without consideration of the multiple associated conditions that need to be taken into account in order for the intervention to be considered successfully brought to scale. Coburn presents a framework for examining the outcomes of efforts to bring school reform programs to scale across four dimensions—depth, sustainability, spread and ownership. She then suggests how her approach to conceptualizing scale has implications for reform strategies. Coburn's dimensions expand the definition of scale from one based primarily on numbers to one that considers how an educational initiative can interact with the local conditions that make positive and sustained programmatic impact possible.

Coburn's framework focuses on whole-school reform programs, but provides a valuable lens for analyzing the ability of any program aimed at enhancing teaching and learning to create impact on a large scale. In the following paragraphs, we describe Coburn's dimensions for assessing the relative success of efforts to scale education programs, and examine each one more specifically in relation to relevant literature on professional development for K-12 teachers in general, and technology-focused professional development in particular.

Scale with depth

This dimension of Coburn's framework focuses on the quality of what occurs at the classroom level as a result of a programmatic intervention. Coburn (2003) argues that, for a school reform effort to be meaningfully brought to scale, it must instigate "change that goes beyond surface structures or procedures (such as changes in materials, classroom organization, or the addition of specific activities) to alter teachers' beliefs, norms of social interaction, and pedagogical principles as enacted in the curriculum" (p. 4). This is consistent with the findings of other researchers who have studied scaling efforts and have found that, although these efforts frequently succeed in altering structural and procedural aspects of school culture (such as organizational, administrative and decision-making practices), where they most often fail is at the level of teachers' instructional practice (Cohen & Hill, 2001; Cuban, 1990; Elmore, 1995; Tyack & Cuban, 1995). A reform effort that scales with any meaningful depth, then, is one that has an impact on how teachers work with students.

The literature on professional development offers a number of insights into what programmatic features are most likely to lead to depth of scale. Some researchers (Lieberman, 1995; Little, 1993; Olsen & Kirstman, 2002) have indicated that effective professional development (that which does have an impact on teacher practice) is structured to help participants forge connections between new ideas and their existing practices. Others have shown that professional development is most effective when teachers choose to participate rather than being required to do so (Elmore, Peterson & McCarthy, 1996). Researchers have also found that, for professional development to be translated into practice, teachers must have the opportunity to make sense of the ideas upon which educational initiatives are based, to apply them to their local context, and to consider how those ideas are reflected in the actual work of students (Carrigg, Honey & Thorpe, 2003; Cohen & Hill, 2001).

However, understanding the relevance of program ideas to teaching needs does not necessarily lead to the actual implementation of those ideas, and implementation is an essential first step on the path to changes in practice. Similarly, the processes of locally-driven sense-making and bridge-building described above are not easily packaged for delivery to large numbers of teachers. Perhaps for these reasons, some researchers have found that professional development mandated as part of prescriptive, externally-developed educational programs is more likely to achieve broad classroom-level implementation than similar programs that rely on local professional development

(Bodilly, 1996; Desimone, 2002; Smith, Maxwell, Lowther, Hacker, Bol, & Nunnery, 1997).

The success of such prescriptive professional development may be due in part to the fact that these programs are often initiated from the top down by school and district decision-makers and may be non-negotiable. Achieving broad classroom-level implementation may also occur because these programs generally include materials that can be readily used in classrooms and do not require teachers to invest the time and effort it takes to produce locally developed materials (Nunnery, 1998). Teachers are told quite specifically what they should change about what they are doing, and are presented with the tools and techniques that they are expected to use in their classrooms. This research suggests that prescriptive programs may achieve a high degree of classroom-level implementation among their participants because they are fundamentally doable. However, although impact can not be achieved without some form of implementation of program materials or strategies by teachers, it does not necessarily follow that the kind of classroom implementation associated with prescriptive programs leads real changes in teachers' underlying pedagogical beliefs, the kind of change that Coburn suggests are essential if a program is going to achieve scale with any depth.

Although these different types of research findings appear on the surface to be contradictory, both sets of studies point to the significance of an element of the teaching context that professional development programs need to take into account, namely, that teaching is a challenging, time-consuming profession, with many demands and requirements. All of this research suggests, implicitly or explicitly, that—although locally-driven processes and the assimilation of new practices into existing environments may be central to achieving real change in teacher practice—teachers cannot be expected to develop new curricula and assessments if they do not have time and resources to turn ideas into usable teaching materials.

Teacher practice is deeply affected only when teachers can see how to translate the concepts of a program into tangible products, activities and lessons within the given physical, economic and social strictures of their working environment. However, this does not mean that teaching materials and methods need to be delivered whole and intact to teachers in order for them to be usable. In fact, materials and methods that are not made relevant and meaningful to teachers may be easily discarded when the next initiative is introduced (Tyack & Cuban, 1995). Teacher practice is a function both of teachers' own beliefs and interests and of what they can actually do in the classroom (Olsen & Kirstman, 2002). For programs to attain any degree of depth, they must not only appeal to teachers' intellects, but also help them develop and work with concrete resources that enable them to see how the program principles can be enacted.

Scale with sustainability

The second dimension of Coburn's framework for expanding our definition of program "scale" is sustainability. According to Coburn, only if a reform effort can be sustained at the sites in which it is implemented can it be considered "brought to scale" in any useful way. Sustainability, in turn, requires commitment to the goals of a given program from a variety of actors within an educational community. This requires appropriate mechanisms at multiple levels of the system. As Coburn notes, externally-developed programs are particularly difficult to sustain because there may be limited commitment to the program on the part of schools and districts, and because the program developers may only have fleeting involvement with any particular site. For this reason, she argues that it is essential for external program developers to recognize the importance of local adaptation and enlistment of local educational leaders in program implementation, and to address this challenge in their design for scale.

Researchers have documented a range of strategies that have been used to encourage local investment in professional development programs as they are being brought to scale. For example, a program that targets its recruitment at the district level can invite knowledgeable district leaders to make locally-appropriate programming decisions and adaptations to the initial program model. Such an approach is likely to establish stronger and more lasting support structures than when programs target individual schools for recruitment (Berends, Bodilly, & Kirby, 2002). In addition, an implementation design that focuses on developing expertise in the program content within districts, rather than one in which expertise remains external to the district, leads to more sustainable impact (this notion is developed more fully in the Shift in Ownership section below). Finally, an implementation process that creates communities of program participants within individual schools can cultivate the supportive networks that make sustainable change possible (McLaughlin & Mitra, 2001).

Some research suggests that buy-in, leadership, and programmatic adaptation by local educational leaders is necessary to ensure sustained impact for technology-oriented professional development programs. Research on technology-related educational initiatives has found that such efforts must be driven by local concerns and be responsive to local conditions to be effective (Culp, Hawkins, & Honey, 1999; Hawkins, Panush, & Spielvogel, 1997, Zhao et al. 2002). Similarly, others have shown that for technology professional development to have a sustained impact on teaching and learning, it needs to be coupled with in-school, peer-driven follow-up and support; adequate technology infrastructure; and administrative support at the local and district levels (Becker & Riel, 2000; Howard, McGee, Schwartz, & Purcell, 2000; McCannon & Crews, 2000; Norton & Gonzales, 1998).

These ingredients are necessary because teachers seeking to integrate technology in their classrooms generally require a support system that extends beyond the individual classroom, in the form of knowledgeable colleagues, technical support, and opportunities to select and invest in novel materials and resources. A sustainable technology-focused professional development program cannot rely primarily on what Elmore (1996) describes as the "intrinsic commitment" of teachers wishing to engage in innovative teaching practice. Therefore, a sustainable, large-scale technology training program needs to incorporate in its implementation design elements that can lead to the establishment of these support structures.

Scale with spread

Coburn (2003) defines the *spread* of a reform not just as the number of classrooms and schools reached by the courses, structures or materials associated with a reform model, but as the spread of reform principles and norms within classrooms, schools and districts. Spread in Coburn's view could, for example, be indicated by the creation of policies and practices that are aligned to the reform goals, thereby serving to institutionalize those goals. This sort of action would contribute to creating a normative structure that supports teachers in their efforts to integrate reform principles into their classroom teaching.

Spread is central to scale because it enables a program to be absorbed into the communities it is intended to affect. This is as true for professional development as it is for whole-school reform models. As Elmore (1996) observes, "Teaching practice is unlikely to change as a result of exposure to training unless that training also brings with it some kind of external normative structure, a network of social relationships that personalize that structure, and supports interaction around problems of practice" (p.21). The conditions under which many teachers work, in particular the incentive and accountability structures that shape their school cultures, often do not encourage teachers to engage in the kinds of innovative practices that are generally at the heart of high-quality professional development (Elmore, 1996). More specifically, the environment in which teachers work profoundly affects their willingness and ability to respond to professional development (Olsen & Kirstman, 2002).

As with sustainability, programmatic spread may be particularly relevant to scaling up technology-related professional development, because teaching with technology is still often seen as an innovative practice that challenges many dimensions of “normal” school and classroom functioning. For example, schools and districts that have not created acceptable use policies for students using the Internet, or that have no long-term plan for hardware investment and distribution, are not likely to be favorable environments for teachers seeking to use technology extensively with their students. In contrast, a district that has adopted clear policies and has long-term plans in place and has aligned administrative matters with the content and goals of their professional development offerings, is much more likely to be accommodating or even encouraging of teachers’ efforts at technology innovation. Consequently, professional development programs seeking to move to scale need to encourage administrators to align professional development goals, administrative policies and procedures, and goals for student achievement.

A technology professional development program that has successfully spread would not only have trained many teachers, but would extend into many facets of teachers’ professional lives. On the classroom level this would mean that teachers would integrate technology into a variety of classroom activities, pursue additional technology professional development opportunities, and feel comfortable utilizing technical resources to enrich their pedagogy. A technology training initiative that has spread among teachers in a school would also influence the kinds of conversations teachers have with their peers, the collaborative projects they engage in and the advice and support they offer each other.

Scale and shifting program ownership

In Coburn's (2003) framework, a shift in reform ownership occurs when "it is no longer an 'external' reform, controlled by the reformer, but rather becomes an 'internal' reform with authority for the reform held by districts, schools, and teachers who have the capacity to sustain, spread, and deepen reform principles themselves" (p. 7). She draws a key distinction between the notion of "buy-in" and an actual shift in ownership. Buy-in implies that participants accept the reform ideas (Datnow & Castellano, 2000) and can facilitate the kind of programmatic spread described above. A shift in ownership means that the participants begin to see themselves as holding responsibility over the reform process and embrace the reform principles and norms as their own (Stokes, 1997).

In the case of a technology professional development program, a shift in ownership of program ideas and principles can take place on multiple levels. At the teacher level, ownership would entail teacher participants internalizing the ideas of the professional development program and thinking of new ways to apply the ideas to their practice. In order for this to occur, teachers would need the opportunity not only to learn about new materials and resources, but also to experiment with these resources, see how they can be adapted to meet their teaching needs and create their own unique products that they can implement in their classrooms (Baker, Gearhart & Herman, 1994; U.S. Department of Education, 2002). By having materials they develop and use, the skills and knowledge introduced in the training are no longer only the property of the staff developers, but become part of a teacher's internal pedagogical repertoire. In addition, as teachers try to implement the projects they have created, they begin to understand the real challenges of technology integration, can identify the kinds of support they need, and can make specific requests for support and resources based on their own experience (Becker, Ravitz & Wong, 1999). On the school and district level, a shift in ownership requires that both the knowledge of the program content and the authority to make decisions about program process remain in the school or district after formal participation in the program has ended (McLaughlin & Mitra, 2001).

Programs seeking to move to scale could encourage such processes in a number of ways. For example, although dispatching a cadre of external staff developers to districts participating in a program (a common strategy for large-scale programs) may appear on the surface to be an efficient way to ensure that the program will be delivered intact to large numbers of participants, building professional development capacity within schools and districts creates a system by which the knowledge can remain with those who are in the best position to ensure that the program principles are translated into practice. A program cannot expect a shift in ownership to take place simply because participants agree with the program goals. Rather, for this shift to occur a program must contain explicit mechanisms for handing off the baton of ownership by having development and creation of local leaders as an integral part of implementation (Coburn, 2003).

Implications of Coburn's framework for evaluation

The dimensions that Coburn articulates present a challenge to evaluators examining large-scale programs. They require evaluators to attend to numerous aspects of school culture and classroom practice in order to understand not only whether and how a program is delivered to large numbers of educators, but also whether and how it actually becomes integrated into the educational environment. Delivery, no matter how extensive, is only the first step along the path of achieving meaningful programmatic scale. Without at least some degree of depth, sustainability, spread and shift in ownership, any educational initiative is at risk of losing momentum and opportunities for real impact on education (Tyack & Cuban, 1995).

Program developers seeking to move to scale must make specific choices about how to design their programs, what program content to convey, what delivery mechanisms to use, and what type of partnership between program developers and recipients to foster (Dees et al., 2002). These choices may or may not allow a program to scale along the dimensions described by Coburn (2003). Only through a combination of the strategic thinking and the attention to the complexity of local circumstances can developers expect to deliver resources that engage large numbers of teachers and have substantive impact on instructional practice.

Examined through the lens of Coburn's framework, this paper argues that Intel Teach to the Future is an important case study illustrating a largely effective instantiation of Dees, Anderson and Wei-Skillern's (2002) ideas about designing scalable programs. Hawkins' (2003) description of the key elements that enabled Intel Teach to the Future to scale (maintaining focus, building alliances, establishing effective leadership networks, adapting to local circumstance and timing) can be viewed as a set of choices that respond in some detail to Coburn's framework. For example, Hawkins (2003) indicates that she and her colleagues conceptualized their program as a process of forming relationships rather than delivering services, a stance that allowed for a significant amount of transfer of decision-making to the local level. Intel Teach to the Future developers were mindful that an externally-driven teacher training initiative has to forge connections with the teachers, schools and districts it serves, and that program content has to be made relevant to participants, if the program goals are going to be sustained after the initial implementation phase has ended. The program developers created a highly focused implementation model that contains mechanisms for local adaptability, local leadership development, and local creation of materials. The research discussed above suggests that this "structured on the outside, flexible on the inside" approach to program design has allowed Intel Teach to the Future to achieve a level of scale that goes beyond sheer numbers of participants reached to deeply affect how teachers, schools and districts think about and use technology to enrich teaching and learning.

In the remainder of this paper, we review key evaluation findings in relation to the program's delivery model and consider how they address the high standards for successful scale-up set forth by Coburn (2003).

Methods

The Education Development Center's evaluation of the U.S. implementation of Intel Teach to the Future was conducted over three years and has drawn on a range of methods to investigate general response to the program, the local complexities of program implementation, and impact in individual districts, schools and classrooms.

Methods employed have included:

- An application form: located on the Intel Teach to the Future website. Through an agreement with Intel, which manages the application process for the program, the evaluation team is able to collect information on teachers' sex, racial/ethnic background, years of teaching experience, subject area, and grade levels taught.
- End of Training surveys: conducted with teachers completing this professional development program. This instrument collected information on satisfaction with

the training and perceptions of training goals. As of December 2003, this survey had been completed by 1,702 Master Teachers (response rate of 78%) and 49,329 Participant Teachers (response rate of 60%). Chi-square tests were conducted on all categorical data and ANOVA analyses were conducted on continuous data. All reported findings are statistically significant, with a p value of < .05.

- End of School Year survey: conducted annually with teachers completing this professional development program. This web-based instrument is a wide-ranging survey collecting data on topics including teachers' use of technology, their use of the materials they created during their training, and their instructional practices. Each spring, the entire pool of teachers who had participated in the program were sent emails asking them to respond to the survey. In 2001, 1,906 Master and Participant Teachers responded (response rate of 25%); in 2002, 4,720 Master and Participant Teachers responded (response rate of 22%) and in 2003 the survey was completed by 4,223 Master and Participant Teachers (response rate of 12%). Response rates are calculated based on the number of emails sent minus the number of emails that were no longer valid. Some analyses in this article reflect matched responses to the End of Training and 2003 End of School Year surveys (n=1,347). Chi-square tests were conducted on all categorical data and ANOVA analyses were conducted on continuous data. All reported findings are statistically significant, with a p value of < .05. All survey results reported below come from the most recent (2003) End of School Year survey.
- Observations and site visits: In the first year of research, evaluators traveled to 11 participating districts, attended trainings, observed participating teachers'

classrooms, and interviewed district technology coordinators, local program coordinators, trainers, and participants while trainings were in session.

- Phone interviews: The evaluation has used several waves of phone interviews in order to learn more about Intel Teach to the Future's role in districts' broader approaches to technology and professional development**.** In the first year of the evaluation, phone interviews were conducted with 24 local program coordinators after site visits had been conducted. In the third year of the evaluation, phone interviews were conducted with district technology coordinators in 35 randomly selected districts that participated in the program.
- Case studies: In the second year of research, evaluators made three separate visits to five different schools in three participating districts (15 visits overall) representing a range of geographic and socioeconomic contexts. Evaluators conducted classroom observations, interviewed school and district personnel, trainers, participant teachers and students, and examined student work.

Complete descriptions of methods can be found in our evaluation reports, available at [omitted for peer review].

Findings

In this section we first discuss findings related to the level of *depth* of scale achieved by the program. We then present findings related to the level of *spread* of program core goals and messages among program participants, particularly within schools. Finally, we combine Coburn's categories of *sustainability* and *shift in ownership* as dimensions of scale to discuss a final group of findings related to changes in school- and district-level practices, priorities and policies.

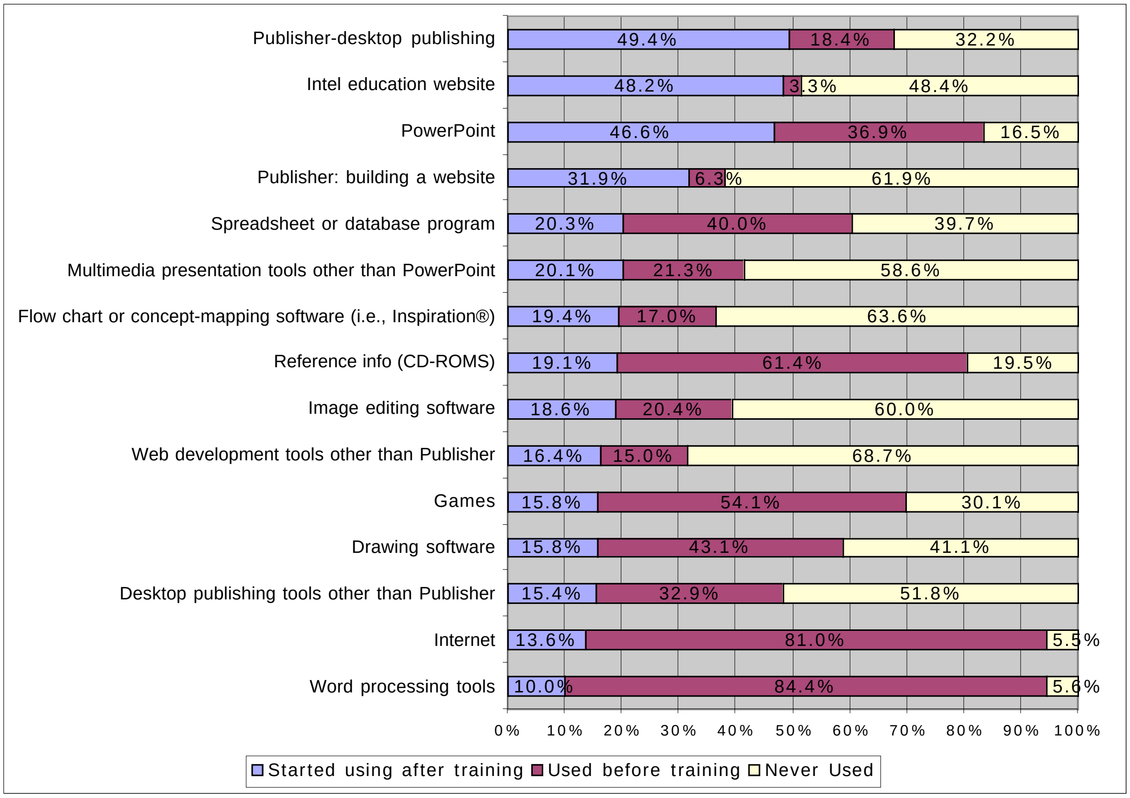
Achieving depth

As Coburn states, depth of scale is achieved when an intervention goes beyond surface-level changes to have an impact on teachers' beliefs and pedagogical principles. Our evaluation indicated that not only were teachers using the specific materials that they developed in the training, but they were also beginning to see other ways in which technology could be drawn upon to support instruction and their teaching practice. In addition, teachers also begin to make use of a broader range of pedagogical strategies, particularly related to supporting project-based work, with their students. We interpret these findings as evidence of the *depth* of scale of the program, and attribute this level of impact to the adaptability and relevance of the curriculum and its core activities.

Teachers experiment with technology. Both quantitative and qualitative findings over three years illustrate that teachers who participated in Intel Teach to the Future began to experiment with technology when they return to their classrooms. Not only did a majority report implementing all or part of their unit plans with their students (79.1% in the 03 End of School Year survey) but a large majority of teachers (80.9% in the 03 End of School Year survey) also reported creating and implementing other new technology-integrated lessons that they did not use before their training. The evaluation also found that most teachers continued to engage in technology integration over time. A majority of teachers trained a year or more before they completed the 2003 End of School Year survey reported implementing all or part of their unit plans more than once (67.8% of the 2000-2002 cohort and 53.9% of 2001-2002 cohort). When teachers were asked whether they had implemented their unit plans in the current year, there was little difference in the rates of implementation for teachers across all three years of training (80.6% of the 2002-2003 cohort, 80.9% of the 2001-2002 cohort and 74.6% of the 2000-2001 cohort).

The Intel Teach to the Future training focuses primarily on the use of Microsoft PowerPoint, Microsoft Publisher and the Internet. However, one of the goals of the training is to help teachers understand how to use technology in general to support their teaching. 2003 End of School Year survey findings indicated that the software tools most respondents reported using more often since the training were, not surprisingly, PowerPoint (46.6%), Publisher for desktop publishing (49.4%), Publisher for building a website (31.9%) and the Intel Education website (48.2%). However, teachers also reported having their students use a wide range of other kinds of software that had not been addressed specifically in the training more often since their participation. For example, 20.3% of the respondents said they were using spreadsheets or database programs with their students more often; 20.1% reported using multimedia presentation software other than PowerPoint more often; and 19.4% said they used flow chart of concept mapping tools more often since the training (see Figure 1). Although no individual software tool other than those presented in the training was being used more often by more than one-fifth of respondents, collectively, these findings show a 10-20% increase in the use of a wide array of different software tools by teachers. This suggests that some teachers had moved beyond the material covered in the training and were experimenting with new kinds of software in their teaching practice.

Figure 1. Use of Software with Students



Case study findings from the second year evaluation illustrated that teachers were making technology a regular part of their teaching routines. Many of the teachers interviewed and observed used their unit plans in their teaching, but others also created new technology-rich lessons and were making use of other kinds of software and technical resources to augment these lessons. For example, teachers were having students use digital cameras to create visual materials to include in PowerPoint presentations and were having them create charts and graphs in Excel to represent scientific data. Teachers observed that their original unit plans served as a catalyst for generating ideas about how to use technology in novel ways.

The evaluation findings suggest that certain key elements of the training (such as the development of a unit plan and an implementation plan) helped teachers feel more confident experimenting with technology integration. During visits made to trainings in the first year of the evaluation, both MTs and PTs spoke of the value of the hands-on experience that the training offered, and how they appreciated having enough time to think about and create a technology-enhanced unit plan that would address the curricular standards they are required to meet. Additional findings from the second year case studies reified the importance of unit plan development. Teachers who described themselves as techophobes stated that without these ready-to-use teaching materials, they would never have taken that first crucial step along the path of technology integration. A large majority of teachers reported that they were satisfied with their experience implementing their unit plans (86% in the 2001 End of School Year survey, 85% in 2002, 84% in 2003). Teachers in the case studies observed that having a successful first experience was crucial in encouraging them to continue investing the time and energy required to make project-based technology use a regular part of their teaching.

Relationship between implementation and relevance of teaching strategies. Teachers from the case study schools felt that the Intel Teach to the Future training, unlike other technology trainings they had attended, drew connections between the use of technology and their instructional needs. These connections helped them understand not only how to implement technology, but why they would choose to do so. The majority (97%) of teachers who responded to both the 2002 and 2003 End of School Year surveys felt that the teaching strategies were relevant to their teaching goals. When data from the 2003 End of School Year survey were analyzed to determine how much of an impact teachers' beliefs about the relevance of these strategies were to their rates of implementation, a very strong relationship was found (see Figures 2-4,). Teachers were more likely to integrate technology and to do so repeatedly if they believed the teaching strategies modeled in the training had relevance to the work they do with students.

Figure 2. Implementation of Unit Plan in 2002-2003 School Year by Relevance

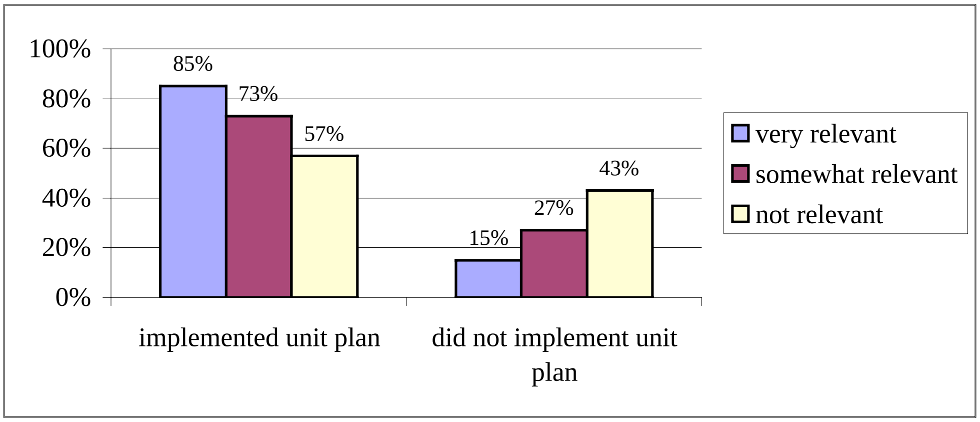


Figure 3. Frequency of Unit Plan Implementation by Relevance

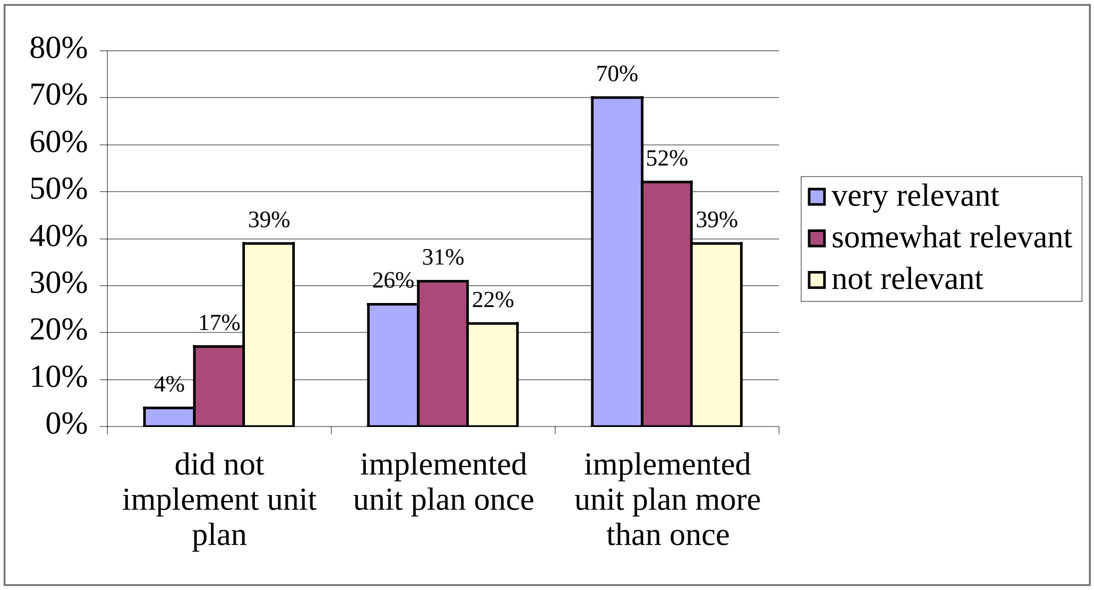
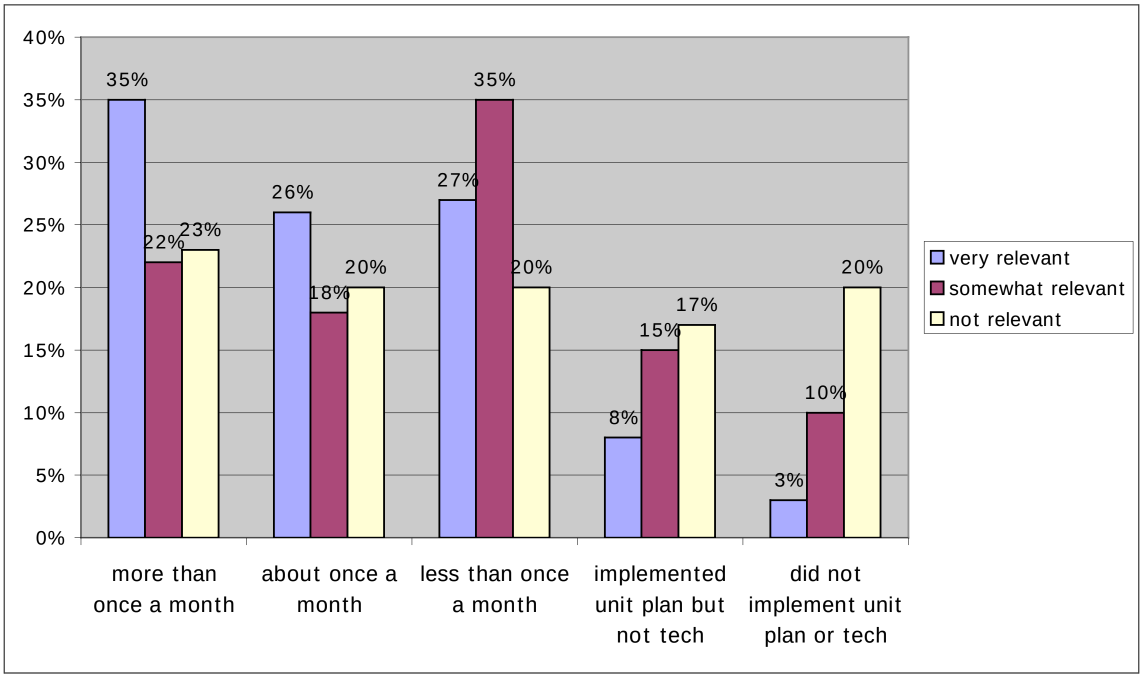


Figure 4. Frequency of Implementation of Technology-Integrated Lessons by Relevance.



Teachers experiment with new teaching practices. Apart from implementing technology-integrated activities with their students, evaluation findings also demonstrated that the program has had some impact on how participants teach. Majorities of teachers reported using technology more often after the training in a variety of ways to support their practice (see Figure 5, data from 03 End of School Year survey). For example many reported accessing the Internet more often to research lesson plans, and using technology to produce instructional materials. In addition, approximately a third of teachers reported using a variety of project-based teaching strategies presented in the training more often after participation in the program (see Figure 6, data from 03 End of School Year survey). Teachers who took part in the case studies were experimenting with rubrics for evaluating student work, structuring lessons to include more group work and having students present more often to their peers. These teachers observed that the kinds of technology integration activities and methods discussed and modeled in the training helped them understand how to organize lessons within a project-based framework. As one Participant Teacher in our case studies put it, “I feel like I’m spending more time on the good teaching practices part of this [than] the basic technology part.”

Figure 5. Practice-Related Activities Teachers Engage in since the Training

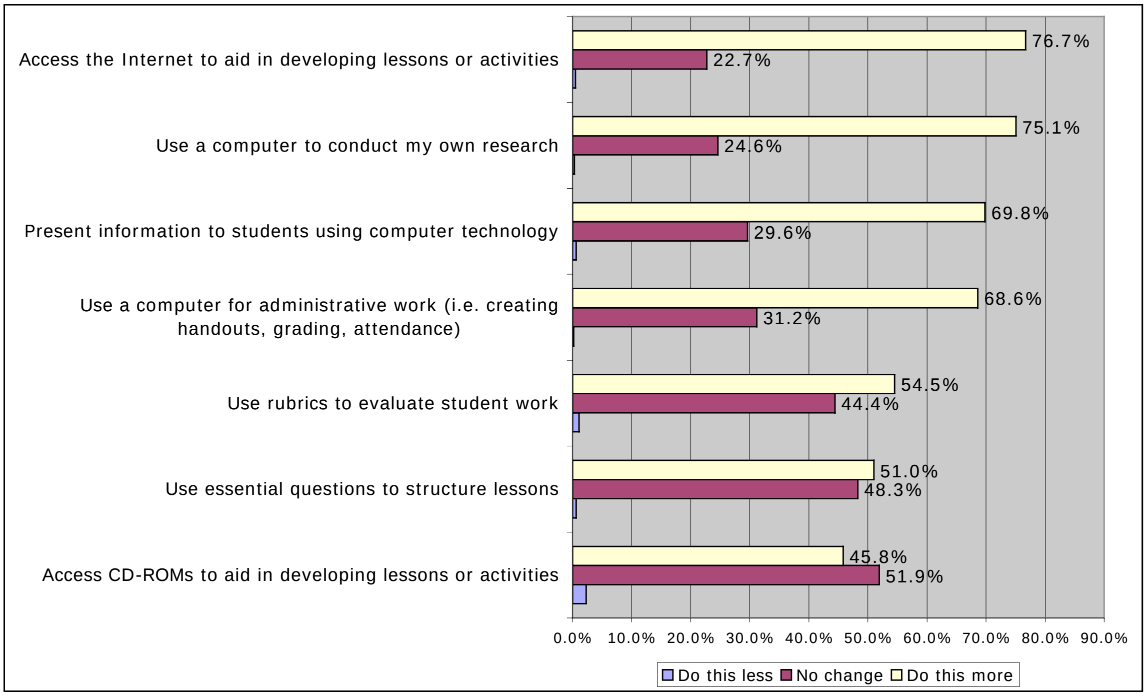
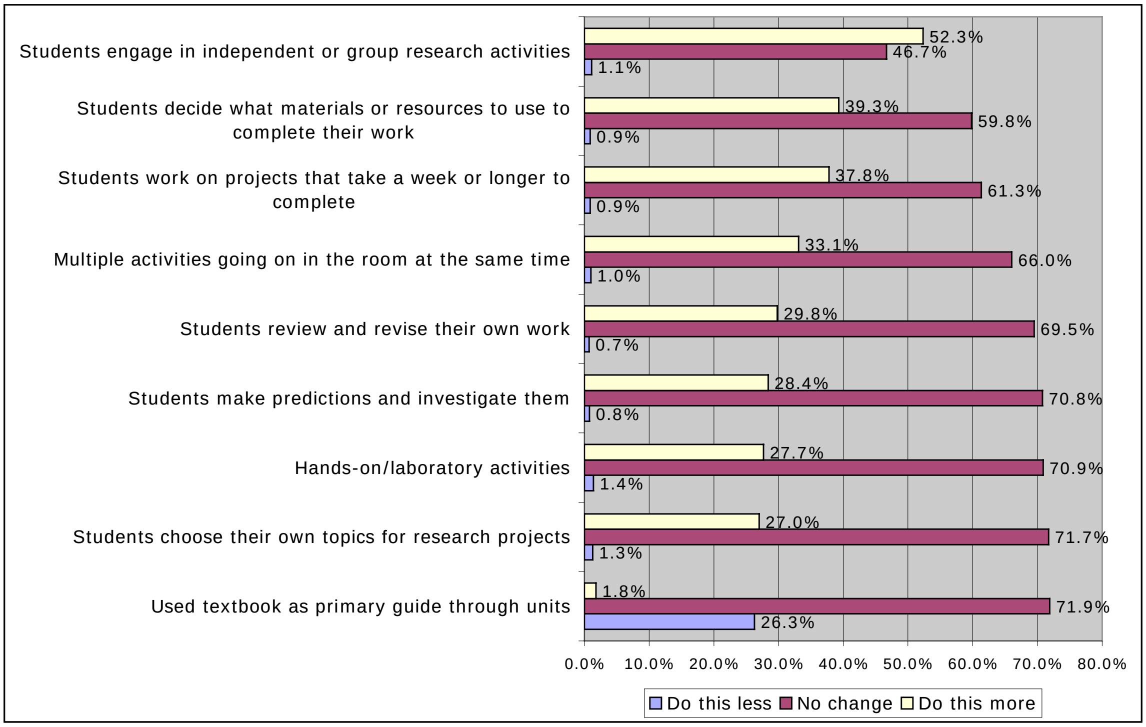


Figure 6. How Often Teachers Use Instructional Strategies since the Training



It is often very difficult for teachers to change the way they work. Therefore, change in technology use or larger changes in teaching practice can not take place instantly after one professional development experience. However, these findings do suggest that teachers who participated in Intel Teach to the Future were beginning to think about and use technology in different ways, and were beginning to see how project-based teaching strategies in general could be applied more often to their practice.

Program spread within schools

In site visits and teacher interviews conducted in this evaluation, we found that teachers had developed cohorts of fellow Intel Teach to the Future participants within their schools. Because these cohorts shared a common, current interest and new set of needs, they were making the effort to push for more resources, to take on new responsibilities within their buildings, and to coach and support one another in their classrooms. Further, the size of the cohort of teachers within individual districts who had gone through this training spurred districts to re-examine and modify their sequence of technology-related professional development offerings, not only adding more advanced courses to their sequences, but also in some cases reframing trainings to focus on concepts that were now familiar to these cohorts of teachers, such as student-centered use of the technology, assessing technology-rich student work products, and enhancing existing unit plans with student use of presentation tools such as PowerPoint and web page builders.

Groups of trained teachers forming support networks. Although the most striking evidence of program impact was at the classroom level, our evaluation also indicated that, in some instances, large groups of trained teachers were having an impact beyond the classroom level. In the schools that we visited in our five case studies, a majority of teachers had participated in Intel Teach to the Future. This had led to a relatively sudden increase in teacher interest in integrating technology into their everyday practice, which had an impact on the cultures of these schools. First, there was a new group of relatively tech-savvy teachers in the building, sharing a particular approach to thinking about technology in the classroom, confident in their abilities to solve at least rudimentary technical problems, and able to share ideas and encouragement with one another. These observations were consistent with data from the 2003 End of School Year survey, in which 57% of respondents reported that, since the training, they conferred more often about technology related issues with fellow Intel Teach to the Future participants, and 72% said they conferred more often about technology issues with their colleagues in general, even with those who had not participated in the program. Participants also reported that after the training their roles in the school had changed. Fifty-seven percent stated that they had taken on more of a trouble-shooting role in regards to technology after the training, and 57% reported they had assumed more of a technology leadership position in their schools.

At the same time that support networks were forming, there was increased demand on the school's technology resources; all at once, a large bloc of teachers was signing up for time in the computer lab, requesting tech support, and seeking more and better hardware and software in their classrooms. A new sub-population of teachers actively pursuing technology integration was emerging. In each of the case study sites we heard a remarkably similar story — demand for lab time, once limited, had become intense. Whereas the lab before had been the province of business classes and a few tech-savvy teachers, school technology coordinators now had to meet the demands of whole departments of core-subject teachers, all hoping to do significant units of work with their classes in the lab. In many cases, schools no longer had adequate resources to accommodate all of the teachers who wanted to use the computer labs. Our survey data corroborated these case study findings. Half of the 2003 End of School Year survey respondents "agreed" or "strongly agreed" that "not enough computers were available," when they tried to implement their unit plan or other technology-rich lesson; 47.4% "agreed" or "strongly agreed" that "it was difficult to schedule adequate time in my school computer lab." Although this lack of access was a source of frustration to many teachers, as one principal observed, the crunch in the lab was one side of a positive development — increased interest in technology integration.

Rather than allowing lack of access to resources prevent them from implementing their lessons, we found that many teachers in our case study schools worked collaboratively to overcome this challenge. Partial solutions abounded, as teachers and administrators found creative ways to share classroom computers and free up lab time. In two of the case study schools, teachers chose to donate their classroom computers to common labs so they could be used by all the teachers and students in their school. A teacher in one of these schools stated:

> The district gave each teacher a workstation for their classrooms, but the teachers at [our school] gave up their teacher workstations to the lab for students to use. Because we do so many group projects with kids, it made sense to have the computers in one place where kids could work on them. Teachers come to the lab to do administrative work. Each school

> has a site plan for technology distribution. The committee at our school decided where the machines should go.

According to this teacher, the choice to pool resources reflected the teachers' recognition of their own instructional needs.

> The lab is important. The alternative was two computers per classroom, which was the way [the district] wanted us to set it up but we want the lab. So the computers in the lab "belong" to the teachers and we've agreed to have them there.

In another school we studied, teachers opted to turn the teachers' lounge into a second computer lab, and those teachers who had participated in the training agreed to have the principal use their discount to purchase computers for the lab rather than have the computers in their own classrooms.

At a third school, teachers made their classroom computers available to their colleagues' students. They combined this strategy with a collaborative approach to scheduling lab time to allow each teacher access to the greatest number of computers possible at one time. In the words of one such teacher, "When you have 25 kids … three [computers] don't go far, so we work together. We have [lab] activities on different days. I have students from another class work on computers in my room." A colleague added, "We scatter [students] around and I'll have them go to six or seven classrooms of other teachers who are not using [computers]."

Large groups of trained teachers also began making more urgent demands for further professional development in technology. These teachers pressured schools and districts to provide follow-up trainings similar in format to Intel Teach to the Future. This demand spurred thought and action among school administrators on how to address these new needs. Schools responded by offering technology trainings as part of staff development time and in-service trainings. One administrator commented, “Now we have some dedicated staff training time for technology.” Another said, “One of the things we’re doing is always trying to show teachers how much information they can get, how they can utilize the technology appropriately so that the kids can get the most out of it. We dedicated some of our in-service time to technology. The Intel training has had some impact on our approach to in-services.”

Master Teachers as school technology leaders. A key factor in the creation of a supportive environment for technology integration in our case study schools was the presence of a strong educational technology leader. Intel Teach to the Future made an effort to recruit content teachers as Master Teachers, but a fair number of Master Teachers were technology coordinators or computer teachers as well. Each of the five schools we studied had an Intel Teach to the Future Master Teacher on the faculty, and in most cases they were the technology coordinators or computer teachers in their schools. The first consequence of an on-campus Master Teacher was that Master Teachers often recruited Participant Teachers most heavily on their own schools, and so there were large numbers of trained Participant Teachers in those schools. In addition, these Master Teachers had recruited *first* on their home campuses, before looking farther afield to fill their second and third trainings. Therefore, Master Teachers' home schools had a relatively experienced group of Participant Teachers, many of whom had had a full academic year to integrate what they had learned from their training.

In each of the schools we visited in our case studies, a Master Teacher was the vital center of a group of trained teachers. Whether these Master Teachers provided informal tech support or held an official role as a school technology coordinator, all of them had taken on leadership roles assisting teachers in the use of technology in instruction. The on-campus Master Teachers we observed continued to provide technical and instructional support beyond the training and often advocated for teachers seeking additional technology resources. On-campus Master Teachers knew the teachers, the curriculum, and the students and were able to provide tailored instructional support to teachers as they explored new ways of approaching technology. "I think more teachers are willing to take the risk of using technology because they [can] always ask me questions," one Master Teacher told us. In fact, in End of School Year surveys, Participant Teachers with Master Teachers in their schools consistently rated "lack of instructional support" and "lack of technical support" as less serious obstacles to integrating technology into their teaching than Participant Teachers without Master Teachers in their schools.

Master Teachers were often called upon for technology support and troubleshooting within their schools. One Master Teacher who was part of her school's tech-support team stated, "All three of us [on the team] are available and it's seldom that one of us will walk down the hall without getting yanked into a classroom to help on something. We try to make ourselves available for any kind of support." This immediate availability was especially important when teachers experienced technical difficulties during their lessons. Master Teachers in our case study sites had aided Participant Teachers by responding to crashed servers and Internet access issues that arose in the middle of technology-based units. It is interesting to note, however, that, in schools without in-house Master Teachers, Participant Teachers were able to assume the kinds of responsibilities that Master Teachers did in our case study schools. In our 2002 End of Year survey, those respondents who did not come from a school with a Master Teacher were more likely to "agree" or "strongly agree" that they had taken on trouble-shooting and technology leadership roles regarding technology than those who came from school with a Master Teacher.

Since the training, the Master Teachers we interviewed, even those who were already technology coordinators, had altered their approach to supporting teachers, moving beyond basic tech support to providing instructional support as well. Some Master

Teacher technology coordinators that we spoke with spent time after school and during staff training periods helping teachers prepare for technology integration. This support was not limited to addressing unit plans created during the Intel Teach to the Future training, but also built upon other lessons into which teachers wanted to incorporate technology. An administrator noted that she has seen the Master Teacher in her school "working with teachers during their conference time, after school, outside of Intel time … she makes sure the teachers who have been trained continue to use what they've learned…. [She also works] with teachers who are out of the program, with teachers that need help."

As Master Teachers emerged as technology leaders, some became increasingly involved in decision-making in schools that had the flexibility to modify their technology plans to better meet the needs of teachers. As a result, Master Teachers helped Participant Teachers get additional hardware and software to support their use of technology in the classroom. Some Master Teachers we spoke with were actively involved in deciding where to put new computers — to create a new lab, to put them in an existing lab, or to distribute them among teachers. With the emergence of large groups of trained teachers and a subsequent strain on resources, the Master Teachers' input into hardware allocation became increasingly important. As technology point people in the school, Master Teachers aided in decisions about how to distribute resources based on their knowledge of which teachers would use them most effectively. "My principal doesn't make the hardware allocation decisions herself," said one Master Teacher. "She calls me and [another tech support person] because we know what's going on."

Sustainability and shift in ownership

Evaluation findings suggest that the scale and the timing of this program influenced how it was adapted and adopted at the district level. School districts were using Intel Teach to the Future as a catalyst to initiate, expand, or institutionalize an approach to technology professional development that foregrounds curriculum and learning goals and that helps teachers to identify productive ways to integrate technology into their students' work. These efforts resulted both from the pre-existing need in many of these districts to update technology professional development to meet the growing need for training and from the number of teachers in these districts who had participated in this training and wanted similar kinds of training. In these districts, Intel Teach to Future dovetailed with these needs while also modeling a way of approaching professional development that could be adapted in other professional development offerings.

District technology leadership. Both our case studies and our district phone interviews indicated that, under certain conditions, Intel Teach to the Future could provide a mechanism through which structural changes in school and district approaches to educational technology could be launched. The districts involved in our case studies had varying levels of commitment to educational technology, but even those that had dedicated considerable funds for hardware and software were only just beginning to conceive of technology as an instructional, rather than an infrastructure, issue. A school technology coordinator attested that her "district has a tech plan but it's just for purchasing and equipment. The district runs the infrastructure side but nothing from the classroom out." This attitude toward technology had influenced districts' previous approaches to professional development as well. Earlier training opportunities had primarily addressed basic technology skills rather than the incorporation of skills into existing curricula and addressing standards. “Before Intel,” said one teacher, “the technology professional development in the district consisted of short afternoon or weekend courses at the technology center in the district, which teachers had to pay for.…These were just a few hours long and would focus on an application.”

However, as more and more school district leaders participated in Intel Teach to the Future, and as more and more trained teachers moved into leadership positions, they were increasingly able to bring their experience and knowledge to bear on district educational technology policies. Master Teachers who had taken on leadership roles within their schools also became advocates for teachers at the district level. In one case study district, Master Teachers played a significant role in district hardware allocation, so that computers were distributed to those teachers whom the Master Teachers thought were most likely to use them. “[Another Master Teacher] and I worked really hard to convince the district that they're going to be spending money on technology anyway, so why not take that money and put the computers in front of the people who are trained to use it,” said one Master Teacher. These same Master Teachers sat on a committee that developed the district technology plan and helped write a staff development piece addressing the teachers’ different levels of technology knowledge. “[The Master Teachers are] part of a voluntary group of tech coordinators in the district,” said a teacher in one of the case study schools. “This year they created a tech plan for the district that focuses on professional development rather than purchasing.” These particular Master Teachers were in technology leadership roles before their participation in Intel Teach to the Future, but the program became a model of how to address professional development that they could draw on for district technology planning.

District technology professional development. Survey data suggest that focusing professional development on curriculum integration rather than skills would be perceived positively by teachers, who often felt existing district offerings were less useful than the Intel Teach to the Future training. Nearly all respondents (95%) in our 2002 End of School Year survey felt that the Intel Teach to the Future training was "very useful" or "quite useful," a higher rating than respondents gave for every other kind of technology professional development in which they had participated, including in-service workshops, conferences, informal tutoring, university/college courses, and online courses. One teacher explained that, in the past, her district offered "little individual things, not on the level of Intel — doing a complete lesson plan. Nothing else was offered like that." A Master Teacher at one of the case study schools compared her district training experience with the Intel Teach to the Future training: "I did realize that the way our district has always offered trainings is wrong, and that we need to offer trainings that have a beginning and an end and a purpose. In the past I taught just [an application] to 10 to 15 teachers but we didn't train with a reason or a purpose, and I get to do that in the Intel class….Teachers come up with a unit. They have a focus. It's not just pretend. Teaching [applications] in isolation is not effective. It would be neat to be able to have the control to do that in our whole district…. We need to develop this kind of curriculum and implement it district-wide."

While not all districts were flexible enough to make immediate changes, some districts we visited and that we learned about in our phone interviews were already responding to this shift in demand for technology-related professional development experiences that address instruction. For example, in response to the Intel Teach to the Future training, one district revised a summer institute it ran to provide technical training for teachers. In the past, the summer institute entailed learning discrete technology skills and software applications. However, the district staff member in charge of designing the institute reported, “This year it’s, ‘Come and let’s see where you are in your curriculum and in your standards-based use of technology, and let’s see how we can help you use the appropriate technology to help you move forward in your use of technology.’ I’m sure the Intel program was not the sole reason, but it really heightened our awareness and showed us that the emphasis needs to be on the curriculum, not just on the technology.”

Similarly, in another case study district, as more teachers moved through Intel Teach to the Future, there was a push for other, similar professional development options. Teachers who participated in Intel Teach to the Future were now no longer satisfied with the kinds of professional development options their districts had previously offered. One administrator in this district noted, “[The district] had some classes that were more skill classes in MS Word and PowerPoint. They were eliminated. [Teachers] have said, ‘I’ve taken Intel. What can you offer *now*?’”

District technology planning and structure. Our findings from the district phone interviews were consistent with our case study findings. Although few district personnel gave Intel Teach to the Future all of the credit for driving change, these educators pointed out that the program’s arrival on the scene was a serendipitous event for their districts. Initiating widespread reforms is a complicated endeavor, and some administrators we spoke with observed that Intel Teach to the Future took some of the burden of designing professional development programs off the districts, allowing them to concentrate on other aspects of their efforts to transform their approach to educational technology, such as creating technology plans and building up the district-wide technical infrastructure.

Because of its focus on curriculum, experience with Intel Teach to the Future sometimes led administrators to rethink lines of communication and to place an increased focus on linking technology integration to state and local standards. A district technology coordinator in our case studies commented, "[My department] recently switched from reporting to the technology department to reporting to the instructional department. And that makes a difference in terms of how well the curriculum emphasizes integration and not just knowing how to use the software. It also has given us the ability to jump on that standards bandwagon in a focused effort — as opposed to just offering software classes."

Discussion

In the literature on scaling up of educational initiatives, large-scale implementation and local relevance are often portrayed as mutually exclusive program goals. However, findings from the evaluation of Intel Teach to the Future suggest that these goals can, with careful strategic planning, actually function in concert. Program components originally intended to ensure that the program reached large numbers of participants actually increased the program's ability to achieve scale across multiple dimensions, as described by Coburn (2003). The remainder of this discussion briefly reviews the findings presented above in relation to Hawkins' articulation of the qualities of the program that allowed it to scale successfully: commitment to clear goals, forming alliances, supporting leadership networks, adapting to local circumstances, and recognizing good timing.

Depth of scale: A benefit of good timing, alliances, and adaptability to local circumstances

The data suggest that the high level of follow up and impact on teacher practice is closely connected to the alliances Intel chose to form when developing the program, the timing of the program and the adaptability to local circumstances embedded in the structure and content of the curriculum. Intel's decision to invest in alliances with other organizations with relevant expertise (such as the collaboration with ICT, a non-profit dedicated to supporting teachers' technology-related development) was key to delivering a high-quality curriculum. Regarding timing, program participants consistently stated that this training focused on a kind of technology use that they were already interested in pursuing. Finally, the local adaptability built into the program curriculum meant that Participant Teachers came away from the training with a usable product (their unit plan, focused on a topic of their own choosing) that was aligned to their existing curriculum. The teachers with whom we spoke in our case studies cited their unit plans as an important element in their effort to integrate technology: possessing this ready-made activity for use in the classroom spared teachers the difficulty of searching for ways to squeeze technology into already busy schedules and helped to ease teachers into what might otherwise be an intimidating enterprise.

Spread of program content and core goals: A benefit of large numbers and leadership networks

The evaluation demonstrated that, in districts that engage with and fully implement the program, there is a high probability that teachers will both build school-level cohorts sharing a common perspective and create locally relevant and usable materials. These teachers then turn to each other for support as they take the initial steps toward technology integration, and they work together to advocate for the resources they needed. These are two of the most frequently cited conditions for translating professional development experiences into practice (Darling-Hammond, 1999; Elmore, et al., 1996; Little, 1993).

Intel's investment in creating and sustaining leadership networks contributed significantly to the ability of this program to extend its initial impact on individual teachers to broader groups of practitioners. Intel supported the development of a cadre of Master Teachers, who often acted as leaders and coaches to groups of program participants within their schools or, in some cases, across their entire district. The presence and commitment of the Master Teachers was crucial in providing the guidance and the resources program participants needed both to implement the specific unit plan they developed, and to extend the lessons they learned into other areas of their work and across their school environments.

Sustainability and shift in ownership: a benefit of large numbers, timing, leadership networks, and affiliations

This program was deliberately designed to create a network of affiliated program administrators, including regional training agencies and district-level program liaisons, who could respond to local needs and priorities. These leaders contributed to the spread of the program by troubleshooting issues such as hardware purchasing needs and the distribution of curriculum materials. More importantly, district-level liaisons (who were sometimes also Master Teachers) were able—either of their own accord or at the urgings of others—to extend the reach of the program to influence technology planning and professional development much more broadly within a district.

Summary

This case provides insight into the complicated interplay between the scale and design of a program. Local adaptation does not have to become a casualty of the scaling process, but program designers need to be mindful of the difficulties involved in translating new ideas into practice. Rather than “teacher-proofing” educational materials to ensure they are implemented on a large scale, a program can designate space and time for teachers to actively participate in the development of materials relevant to their work, while also linking that work to larger program goals. Although the implementation processes of large-scale initiatives may need to be highly structured, involving school and district stakeholders in the implementation of the program can strengthen local educational leaders’ and teacher participants’ investment in the project. When programs are designed and implemented with sensitivity to the real-world conditions that influence the professional lives of educators, the process of scaling up need not require the negation of contextual factors, but can play an integral part in the construction of a new set of contextual factors that subtly reshape the environments of the schools those programs reach.

It is important to mention Hawkins’ first theme: a strong and sustained focus on clearly defined goals. As ambitious as Intel Teach to the Future was in its numerical targets, the program designers also had specific but realistic expectations for the impact the program was intended to have on teachers. They committed themselves early on to a goal that was defined in relation to teachers’ instructional practices and that focused on helping teachers move forward from their personal starting points, rather than moving all teachers to a certain specified goal state. They made explicit their understanding of what "technology integration" looked like by articulating this, in detail, in the curriculum they disseminated.

This program was never intended to transform teachers into expert technology users after one 40-hour series of workshops. Instead, it was designed to facilitate significant, attainable alterations in practice in large numbers of teachers. The program was designed to make technology integration—a practice that is sometimes perceived as peripheral to teachers' daily lives—relevant to the life of the classroom, by connecting it to a core concern for all teachers: engaging in quality teaching practice in order to improve student learning. The training gave participants the opportunity to learn how to use common software applications that they were likely to have available on their school computers to teach their existing curricula, encouraged them to integrate project-based teaching techniques into their unit plans, and provided them with the concrete tools and experience they would need to make technology integration possible. This evaluation has shown that they were largely successful in achieving their aims, and that the scale of the program supported, rather than impeded, their success.

Conclusion

Intel Teach to the Future illustrates how a large-scale initiative can maintain key design elements that make the program relevant to participants, and suggests that the scale of the program may have actually helped to establish the local conditions that lead to sustained impact. The findings presented support three conclusions regarding the scaling strategy used by Intel for this program. First, the strongly structured "how" strategy they chose allowed them to not only meet, but to surpass their numeric goal of reaching 100,000 teachers in three years. Second, the "what" strategy they chose – delivering a training experience that had at its center a locally-driven process of technology-enhanced, project-based curriculum development – ensured that the large majority of those 100,000 teachers responded positively to the training, felt they benefited from it, and followed up on what they learned by using the materials they had created in their own classrooms. Finally, specific interactions between the "how" and the "what" of their strategy led to peripheral outcomes that, taken together, allowed many participating teachers and districts to experience broader and deeper kinds of program impact closely related to the program's overall goal of "improving teachers' ability to integrate technology into their classrooms." Collectively, these findings suggest that delivering large-scale, effective professional development related to educational technology will require thoughtful intertwining of relevant and locally-adaptable content; strongly structured and adequately supported delivery mechanisms; and multiple levels of human networks that can support, sustain and expand upon initial program offerings.

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