WHITE PAPER
Education Transformation
Education

Intel Education Transformation Research: Lessons Learned Across Five eLearning Programs

INTRODUCTION

The development and diffusion of information and communication technologies (ICT) is having a profound effect on modern life. As the world transitions from an industrial to an information economy, ICT plays an increasing role in education, especially in equipping students with 21st century skills to enable their full social and economic participation. Over the last five years, as technologies and their application in everyday life have become more ubiquitous, policymakers and educators have started paying more nuanced attention to the educational value of ICT. They are seeking to understand whether ICT can improve learning outcomes for students. They are also questioning the extent to which ICT can be a key element of education reform, and they are becoming more interested in identifying strategies for modernizing education by integrating ICT into teaching and learning. The shift in educators' questions and the need for rigorously conducted studies to address their questions dictates new directions for research in education technology. Careful investigation of the grounds-up process or the "story" of education transformation is needed in diverse settings, from which lessons can be identified and applied to new contexts to inform other education transformation efforts.

The present Education Transformation Research addresses exactly this need. Developed by a team of researchers from Intel and SRI International, this research is designed to meet the emerging questions and needs of governments, universities, nongovernmental organizations (NGOs), and other actors interested in transforming education systems through the integration of ICT. At the center of this research is an ethnographic approach aimed at uncovering the complex process of education transformation in various geographical regions and across a range of Intel-powered eLearning programs of differing maturity.

To date, Education Transformation Research has been conducted in five countries: Argentina, Brazil, Macedonia, Portugal, and Turkey. Each involves an Intel® Learning Series deployment. Because each program addresses the process of eLearning integration, the findings from our research may be widely applied to technology-supported education transformation. The eLearning integrations in Argentina, Macedonia, and Portugal are on a national scale, involving large populations of students and teachers, whereas the eLearning programs in Koaceli (Turkey) and Piraí (Brazil) are more geographically centered programs, addressing citywide populations. In each country where the research has been conducted, local research teams have been involved in the data collection and analysis and have contributed extensively to explicating the social and political factors at play.

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Intel Education Transformation Research is conducted in regions around the world to understand the successes, challenges, and policy implications of a variety of eLearning programs, and compare them to other programs worldwide. The information in this report is based on original data collection and analysis by researchers at the Universidad de San Andres, AED, Universidade Federal do Rio de Janeiro, Universidade Federal Fluminense, Anadolu University as well as education researchers in Portugal in collaboration with SRI International and Intel.

The research has focused on analyzing grounds-up data (consisting of qualitative stakeholder interviews, background materials and documents, and earlier research and evaluation reports) from each eLearning integration effort. An important objective of this research is to provide rich detail on the status and success measures of each program and identify the successes, challenges, and policy implications of each specific eLearning program. The successes, challenges, and policy implications also form a basis for comparing and contrasting eLearning programs, thereby highlighting the multiple pathways available for implementing an education integration effort.

A key outcome of this research is an approach and a set of analytic resources that can be used across education technology integration efforts for planning, assessing, and describing progress and, if necessary, for recommending course corrections. This report describes two specific resources to help guide ongoing or new eLearning integrations: (1) a common framework and considerations to help decision-makers compare and learn from different eLearning efforts and (2) general rules that consolidate the lessons learned from the cases analyzed for this research. With these resources, leadership teams responsible for technology-supported education reform in diverse contexts can build on their own and others' experiences to refine their eLearning initiatives.

Common Framework and Considerations

Each eLearning effort begins from a unique starting point, addresses distinct goals and expectations, encounters disparate challenges, and operates in a local and specific educational and policy context. This paper discusses the following five eLearning programs:

- The ConectarIgualdad program is designed to improve and equalize the quality of education across the secondary schools in Argentina.
- Koaceli's 1:1 eLearning program is aimed at regional economic development by building the Turkish Silicon Valley and preparing its residents to be "the next Bill Gates."
- Embedded in a comprehensive national education technology plan, Portugal's e.Escolinha, or Magellan, program focuses on developing students' 21st century skills by infusing ICT in informal and formal learning settings.
- Delivering on an election promise to provide a computer for every child, Macedonia's eLearning program emphasizes the integration of technology into the classroom.
- Piraí's citywide eLearning program is an extensive digital inclusion effort aimed at addressing local economic development concerns that include IT infrastructure development, access centers for adults, and other investments outside school.

While we acknowledge the distinctive nature and particular characteristics of each eLearning integration deployment, our research also has shown how each program builds from a shared framework. Specifically, we have identified four broad stages of eLearning program implementation: vision, planning, implementation, and evaluation and adaptation. Different considerations are relevant at different stages of an education technology integration (see Table 1), and the considerations that are salient at each stage vary according to the maturity of the program. In early adoption phases, programs might be more concerned with financing and infrastructure preparation, whereas these topics might surface as sustainability of funding, maintenance of infrastructure, and providing technical support as programs become more established. Different considerations become relevant and need to be attended to at different points in the progression of an eLearning program.

While we pay attention to the specific details of each deployment setting, we also need to understand the fundamental considerations and how they are articulated in each eLearning context. The shared framework and the finite set of common considerations nested within each stage offer a shared standard vocabulary for describing and assessing eLearning programs. Specifically, decision makers of eLearning integrations who can use this framework to:

- Assess the progress of a specific eLearning initiative
- Identify and track challenges and generate recommendations for new courses of action from practical, policy, and business development perspectives
- Compare two or more eLearning initiatives (ongoing or planned)

The common framework and considerations for planning and executing an eLearning integration effort can guide decision makers who are responsible for creating the eLearning vision and stakeholders who are responsible for enacting the program and helping it achieve success. The framework and considerations should be incorporated into a more comprehensive model of policy development intended to influence the direction and scope of educational change (e.g., Kozma, 2011[1]). The following four steps deriving from the framework can help education leaders and program implementers craft policies and sustainable programs that contribute to education reform and to economic and social development:

(1) Generate a long-term shared vision

(2) Develop a policy master plan

(3) Outline process for operations and implementing the program

(4) Adapt eLearning integration efforts on the basis of ongoing evaluation

In addition, policymakers and program planners should pay attention to the interrelationship between the stages and the corresponding implications for who is involved and what activities are conducted. Although the vision stage may initially involve only a select few decision-makers, a more diverse group, including stakeholders, implementing agents, and end users, should be engaged in articulating a longer-term shared vision toward the end of the stage. Including input from implementing agents and end users in the vision stage will inform implementation, create a sense of ownership, and foster adoption in the implementation stage. Moreover, the vision should be translated into more actionable statements to guide

Table 1: Common Framework of eLearning Programs

Vision	Planning	Implementation	Evaluation and Adaptation
▪ Political climate and opportunity ▪ Education and ICT policy context ▪ Priorities ▪ Goals and indicators ▪ Champions ▪ Funding model	▪ Geographical scale ▪ ICT infrastructure preparation for rollout ▪ Program functional features ▪ Program coordination and operations ▪ Strategies for stakeholder engagement ▪ Communication (to support stakeholder alignment and program coordination) ▪ Feedback mechanism for course corrections	▪ Rollout of elements/ components ▪ Program coordination ▪ Ownership of specific components ▪ Stakeholder engagement and alignment ▪ Enacted communication	▪ Planned change ▪ Emergent change ▪ Formative, just-in-time monitoring of program operations ▪ Dissemination of course corrections ▪ Summative monitoring of progress toward goals ▪ Dissemination of summative findings

planning efforts (second stage). Setting up well-defined objectives in the vision stage; clarifying processes for operation, coordination, and evaluation; and outlining mechanisms for communication and feedback in the planning stage will support smooth implementation (third stage) and help identify contextual characteristics the program should adapt to (evaluation and adaptation stage).

Although we define the stages one after another, it is important to note that the process of eLearning integration is cyclic rather than strictly linear. Moreover, we recommend weaving in evaluation processes through the vision, planning, and implementation stages, so that the information gathered can inform how the program can be modified to adapt to emerging contextual factors. In the following sections, we discuss the stages of the framework, describe how considerations surface and relate to one another at each stage, and define how the stages are related. (A glossary of terms used in the framework and considerations is appended.)

Vision

Typically, a narrow set of champions and decision makers articulate the program vision, define the government and stakeholder vision, and analyze the socio-ecosystem. While the stakeholders involved in this stage and their vision may vary widely from one context to another, certain considerations are common to all efforts. The general political climate and policy context frame the program priorities and inform specific goals and success indicators; similarly, considerations about program funding are shared across all integration efforts. These early considerations set the context for and, in hindsight, help make sense of an eLearning program's progress.

For example, the e.Escolinha or Magellan program in Portugal was envisioned, planned, and implemented in the policy context of Portugal's Technology in Education (PTE) plan, which grounded the integration effort in a broader agenda of education reform. The program was a collaborative effort between the Ministry of Education (MoE) and the Ministry of Public Works, Transportation, and Communication (MOPTC), with the former providing leadership for the program and the latter coordinating purchase and distribution of devices. The program enjoyed strong support from the prime minister's office, which could be considered a program champion, and several corporate agencies. Digital inclusion and the acquisition of 21st century skills are strategic priorities of the program; specific goals include equal ICT access for all students and the use of computers and the Internet for learning. Indicators of change include improved computer-student ratio (one computer for every two students), greater Internet connectivity (tracked using broadband penetration), and enhanced digital literacy.

Because these considerations are common across diverse eLearning programs, they can be used to compare efforts. For example, the priority of social and economic change, achieved through the modernization of education, undergirds all five technology integration case studies included in this research. Across settings, these priorities are also expressed as similar goals: increased and more equitable ICT access, greater ICT proficiency for teachers and students, and the acquisition of 21st century skills.

At the same time, because political events influence the timeline and goals of education technology integrations, differences in the political climate contribute to a different "flavor" in different eLearning contexts. The Macedonia rollout, which is aligned with time-sensitive campaign promises, targets students in primary grades across the country. In this rollout, the modernization of education in the form of computer access for students and therefore improved ICT literacy was positioned as the immediate short-term indicator of success. In contrast, the Koaceli rollout in Turkey focuses on sixth-grade students in one municipality. That ongoing program is one element of a longer-term, multifaceted plan to transform the local economy. In this context, digital inclusion is but one element of the municipal government's larger plan to transform Koaceli from an industrial hub to Turkey's Silicon Valley.

The vision for eLearning integrations sets the stage for planning activities, which spell out preparations, processes for operations and coordination, and mechanisms for evaluation and dissemination of course corrections that are required to translate the vision into practice. For example, the vision of digital inclusion and the focus on informal and formal settings in Portugal made it necessary to plan for subsidized Internet connections for families and broadband capability for schools. Because the program was part of a more comprehensive education technology policy, professional development for teachers was coordinated with other teacher certification offerings provided by the MoE.

Planning

In the planning stage, the pool of stakeholders expands beyond the early champions to include decision makers from a wider range of government and educational organizations that create a long-term plan, look for levers of change, build multistakeholder alignment, and design strategies. During this stage, stakeholders outline the organizing principles and processes for implementing the vision. Common consid-

erations include the geographic and human scale of the program, ICT preparedness of rollout sites, and the processes for program coordination and operations, stakeholder alignment, communications among stakeholders, and the dissemination of course corrections. These considerations can be used during the planning stage to scope, scale, and time the preparations necessary to translate the vision into concrete processes for program implementation at the targeted or "last mile" eLearning sites.

For example, the ConectarIgualdad (Argentina) goal of economic development through educational transformation calls for a nationwide implementation, including all secondary school students and their teachers; multisector ownership and management; coordination and cooperation of stakeholders from numerous governmental agencies, such as the Ministry of Planning, the MoE, the pension and retirement fund, and others; and a process for effective communication among the different agencies involved in the planning stage. The federal ConectarIgualdad committee was established for the primary purpose of tackling the latter three considerations.

Common challenges in the planning stage arise when the program vision limits the scope of planning; for example, the vision might exclude stakeholders that later prove integral to successful implementation or timelines may be forced that do not prioritize educational change. In the case of the ConectarIgualdad program, early planning aligned key stakeholders across the different agencies at the federal level. However, the aggressive timelines of the rollout prioritized distribution goals over gaining buy-in and alignment with provincial and municipal stakeholders. The result is that federal-tier planning has proceeded smoothly, but as the rollout precedes planning the next tier of implementing agents within each coordinating organization, there are concerns that key stakeholders are not vertically aligned. The distribution of eLearning devices has already commenced in several provinces, although explicit processes for involving the provincial agencies, schools, and teachers are not yet in place. The mismatch in timing signals a potential problem for implementation and highlights the need for the integration effort to expand the group of stakeholders to involve the leadership at the regional levels.

Comparisons across programs can help decision makers make more informed program decisions. For example, the eLearning integration in Argentina is the result of a presidential initiative characterized by an ambitious top-down vision and timeline that are difficult to achieve without tight coordination. In contrast, the scope of the 1:1 eLearning program in Koaceli is more focused, although the vision is comparably ambitious. The Koaceli program concentrates on the economic development of one region and the rollout is incremental in nature, emphasizing one target population—sixth-grade students—annually for five years. The same considerations of program coordination and stakeholder alignment are equally vital in both eLearning integrations but are executed on a different scale and timeline in each case and as a result require different resources and alignment. Program decision makers can take these into account when designing their own eLearning programs.

Planning considerations, which are informed by the vision and contextual attributes, influence the implementation stage and ideally lay the groundwork for executing the eLearning program. The planned annual refresh of the rollout to sixth-grade students in Koaceli allowed the eLearning program implementation to proceed in a phased, incremental manner. In contrast, the ambitious goals and timeline of ConectarIgualdad in Argentina are driven by the prevailing political climate. The fact that this program is expected to be an important element of President de Kirchner's 2011 re-election campaign imposes urgency on the schedule for distribution and intensifies the need for the program to meet its goals. The eLearning programs in Argentina and Koaceli can therefore be expected to encounter implementation challenges and successes that are commensurate with their respective approach and scale.

Implementation

The implementation stage engages the broadest and most disparate pool of individuals, including stakeholders and decision makers, implementing agents, and primary and secondary users of the rolled out solution, such as students and their teachers or parents. The activities at this stage involve program operations and management, typically concentrated at the eLearning sites. If we consider the planning stage to be one where the vision is translated into distinct, measurable action steps, then we can consider the implementation stage to be one where the vision is enacted as a concrete set of practices. It is also in this phase that visions and plans meet their greatest challenges. Common considerations at this stage include the rollout of elements; program adoption, operations, and management; and ongoing processes for stakeholder alignment and communication.

In the integration effort in Koaceli, where the focus is on a single grade level in one municipality, eLearning devices are distributed annually to all sixth-grade students and their homeroom teachers.[2] The impetus for the Koaceli integration comes from the mayor's office, reinforced by support from the prime minister's office because

of shared party loyalties. However, the program is characterized by a lack of coordination and communication between the mayor's office and the MoE at the federal and provincial levels. According to the MoE in Ankara, the responsibility for supervising and managing the integration lies within the mayor's jurisdiction. Consequently, neither the MoE nor the Koaceli Department of Education (DoE) appear to own the program or feel responsible for implementation. On the other hand, representatives from the mayor's office maintain that the MoE should play a more central role and provide professional development and pedagogical support to help teachers integrate the eLearning device effectively into teaching and learning practices. Contention about program ownership, in turn, affects associated implementation processes, such as the timing and rollout of professional development and pedagogical support for teachers and the development of curricular resources. One result is that teachers report feeling frustrated and disappointed by the paucity of professional development and curricular offerings and therefore disengaged from the integration.

Challenges typical during implementation include poor coordination of the rollout elements, resistance from schools and teachers, and poorly executed handoffs between horizontal and vertical stakeholders. The programs that best tackled these challenges clearly prioritized educational change and maintained integrity to the underlying vision. This allowed program coordinators and decision makers to make difficult program-wide tradeoffs. For example, a number of teachers initially resisted the rollout in Piraí, protesting that they were not adequately prepared. In response, program coordinators temporarily halted the distribution of devices to schools while they conducted additional sensitization training for the teachers.

These considerations can also help illustrate how differences in approach can lead to differences in buy-in and program adoption. A holistic cross-contextual approach, focusing on school settings and informal family settings, distinguishes Turkey and Portugal from Macedonia, where the eLearning initiative is concentrated exclusively in schools and classrooms. Although teachers are expected to integrate ICT into teaching and learning, usage of the eLearning device is voluntary in Koaceli (Turkey) and Portugal. As a result, there is less entrenched resistance from teachers, and both countries are characterized by examples of innovative ICT use, even though program adoption tends to be somewhat uneven overall. Usage is, however, mandatory in Macedonia, where policy requires teachers to use ICT in instruction 30 percent of the time. This policy enacts a monitoring mechanism. It has also spurred a wide range of teacher responses, from compliance to resistance.

Evaluation activities are important across the vision, planning, and implementation stages. Our case study research indicates that ongoing formative assessments are especially vital as they capture information about ongoing progress of the eLearning integration and highlight areas where the program must be adjusted to address challenges or adapted to accommodate contextual attributes.

Evaluation and Adaptation

Stakeholders in the evaluation and adaptation stage may include additional players, such as independent academics and program advisors as well as opinion leaders and the public press. In this stage, stakeholders monitor and review progress to refine and adapt both the program itself and expectations about its goals and success. The evaluation and adaptation stage explores the extent to which implementation of the 1:1 eLearning project is (a) unfolding according to design and (b) effective in catalyzing educational change according to locally defined success indicators. Ideally, evaluation and adaptation activities permeate and inform all stages of the eLearning integration. The assessment of implementation and planning processes, for example, might hold key implications for how the vision of the program must be adjusted to incorporate the practical realities of the program context; likewise, ongoing assessments can also yield recommendations for the adaptation of program implementation processes to address emergent challenges.

Activities in this stage include formative assessments of the program, identifying course corrections for the current integration effort and lessons for future planned efforts, and summative evaluations. Unknown or unanticipated features of the integration context (e.g., teacher characteristics, buy-in at various levels of implementation, organizational capacity and structures, local politics) may have a profound influence on program implementation. Therefore, evaluation processes should describe both planned program characteristics and emergent environmental features. In this regard, just-in-time feedback from ongoing assessments highlights course corrections, while longer-term summative evaluation serves to inform the vision and the planning stages during subsequent efforts.

Ongoing qualitative monitoring of program implementation was a distinctive feature of the municipal rollout in Piraí, which began with one experimental school and was expanded for the municipal rollout. Interviews with teachers and parents revealed important information about laptop use and how it changed over time, transformation in the schools, and overall attitudes and concerns about the rollout. In the experimental school, the integration of the technology and pedagogical

plan included changes to the structure of school activities (e.g., use of time and space) along with changes to the curriculum. Intel was responsible for providing funding and a standard research design and data collection toolkit, and helped catalyze the formative assessment that leveraged learning from the experimental school and motivated key design decisions for the subsequent citywide rollout.

On the other hand, third-party monitoring has been used in Portugal to assess the effectiveness of the integration and its progress to success. The MoE has established the Coordination, Monitoring, and Evaluation team to track the progress and budget of the eLearning initiatives outlined in the PTE; another group called the directory (a loose affiliation of researchers and evaluators) has also been engaged in summative assessments of the program. Formal monitoring of the eLearning integration in Portugal did not begin until the second and third years of the rollout, and most of the research that has been conducted on the program to date has been summative rather than ongoing and formative. While the program is to be commended for its summative research, conducted by third-party researchers, ongoing formative monitoring aimed at informing program changes is also essential and needs more attention.

The framework and considerations explicated here provide a set of tools and a common language for planning, describing, and analyzing eLearning integration efforts. These considerations have emerged from a detailed analysis of the eLearning program case studies conducted to date in Argentina, Brazil, Macedonia, Portugal, and Turkey. Each program provides a canvas that illustrates how the considerations are articulated as concrete program characteristics[3] in every stage of implementation. The early findings from the first phase of research demonstrate the value of using the framework and considerations to guide Intel teams in their efforts to market and deploy 1:1 solutions worldwide. In the detailed program case studies, we applied the framework and considerations to describe each program, highlighting its successes and the challenges, and offered program-specific recommendations of best practices for 1:1 eLearning deployments, Intel's policy advocacy, and Intel Learning Series business opportunities.

With such a common framework and considerations, decision makers responsible for technology-supported education reform in different contexts can assess ongoing eLearning integrations, identifying successes and challenges; compare across eLearning integrations; develop strategies; and make recommendations to address persistent, important barriers. In addition, the research has brought key issues to light in all five programs and unearthed on-the-ground wisdom that can be used to tackle them. We expect that these issues will surface across integrations and will need to be addressed. In the next section, we describe the general rules for addressing common challenges and the collective wisdom drawn from our case study research of the eLearning integration programs studied.

General Rules

1: Take measured steps toward visionary goals, but leave room for innovation.

"Design within constraints" is a hallmark of a successful eLearning program, requiring a fine balance between an open, imaginative vision and the expression of the vision as a series of tangible action steps. Introducing specificity clarifies expectations for implementing agents, such as teachers, administrators, technical support staff, and curriculum designers. Drawing from the examples of our program case studies, we wish to emphasize the translation of a bold vision into concrete action steps as an important practice; at the same time, we also underscore that multiple pathways are available to do so, based on considerations of what is most pragmatic and strategic for the program context.

The eLearning integrations in Koaceli (Turkey) and Piraí (Brazil) were both characterized by an ambitious vision. For Piraí, this involved transforming it into a Digital City first and then into a Learning City. In Koaceli, the eLearning integration was one dimension of a broader vision of transforming the industrial economy of the region into an information-based economy modeled after Silicon Valley. In both program contexts, an incremental approach was adopted to convert the grand vision into a concrete series of actions and practices; however, in each setting, "incremental" was articulated differently, resulting in distinct trajectories for eLearning integration.

The incremental approach used in Piraí involved leveraging the experiences of one school, which participated in an experimental pilot for the federal UCA (Un Computador por Aluno) program, to build a larger, more comprehensive citywide initiative. UCA began with small-scale "experimental pilots" in five schools, one

of which was in Piraí. Decision makers applied the institutional knowledge base and the lessons learned from the UCA pilot to design the citywide program. In the process, an almost seamless transfer of knowledge was achieved as UCA team members were recruited to serve as program coordinators for the citywide program. The citywide program also drew from the UCA pilot to develop a more expanded model of teacher professional development.

In the Koaceli integration, by comparison, an incremental approach led to a rollout that was spread out over time. For a period of five years, program elements including devices, digital content, professional development and pedagogical support, and technical and technological support were rolled out to students and teachers in one grade level (sixth grade) annually. Each year therefore presented the opportunity to gradually build capacity among teachers, refine the infrastructure, develop more sophisticated digital content, and address emerging challenges, such as the lack of involvement of the DoE.

In contrast, the ConectarIgualdad program in Argentina illustrates a more top-down, tiered model for turning vision into action. In Argentina, the first step was to bring the federal stakeholders into alignment and distribute specific elements of the vision to each of them. Subsequent steps will involve trickling down the vision with each stakeholder organization from the federal level to the provincial levels, then to the municipalities, and finally to the schools. This incremental approach involves expanding the stakeholder group to include more levels of the traditional government hierarchy at each stage of an eLearning integration. Likewise, it relies on the ability for vertical tiers of such a traditional hierarchy (federal, provincial, and municipal) to execute a common vision.

Although the vision should be broken down into a series of practical action steps and clear objectives, planning should be flexible enough to allow for adjustment, innovation, and growth. As practical realities are better understood or change, as lessons from the field are learned, and as the capacities of implementers build over time, the best plans are the ones that evolve to accommodate current circumstances. Most important, new and fresh ideas will need to be brought to bear on problems, and this will come with time and a posture of flexibility—invitations for contributions and an obvious openness to hearing from the diversity of stakeholders—exemplified by the project leaders.

2: Engage a broad cross-section of stakeholders.

Successful education technology integrations are characterized by buy-in and support on a wide scale, usually resulting from the participation of a cross-section of stakeholders in all aspects of the program, including vision, planning, and implementation. Translating the underlying vision of an eLearning integration into measured steps implies different strategies for engaging stakeholders to manage the direction and pace of the eLearning integration. Again, several possible approaches may be adopted.

For example, the Piraí eLearning integration emphasized a consensus approach, ensuring the involvement of school administrators, teachers, and parents to identify community goals and develop a pedagogical plan. Such broad-based stakeholder engagement helped to distribute program ownership from an early stage and fostered buy-in for the program from the bottom up. Soliciting input from several stakeholders also helped balance the power and influence of various stakeholder groups by providing a voice and an opportunity to share concerns with all groups.

In Koaceli, a more traditional program planning approach is in evidence where the partner organizations involved in the eLearning integration (namely, the mayor's office and the MoE) executed program responsibilities according to agreed-on roles and divisions of labor. Although designed as a collaborative effort, the lack of alignment between the mayor's office and the MoE emerged as a key challenge. Technology integration did not feature highly among the priorities of the minister of education, who entered office after the Koaceli 1:1 initiative began, and the MoE was less involved in the integration than originally expected. The incremental approach of the program described in the previous section, however, created an opportunity for addressing this challenge gradually. As a result of ongoing discussions, the national MoE recently agreed to expand its priorities to include technology, with a new technology initiative to be announced shortly.

In Argentina, the scope and scale of ConectarIgualdad necessitated a top-down approach to stakeholder engagement that followed the vertical tiers of the traditional governmental hierarchy. In the vision and planning stages of the program, federal stakeholders were the first to be engaged, through a ConectarIgualdad committee that included leaders from all coordinating organizations. The program is designed to involve provincial and municipal stakeholders during later stages of the eLearning integration, an issue that has emerged as a key priority, given the aggressive distribution timeline and the fact that implementation has already begun at various sites.

3: Form a third-party organization for program coordination.

Integrating ICT into teaching and learning to support education reform is complex: Implementations are often ongoing; effects are often indirect and involve multiple time scales; politics are central, even enabling; and contexts are varied and constantly changing. To be effective, eLearning integrations require alignment and a shared sense of ownership among a varied and sometimes factional set of stakeholders. Well-managed programs buy time and create the context for educational change by fostering mutual commitment, alignment on important priorities, and distributed ownership and coordination among a set of stakeholders (individuals or organizations) with diverse, competing agendas.

To engage a group of stakeholders, deliberate coordination and communication are vital. Effective program-specific coordination requires a clear, high-level authority that uses compelling and well-communicated ideas to coalesce stakeholders around the integration's vision and goals. In general, more effective coordination efforts create buy-in, engagement, and ownership across stakeholder levels, cultivating genuine interest rather than dictating policy. More effective programs also plan for coordination both horizontally, across stakeholder organizations, and vertically, within the hierarchy of any single agency. The integrations we studied shared the challenge of sustaining stakeholder alignment and communication at both levels. Specifically, our research indicated the importance of intermediaries in an eLearning integration: organizations or individuals capable of functioning as "boundary crossers" to coordinate and facilitate communication among various stakeholder groups.

Often, such a coordinating function can be executed by a third-party organization constructed organically, representing multiple stakeholder groups, centered on the program, and working to coordinate the activities of the eLearning integration. In this instance, too, we acknowledge various approaches for coordinating multistakeholder engagement consistent with different program models and priorities. In Piraí, for instance, a group formed out of the program coordinators was responsible for managing day-to-day program operations. In keeping with the consensus model of stakeholder engagement described in the previous section, this group facilitated two-way communication, disseminating information about the program and gathering feedback and insights among all tiers of stakeholders, including municipal offices, school staff and teachers, and parents.

A contrast is Argentina's ConectarIgualdad, which has succeeded in creating a high-level management committee that aligns goals and actions at the national level. However, as discussed earlier, the smooth coordination evident at the federal level has yet to trickle down into the provincial levels where the infrastructure and human capital for implementation reside. In Argentina, vertical alignment is the pressing issue that needs to be addressed by bringing teachers and school leaders into the planning process and clarifying responsibilities for supervising the implementation at the local level.

4: Adopt a distributed model for program preparation. Assume a contingent, flexible stance.

The implementation of an eLearning integration hinges on the tight coordination of a sequence of elements and a carefully planned implementation process that requires staged distribution and ongoing evaluation. For example, the electrical infrastructure for Internet connectivity must precede the distribution of laptops. By the time laptops are delivered, implementing agents, such as teachers, should be trained. Each learning environment should also have in place provisions for on-site, timely technical support and ongoing pedagogical support for teachers. Once teachers and students have begun using the technology, the development and distribution of digital content must keep pace with their needs.

Given the number of elements that must be in alignment, preparation for a technology integration effort is an enormous undertaking, requiring great attention to detail. Key areas of preparation are physical infrastructure, human resources, and community. Internet connectivity and electrical capacity must be in place for eLearning implementation. Teachers' professional development should not only focus on the technical usage aspects of the eLearning solution, but also include pedagogical strategies for incorporating ICT into teaching and learning, and modifying instructional practices to support students' acquisition of 21st century skills. Ideally, teacher professional development should also cohere with other education policy imperatives. In addition, our research found that an ecology of organizational infrastructures such as management, technical support, pedagogical support, and parental involvement were also key supports for eLearning programs.

The literature on the enactment of technology-supported school reform and examples from our integration research verify that preparing for an eLearning integration is an ongoing process that does not end before implementation. The collective wisdom from our research emphasizes a distributed approach to preparation. Beyond building a common vision, stakeholders in the integration

process need to assume diversified roles and responsibilities that are clearly specified and monitored. Roles and responsibilities must be comprehensive, covering mission-critical aspects of the integration, and clearly defined and distinct so as to alleviate stakeholders' concerns about encroaching into others' domains.

The multisector ownership of Argentina's ConectarIgualdad is one model of distributed preparation illustrating how different organizations can coordinate different aspects of an integration. The Ministry of Planning is responsible for infrastructure preparation, the pension and retirement fund handles funding and financing, and the MoE is in charge of professional development and pedagogical support. A very different model is evident in Macedonia, where the distributed approach to preparation includes various third-party organizations, such as the Academy for Educational Development, that were brought in to provide professional development and pedagogical support and thus bolster the MoE's efforts. A distributed model of program preparation can also include a phased approach to eLearning integration. In Turkey and Portugal, the eLearning integration prioritized the home and family contexts. Therefore, preparation in terms of electrical and Internet connectivity infrastructure was focused on informal learning settings. Infrastructure preparation in classrooms and schools is, however, underway and expected to be more fully developed by the time device usage is required in formal education settings.

Preparation for an eLearning integration is an ongoing process, requiring a sustained investment of resources. In all five case studies, we observed continued physical infrastructure needs including systems maintenance, repair or replacements of hardware, and software upgrades or purchases. Systems and devices also malfunction occasionally, and users require prompt and efficient technical support. Further, teachers' professional development and pedagogical support must be addressed on an ongoing basis to promote a culture of continual learning and improvement.

Given the number of details to be juggled and challenges likely to arise at each stage, the process of preparing for an eLearning integration is neither perfect nor ever complete. Examples from all our field research sites indicate that in practice, and despite the best intentions, devices are distributed before the entire physical infrastructure has been readied, technical and pedagogical support is not always in place when devices are handed out, and teacher professional development sometimes follows distribution instead of preceding it. We recommend that program planners and implementers adopt a flexible, contingent approach toward preparation. As they address the challenges presented by the integration, the capacity for implementing agents will change over time, increasing their ability to address more sophisticated challenges and goals. To get to this stage, government officials must recognize the types of communication and experiences most effective for expanding the capabilities of implementing agents.

Conclusion

The literature on technology-supported education reform and the experiences of practitioners indicate that eLearning integrations pose a number of challenges. Although several empirical studies have highlighted the successes and challenges of specific eLearning integrations, little research has investigated patterns across education technology integrations to explain why. Our project addressed this gap in research and practice by focusing on five eLearning integrations and comparing them to construct a framework for analyzing the progress of eLearning initiatives. As we reviewed programs through the lens of the framework and considerations, we were also able to identify areas where programs tackled common challenges or evidenced effective practices—the general rules. In addition to the familiar challenges, we were able to discern an emerging collective wisdom about how they could be tackled.

In the near future, we will most likely see more governments and institutions investing in eLearning as an education reform strategy. We advocate a holistic approach for the design of these programs, considering the ecology of contextual, policy, and program considerations that each community will mix to create its own eLearning program. In the process, we offer the framework, considerations, and general rules as resources to help decision makers in governments, NGOs, and universities, as well as Intel team members, to plan, describe, assess, and adapt eLearning integration efforts. At the same time, we emphasize that our research is ongoing. As we expand it to include more program contexts, we expect that our framework and considerations and our understanding of implementation processes will evolve to keep pace with new learning from new contexts.

Appendix

Framework and Considerations Glossary

Vision

Consideration	Definition
Champions	The chief sponsors or advocates for the integration; these may or may not be the principal decision makers.
Education and ICT policy context	The policy milieu in which the integration is being—or will be—enacted that situates each specific integration within a broader framework of education or economic reform.
Funding model	The funding streams that support the integration and strategies for sustaining the integration.
Goals and indicators	The specific targets of the integration and the events that demonstrate whether and to what extent the integration is achieving its goals.
Political climate and opportunity	Current political events or the designs of political actors that shape the integration.
Program priorities	An area of policy emphasis to which the integration is expected to contribute; priorities can be (and often are) expressed in abstract, visionary language.

Planning

Consideration	Definition
Communication	Formal and informal communication strategies to improve the flow of information among stakeholders, enhance stakeholder alignment, and advance program coordination.
Feedback mechanism for course corrections	Planned activities and mechanisms to capture emergent changes, resulting from unknown or unanticipated aspects of the integration context, and adjust program planning and implementation.
Geographical and human scale	Some integrations address a large scale, including entire nations and students at several grade levels (e.g., Argentina, Portugal, and Macedonia), whereas others are more locally centered and incremental in scope (e.g., Koaceli and Piraí). The latter may function as pilots for later large-scale integrations.
ICT infrastructure preparation for rollout	The electrical (outlets, etc.) and connectivity (network cables, broadband connection, etc.) infrastructure that needs to be ready for the use of the eLearning solution. This consideration also includes the agencies responsible for coordinating and assessing the infrastructure preparation activities.
Program operation and management	Systems for ongoing implementation monitoring, providing resources and supports where necessary; program planning or coordination for handoffs between decision makers and implementers.
Stakeholder engagement	Planned activities and mechanisms for inviting engagement from program stakeholders, both horizontally, across coordinating organizations, and vertically, within the hierarchy of a single organization.

Framework and Considerations Glossary

Implementation

Consideration	Definition
Enacted communication	The extent to which communication strategies facilitate communication among various stakeholder groups, and support stakeholder engagement and alignment.
Ownership of specific components	Specific accountability for different program elements.
Program adoption/enactment	The extent to which the integration is mandated or voluntary and to which it is adopted or enacted by target audiences.
Program coordination	Program monitoring that happens on an ongoing basis and the agency/organization that is accountable for smooth day-to-day operation of the program.
Rollout of elements/components	Specifics on how various eLearning components (ICT hardware, software and services, teacher professional development, curriculum and assessment, research and evaluation, and policy) are rolled out to the target audiences.
Stakeholder engagement and alignment	The extent to which program stakeholders connect with and contribute to the integration.

Evaluation and Adaptation

Consideration	Definition
Dissemination mechanisms	For informing stakeholders and implementing agents about course corrections and summative findings.
Emergent change	Unknown or unanticipated features of the integration program context (e.g., teacher characteristics, buy-in by various levels of implementation, organizational capacity and structures, local politics) that may influence enactment in nontrivial ways.
Formative, just-in-time monitoring of program operations	Assessment designed to capture emergent changes and identify adjustments to program operations to accommodate (or take advantage of) unanticipated contextual factors.
Planned change	The extent to which the integration is effective at catalyzing educational change according to locally defined success indicators.
Summative monitoring	Monitoring of progress toward goals to capture planned changes, assess progress to success, and identify lessons learned.

[1] Aligns to the framework describing the process of policy formation in Kozma, R. (2011). Policy for Education Transformation: An Educational Policy Brief. Intel Policy Briefing Series.

[2] The annual refreshes are planned until 2013.

[3] For more detailed examples, please see program case studies.

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