INTEL® EDUCATION TRANSFORMATION RESEARCH

Guiding Principles for the Design and Implementation of eLearning Initiatives

A Synthesis from Nine Implementations Worldwide

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Introduction

IN THIS SECTION

Computers, digitization, and information technology have been steadily changing our lives and the world we live in for over 30 years. The power of technology has grown even more deeply enmeshed in contemporary life with the proliferation of data networks, wireless access, and smart devices. Governments around the world have been modernizing, adapting, and transforming their education systems both to take advantage of these new technologies and to meet the challenges of preparing their students to succeed in the 21st century.

As technology continues to become more powerful and ubiquitous, this education transformation needs to move beyond just adding technology into the mix of resources used by teachers and students. Technology needs to become part of the basic fabric of the learning process; it should support, enrich, and enable the type of learning we seek to offer all our students.

Intel has always sought to be a critical partner to government entities that are working to create comprehensive eLearning environments. In recent decades, Intel has collaborated with eLearning initiatives in numerous countries where education ministries are trying to maximize every advantage that technology has to offer.

To inform educators and policymakers about the benefits and challenges of integrating these resources into their education systems, Intel leverages its long history of support and involvement in education technology and reform and its global network of education-focused nongovernmental organizations (NGOs), government partners, and research institutions to undertake innovative and much-needed research about the use of technology in diverse national contexts.

About This Document

As part of its commitment to education research, Intel has funded multiyear Education Transformation Research projects within nine countries or jurisdictions that are carrying out 1:1 eLearning initiatives. This report synthesizes their findings to highlight a number of guiding principles for designing and implementing eLearning initiatives.

Intel's Education Transformation Research is designed to meet the emerging questions and needs of governments, universities, NGOs, and other actors interested in transforming education systems through the integration of ICT (Intel 2013). 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 initiatives of differing maturity.

For this report, EDC reviewed more than 20 reports and studies, looking for patterns, similarities, and differences in the experiences of these nine initiatives. Our research spanned three phases in the development of each initiative, from design and planning to early implementation to ongoing support and development.

The first section of this report presents seven design principles that emerged from the research and that are key to designing and developing a viable 1:1 eLearning initiative. In the second section, we outline seven implementation principles to guide leaders and administrators in carrying out initiative activities. The third section describes early initiative results and impacts. What follows is a brief description of each eLearning initiative. For more information, see appendices A to H.

Overview of Initiatives

IN THIS SECTION

Argentina: Conectar Igualdad

Argentina's Conectar Igualdad is a nationwide initiative intended to improve public education and reduce digital inequality. Since 2010, the initiative has distributed over 3 million netbooks (Classmate PCs) to high school students. By allowing students to take computers home, Conectar Igualdad targets the dual priorities of educational enrichment and digital inclusion for all families. In Argentina's decentralized education system, the federal government distributes the devices, and each province coordinates its own teacher professional development strategies. Although in the beginning many schools faced challenges connecting to the Internet, families registered strong support for Conectar Igualdad, and the initiative made great gains toward its goal of digital inclusion.

Kocaeli, Turkey: One Computer Per Child

The Kocaeli One Computer Per Child initiative is part of a larger effort to transform this former industrial city into a center for ICT and innovation with the long-term goal of becoming the "Silicon Valley of Turkey." This provincially sponsored initiative sought to impact families as well as schools. To distribute the netbooks, Kocaeli targeted all grade 6 public school students in the province and their homeroom teachers. From 2009 through 2011, the government distributed approximately 27,000 computers to these students and their teachers each year. The Kocaeli initiative offered technology-related professional development for teachers as well as computer training to families through a network of adult learning centers, the Kocaeli Metropolitan Municipality Crafts and Art Education Courses (KO-MEK).

One Computer Per Child has had a major impact on providing technology access to low-income families in the province. The research suggests that students and their families use technology more frequently outside the classroom. All family members—siblings, mothers, and fathers—are using the laptops for a variety of activities related to school, work, and entertainment. Overall, parents and students view computers as useful tools—and the more they use them, the more benefits they enjoy. The Kocaeli initiative is now coordinating its efforts to support the national eLearning project, FATIH (which stands for Fırsatları Artırma ve Teknolojiyi İyileştirme Hareketi, or Movement to Increase Opportunities and Technology) that is focused on deep transformation of education.

Korea: Self-directed, Motivated, Adaptive, Resource-enriched, and Technology Education (SMART Education)

The SMART Education initiative of the Republic of South Korea (hereafter Korea), which is being rolled out between 2011 and 2015, is the fourth phase of the government's master plan for education technology. SMART Education seeks to promote the use of ICT as a primary source of learning, rather than as a supplementary resource. The vision is for each classroom to be equipped with a mix of personal smart devices as well as personal computers or laptops, interactive whiteboards, wireless Internet access, and cloud-based learning platforms and resources. Above all, SMART Education enables learning at any time and at any place through a teaching and learning system tailored to the needs of each individual student. As part of the SMART Education initiative, the government is creating digital textbooks and resources, institutionalizing online classes and online assessments, and creating a virtual learning environment that allows public access of digital learning resources.

At the school level, the Ministry of Education is currently piloting the approach. Schools apply to be a pilot site, and once accepted they become testbeds for the development of models of 1:1 eLearning with multiple devices and digital resources. Based on the case study data, the SMART Education initiative has had a noticeable impact on teachers, particularly in the area of technology and assessment. The teachers are now thinking about how to genuinely integrate technology into the assessment process. Researchers

observed an increase in the use of digital student portfolios and digital tools that enable teachers to make instantaneous changes in teaching by checking on the learning and understanding of students in real time. Researchers observed that students were increasingly using technology as an essential learning tool to explore the world around them, to collect and analyze data, and to share and discuss with peers and their teachers.

Macedonia: Computer for Every Child Initiative

In 2008, as part of the Computer for Every Child initiative, the government of Macedonia made a commitment to distribute Intel Classmate PCs to 53,000 students in grades 1 to 3 and to deploy 55,000 thin-client desktop systems in grades 4 to 8. The Ministry of Education also localized and translated into Macedonian and Albanian 43 open-source applications focusing on mathematics and science and pre-installed them on the netbooks. The Computer for Every Child initiative also used the Intel Learning Series to train teachers on the use of the laptop and on creating a 1:1 eLearning environment.

By 2012, the initiative had produced positive changes across classrooms in Macedonia. The ratio of computers to students, which was 1:45 at the beginning of the initiative, has now been reduced to 1:1. As a result of increased access, more teachers are using ICT in their daily instruction, and all teachers report using an ICT-based activity at least once per week across all subjects. While the quality and complexity of technology integration varies across teachers and classrooms, the improved access has increased communication, collaboration, creativity, and differentiation across all settings. In classrooms with more advanced integration models, researchers are beginning to see changes in teaching practices to create a more student-centered learning environment.

Piraí, Brazil: Um Computador por Aluno

Piraí, Brazil, was one of five experimental sites for the national 1:1 eLearning initiative Um Computador por Aluno (UCA, or One Computer per Student). In Brazil, the federal Ministry of Education works closely with municipal and provincial education departments to support local ownership of the UCA initiative, and thus it is tailored to local needs. In Piraí, UCA was implemented in conjunction with a municipal digitization program, Piraí Digital, an extensive digital inclusion effort aimed at addressing local economic development concerns that includes IT infrastructure development, access centers for adults, and other investments outside schools. Intel program designers were interested in supporting the goals of Piraí Digital in general while including laptops in the overall education transformation effort. The Piraí Digital program expanded public wireless Internet access across the city and built out information technology and human resource capacity in municipal offices. UCA provided laptops to all students and teachers in the municipal schools and introduced a new learning model that gives students more autonomy and control of their own learning.

Portugal: Projeto Magalhães

Projeto Magalhães (Project Magellan) was part of a National Technological Plan, that sought to bridge the digital divide as well as to modernize the Portuguese education system. Between 2008 and 2011, every primary student (grades 1 to 4, ages 6-10), from both public and private school establishments, was given the opportunity to acquire an Intel-powered Classmate PC, locally manufactured by JP Sá Couto, freely or at low-cost with a government subsidy. Over four years, the initiative distributed over 750,000 netbooks and created a portal of educational resources—Portal das Escolas. At home parents and students use the computers for homework. For many families, this is their first computer.

The Magellan Project also helped establish a local company, JP Sá Couto, in manufacturing netbooks and other educational materials for local and international markets. Sá Couto has now sold millions of devices throughout South America as well as in Portugal.

Republika Srpska, Bosnia and Herzegovina: Project Dositej

The goals of Project Dositej are to increase opportunities for students to learn skills that will prepare them for future job markets and to modernize education in Republika Srpska's schools. The initiative launched in the spring and summer of 2012 with the distribution 10,200 netbooks and 408 teacher laptops to 63 selected schools throughout the country. The government is expanding the initiative to all schools in 2014. Within each school, a number of classrooms are set up as e-classrooms with class sets of netbooks and interactive whiteboards; some schools have Internet connectivity. Project Dositej has been successful in promoting the use of ICT in the e-classrooms. Teachers and students are increasingly comfortable and competent with the technology. A continuing challenge is a lack of educational resources in the local languages, but many teachers are translating open-source educational resources and developing their own lessons in the appropriate languages.

Shanghai, China: e-School Bag Project

In 2010, the Shanghai government launched the e-School Bag Project as part of the Shanghai Medium and Long-Term Development Plan for Education Reform and Development. The project has two key components: creating and implementing a digital curriculum environment, and fostering a technology-based self-directed 1:1 eLearning model for students. The purpose of the project is to create an environment in which all students have access to individualized digital content through mobile devices that enable learning anytime and anywhere. The government piloted the e-School Bag Project in 11 of the city's primary and middle schools, which received 2,500 mobile learning devices as well as teacher training and support. The pilots are assisting the Shanghai Ministry of Education in developing appropriate eLearning models and curricular resources and in designing teacher professional development strategies that will help expand these new learning models from the pilot schools to other schools in the city. The pilot research found that the use of laptops and online resources increased the amount of self-directed learning activities that require critical thinking skills and helped students develop collaboration skills.

Terengganu, Malaysia: E-Book Project

In May 2009, the Malaysian state of Terengganu launched an ambitious new e-Book Project (Projek Buku Elektronik) to provide an Intel Classmate PC loaded with digital textbooks and other resources to every primary school pupil in grade 4 (ages 10 and 11). The goal of the e-Book Project was to increase computer literacy among Terengganu citizens, including students and their families, thereby producing tech-savvy, innovative citizens and reducing the digital divide between urban and rural communities and between high- and low-income households. The computers are given to the child, who takes the computer home for family use so that even poor families have access to technology. The project coincided with a number of important national initiatives aimed at moving Malaysia toward an ICT-rich global economy. The national Economic Transformation Programme (ETP) and Multimedia Super Corridor, for example, are intended to provide impetus and infrastructure for increased digital capacity in multiple sectors throughout the country.

The initiative is seen as successful in its goal of bridging the digital divide, with low-income families now having access to computers. By 2012, 93,000 netbooks were distributed to students in grades 4 to 8 (9 to 14 years old), and the Terengganu government has provided wireless access points in rural areas to ensure that rural families can also access the Internet. In addition, a network of model technology-rich schools has been established throughout the province to support the dissemination of innovative pedagogy to other schools in the region.

Characteristics of Each eLearning Initiative

Country	Name	Scope	Year	Grade Level	Ownership
Argentina	Conectar Igualdad	National	2010-present	Secondary	Student
Republica Srpska, Bosnia	Project Dositej	National	2009-present	Primary	School
Piraí, Brazil	One Computer per Student (Um Computador por Aluno)	Provincial	2008 (pilot) -present	Primary and middle	School
Kocaeli, Turkey	One Computer Per Child	Provincial	2010-present	6th grade	Student
Korea	SMART Education	National	2011-2015	Primary, middle, and secondary	School
Macedonia	Computer for Every Child	National	2008-present	Primary and middle	School
Terengganu, Malaysia	E-Book Project (Projek Buku Elektronik)	Provincial	2009-2012	Primary	Student
Portugal	Project Magellan	National	2008-2011	Primary (grades 1-4)	Student
Shanghai, China	e-School Bag Project	Provincial	2010-2013	Primary, middle, and secondary	School

Country	Device	# of Devices	School Set-Up	Internet Provided at School	Internet Provided at Home
Argentina	Classmate PC	4.2 million	Not applicable	Varied by province	No
Republica Srpska, Bosnia	Classmate PC	10,200 student 408 teacher	Technology-rich 1:1 classrooms	No	No
Piraí, Brazil	Classmate PC	5,500 student 560 teacher	Not available	Yes	Yes
Kocaeli, Turkey	Classmate PC	53,418	Not applicable	No	No
Korea	Smart devices	Not available	Varies by school	Yes	No
Macedonia	Classmate PC/ Thin Client	53,000	Classroom sets in primary/ Thin Client in middle	Yes	No
Terengganu, Malaysia	Laptop	93,000	Virtual classrooms: teacher laptop, IWB	Yes	Yes, in rural areas
Portugal	Classmate PC	Over 750,000	Not applicable	Yes	Optional family purchase
Shanghai, China	Tablets	N/A	Classroom sets of resources distributed	Yes	No

Table 1

Initiative Planning and Design

IN THIS SECTION

"Education transformation supported by technology can be reality only when it is be guaranteed by supporting policies and measures." – *Zhang et al. 2013, p. 91*

For a meaningful 1:1 eLearning initiative, careful planning is important. Laptops, wireless access, and smart devices are powerful technologies, but their impact in schools and in the lives of young people will be diluted in poorly designed initiatives. One clear finding from these nine case studies is that formulating a solid plan or logic model of the initiative is fundamental to creating a successful eLearning initiative. The logic model should span all stages of the initiative's life, from development and planning to launch and ongoing support.

This chapter presents a set of guiding questions with examples and recommendations about developing and leading a viable large-scale 1:1 eLearning initiative. Seven core design principles are delineated, and examples from the nine cases are provided to illustrate key concepts.

This guide is intended to support a discussion among stakeholders as they develop their own versions of 1:1 eLearning initiatives. Each section offers a number of direct questions that should help stakeholders focus their discussions. The design principles are as follows:

1. Clarify the vision and set realistic goals.
2. Design a practical and effective technology usage model.
3. Create digital curriculum and resources.
4. Build a strong leadership team and cultivate partnerships.
5. Learn from and leverage past eLearning programs.
6. Create a coherent policy ecosystem.
7. Cultivate support of stakeholders.

Finally, after reviewing these seven principles, the chapter concludes with a discussion on how to integrate these seven themes to develop a coherent project logic model. One clear overarching finding from the nine cases is that initiatives that had a coherent logic model of how the ICT intervention should function in schools and or in homes, planned needed supports, and foresaw expected obstacles yet remained flexible were more successful in the long term and better able to adapt and modify their initiatives in response to emerging challenges.

1. Clarify the Vision and Set Realistic Goals

It is important to establish a clear understanding of the initiative's vision and goals at the outset, being careful to distinguish between the vision, which may be idealistic, and goals that are achievable and measurable. It is vital to remember that the vision needs to be operationalized in the schools and communities as they are today. For governments and the designers of large-scale initiatives, there is always a tension between the world they hope to create with an initiative and the reality of implementing activities that need to start where schools and communities currently are. It is not unusual for 1:1 eLearning initiatives to launch only to find that schools do not have sufficient electrical outlets in classrooms or that the Internet connection is a single landline into the director's office. Careful planning and forethought can help prepare for such challenges.

By looking across these nine cases and comparing the initial vision with the actual activities and goals that were implemented, it is possible to see how these initiatives moved from high-level aspirations to viable undertakings with practical objectives.

What is the focus of the initiative?

All of these initiatives promoted long-term visions for social change and educational transformation that generally fell into four categories: education reform, social inclusion, workforce development, and economic development (Table 2). Each of these targets is very broad; for any of the initiatives to become feasible, it was important to translate the initial concept into a set of practical, attainable objectives.

Long-Term Visions of Each eLearning Initiative

Country	Education Reform	Social Inclusion	Workforce Development	Economic Development
Argentina	•	•		
Republika Srpska (Bosnia)	•		•	
Piraí (Brazil)	•	•	•	
Korea	•			
Macedonia	•			•
Terengganu (Malaysia)	•	•		•
Portugal	•	•	•	
Shanghai (China)	•		•	•
Kocaeli (Turkey)	•	•	•	

Table 2

The education reform category includes initiatives aiming to impact any level of the educational system. Social inclusion encompasses initiatives that provide technology access to poor and rural families. Workforce development initiatives have a component related to job and ICT skills training. The economic development dimension includes initiatives that generate jobs and increase overall GDP.

The initiative's objectives should range from short- to long-term goals. Short-term goals, such as providing poor families with access to laptops, are generally attainable within the scope of the initiative itself. But long-term goals, such as promoting more student-centered learning, are usually dependent on other supports outside the immediate control of the initiative. Therefore, it's important to have a solid understanding of how long-term goals build on short-term goals and what other supports may be needed to achieve long-term success.

It is also important to note that visions tend to be fluid; they can and should change over time in response to initiative changes, to newly identified needs in the population, or to changes in the political situation. For example, Project Dositej in the Republika Srpska (Bosnia) launched with an initial focus on workforce development that evolved into a focus on education as the government learned more about what was needed on the ground. Similarly, the Argentinian initiative, Conectar Igualdad, started with a strong emphasis on education, but because of the numerous challenges to implementation in Argentina's decentralized education system, the rhetoric shifted towards social inclusion.

Is education reform one of the goals of the initiative?

All of these initiatives were intended to impact education, but each one targeted different aspects. Korea's SMART Education initiative, for example, is the fourth phase of a decade-long plan (Chun & Kye 2013); this phase of reform seeks to promote multidevice, exploratory learning activities for students.

Schools are complex networks of interdependent systems and personnel, and any change will need to be integrated into a variety of systems and adopted by thousands of teachers, administrators, and students. Educational reform was the only shared vision across these initiatives as well as the hardest one to achieve.

CASE STUDY

e-School Bag Project in Shanghai, China – Education transformation supported by technology

The core of Shanghai's education transformation is the commitment to the lifelong development of each student. Shanghai students have some of the highest results on PISA, but intense academic pressure leaves little room for students to work creatively and innovatively. Thus, the goal of Shanghai's transformation is to promote a more self-directed and personalized learning model. The e-School Bag project is an important part of the transformation as it seeks to provide every student with access to cloud-based education resources that support their learning.

Learn more about the e-School Bag Project in China

What aspects of education does the initiative target?

Within the broad area of education, the goals of these initiatives fell into four categories: changing teaching and learning; expanding educational resources; fostering digital literacy and ICT skills in students and teachers; and improving student outcomes (i.e., test scores).

Changing teaching and learning: Promoting reformed and innovative pedagogy is perhaps the most ambitious goal some of these initiatives targeted. To achieve deeper reform is a long-term undertaking and requires more than just introducing technology. Shanghai's e-School Bag Project and Korea's SMART Education initiative both sought to foster tech-based, self-directed, 21st-century learning for students (Chun & Kye 2013; Zhang et al. 2013). In both countries, these 1:1 eLearning initiatives began after other education reform projects had revamped the curricula and rolled out basic ICT infrastructure in schools. For example, starting in 1998, the goal of Shanghai's "basic education transformation is to promote students' personalized learning, to achieve a higher level of educational equity, and to realize every student's potential to be fully developed" (Zhang et al. 2013, p. 13). Most Shanghai and Korean schools already had computer labs, and both teachers and students had basic ICT literacy. Additionally, both initiatives dedicated substantial resources to teacher training and ongoing pedagogical coaching.

Similarly, Brazil's Um Computador por Aluno (UCA) initiative aimed to "prepare students to become co-authors of their own learning process and... to prepare them to be competitive" (Rockman 2009, pp. 9–11). To achieve this goal required a major shift in curriculum and pedagogy. Other countries may not be able to dedicate similar resources to promoting pedagogical innovation or are at different starting points.

Expanding educational resources: Some initiatives also aimed to improve education by using technology to provide more resources. The Shanghai and Macedonian initiatives both funded the creation of digital content. The first step in Macedonia's Computer for Every Child initiative was to promote basic comfort and ICT literacy for teachers and students with ICT resources closely aligned with current Macedonian curricula (Nikoloski & Samardzic Jankova, 2012b); to this end, the country's education ministry translated over

80 open-source educational programs into local languages. Shanghai invested resources in revising instructional materials, producing digital resources (including e-textbooks), and creating a dig tal curriclar environment (including online courses) that align to the new curriculum.

Fostering digital literacy and ICT skills in students and teachers: Some initiatives established educational goals that do not require deep pedagogical innovation, such as promoting digital literacy among students and teachers or introducing ICT into the curricula. One of the goals in the Republika Srpska (Bosnia), for example, is to introduce ICT classes into primary schools and provide at least basic digital literacy.

One of the goals of the Magellan Project in Portugal was to spread digital literacy among students and teachers. Portugal has met with success in reaching its goal by distributing locally manufactured PCs to nearly every primary school student in the country and by training teachers to integrate technology into their classrooms. A Ministry of Education survey of all primary school teachers found that teachers are reporting at least some degree of successful PC integration in their classrooms (Paiva et al. 2012b).

Improving student outcomes: Some initiatives had the goal of improving quantitative student outcomes. One of the goals of the e-Book Project in Terengganu (Malaysia) was to ensure consistent performance on the national test scores of grade 6 students. The state of Terengganu has been a top performer on Malaysia's national standardized exams over the past ten years, and the state education department is eager to maintain that high level of performance. According to the Terengganu authorities, grade 5 children were selected to receive the netbooks so that those students and teachers would have ample time to get used to the computers before their critical grade 6 year. The government hoped that the netbooks and the embedded test preparation software and practice tests would improve student achievement across the state on that important exam.

In China, the e-School Bag Project in Shanghai is seeking to promote a different type of student outcome. Shanghai's Ministry of Education is attempting to lessen the focus on test scores to get stakeholders (including teachers, parents, and students) to value more holistic skills such as scientific thinking, problem solving, critical thinking, collaboration, and communication.

Is social inclusion one of the objectives of the initiative?

In addition to impacting education in their country or state, many governments aimed to create a social inclusion initiative that would help reduce the digital divide between the countries' richest and poorest citizens. The distribution of laptops and other technological goods and services, such as software, training, and Internet access, gives previously disconnected populations the opportunity to seek skills, information, and material goods previously out of their reach. An initiative with this focus endeavors to create a more open and inclusive society for all of its members.

The e-Book Project in Terengganu (Malaysia) also aspired to promote social inclusion by reducing the digital divide between the rural and urban areas, and between pupils from high- and low-income families. By giving a netbook to every grade 5 student, the Terengganu government expects that parents and siblings will have access to the outside world and, at the same time, be able to enhance their own educations and livelihoods. Students have access to the Internet through school, and the Terengganu government set up free community WiFi in the most rural areas (Hoon, Loke, Eng, Dzainuddin, & Noor 2012).

In order to meet its goal of creating a ubiquitous eLearning environment for its students and teachers, the Korean government is working to extend ICT access by establishing an integrated educational data service environment using cloud-computing technology. This will give students, teachers, and administrators the opportunity to learn anywhere and anytime. The government also plans to form and operate an open content market so that individuals can access high quality materials and resources through EDUNET (the Korean educational resource portal) at low or no cost (Chun & Kye 2013).

Although Conectar Igualdad was designed to improve educational equality, and increase graduation rates, the initiative also offered many young adults and families their first experience with a computer and provided educational content and activities for all of its members as well. The expected impacts of the initiative are (1) better learning opportunities for the students and gains in student learning, and (2) better technology access for the families. The initiative provided Internet connectivity, albeit limited, in schools, but families were responsible for acquiring their own Internet access (Artopoulos & Beech 2012).

Is workforce development one of the goals of the initiative?

Although these initiatives were all focused on children and young people, two other objectives appeared in our review of the literature: workforce and economic development. The dimensions of workforce development and economic development are closely allied; for the purposes of this report, we define workforce development as training and preparing young people to enter the labor market, whereas economic development is focused on job creation, developing new markets, and growing national GDP. Workforce development can be both a short- or long-term goal for governments implementing a 1:1 laptop initiative. Macedonia, for example, is hoping to build students' ICT skills.

In Republika Srpska (Bosnia), the workforce development goals connect to the promotion of lifelong learning. With Project Dositej, the government hopes to enable its students to respond to the needs of the job market 20 years into the future. The minister of education believes that "success in the 21st century requires knowing how to learn. Students today will likely have several careers in their lifetime. They must develop strong critical thinking and interpersonal communication skills in order to be successful in an increasingly fluid, interconnected, and complex world" (Nikoloski & Jankova 2012, p.7).

The eLearning initiative in Kocaeli (Turkey) sought to develop the work skills of parents as well as of students. In order to capitalize on the fact that the initiative sent laptops home, the municipal network of adult learning centers increased its offerings of ICT skills, and many parents—especially mothers—started taking computer classes.

Is economic development a focus of the initiative?

The connection to economic development is complex and multifaceted. Similar to workforce development, economic growth and development can be a long-term goal like promoting digital entrepreneurship or a short-term goal like manufacturing.

One potential benefit of selecting the Classmate PC is that local companies can assemble the device. The Portuguese manufacturer was able to leverage its experience in local production to expand internationally but many of these initiatives are using locally produced devices.

Argentina encouraged the local assembly of the Classmate PCs, which promoted job and revenue growth across the Argentinian technology sector. From 2010 to 2011, the production of laptops and netbooks within the country grew by 345 percent (Conectar Igualdad 2014). Because most of the hardware and educational content associated with Conectar Igualdad originates in Argentina, the broader domestic technology industry benefits.

In Malaysia, the economic vision spans both long- and short-term goals. At the national level, the country's government is eager to develop a knowledge society and knowledge economy. The prime minister of Malaysia has said, "The next wave of economic growth will come from the knowledge-based economy, with digital technologies as a key driver of progress. In order to stay competitive and reap its benefits, it is imperative that Malaysia has all the right elements and strategies put in place" (Hoon, Loke, Eng, Dzainuddin, & Noor 2012, pp. 2–3). With the e-Book Project, the state of Terengganu has been able to achieve more immediate economic goals: both the production of the Classmate PCs and the delivery of training are creating more jobs and upskilling the local workforce. A local state-owned company is assembling e-books and setting up virtual classrooms. The Terengganu Skills Development Corporation (TESDEC) is training technical teams to support schools across the province. In fact, one of the criteria to be on these tech teams is that they must be formed within the state.

2. Design a Practical and Effective Technology Usage Model

In order to increase the likelihood of initiative success, it is vital to have a coherent and dynamic model for how and when the actual technology devices will be used by their owners and what other technology resources are need to help achieve the long-term objectives of the initiative. Ideally, this model is tied to the vision and goals laid out by the government. Who owns the computers: the children or the schools? Will teachers

CASE STUDY

Project Magellan – Leveraging an education initiative to promote economic growth

Portugal, like other countries, has used leveraged their eLearning Initiative to encourage the local production of the Classmate PCs. For Magellan Project, the Classmate PCs are assembled Portuguese firm that has grown into an internationally recognized company, JP Sá Couto. Beyond sourcing the laptops locally, the Portuguese government strategically leveraged that early start to promote Portuguese exports. In 2008, the Portuguese government signed a trade agreement with Venezuela that included the purchase of one million Classmate PCs (Paul 2008). The Portuguese manufacturer has now sold three million units in South America. Project Magellan thus seeded a local, sustainable economic model that has generated jobs and trade opportunities as well as partnerships among telecommunications companies and technology providers.

Learn more about Portugal's Project Magellan

receive computers? How will students access resources: by Internet or by preloaded software? How will teachers access curricula: design their own or use prepackaged ones from a shared website? What other technology will be available: Internet, interactive whiteboards, tablets, virtual learning environment, digital curriculum? The use model envisioned by the planning team will determine site preparation, acquisition, distribution, and maintenance.

What eLearning device will be the center of the initiative?

Across these nine cases, most of the initiatives used netbooks and Classmate PCs, except for Korea, which was focused on tablets and other smart devices. Classmate PCs were selected because they are inexpensive compared to laptops, yet versatile compared to tablets. Because of the keyboard and expansion slots, netbooks and laptops offer more ways to manipulate content. Netbooks are more affordable, and the licensing process for the Classmate PC often means that local companies can manufacture them, as is the case for Portugal and Argentina. Although most of the initiatives started with netbooks, a few are considering switching to tablets.

Who owns the devices and why does that matter?

If the goals of the initiative are focused on education, two basic distribution models predominate: a personal computer given to each student, or sets of computers given to the school for students to use in class. Countries have made very different decisions on this issue. For example, Argentina and Terengganu (Malaysia) both gave devices directly to students, but Macedonia and Korea distributed classroom sets to schools. Because of limited funding, the Republika Srpska (Bosnia) initiative, on the other hand, set up a limited number of e-classrooms in each of 62 schools.

Cost factors will certainly affect this decision, but there are other points to consider as well. Device ownership, for example, will influence when, where, and how the devices are used (Table 2). In terms of educational achievement, the more successful initiatives tend to be those that gave the devices to the school. The initiatives that gave computers to the students were very successful in bridging the digital divide, but less so with regard to in-class learning: students often forgot their machines, or another family member borrowed it. In Portugal, the distribution of devices to children and families led to the perception that the laptops were toys for leisure, not for learning and schoolwork. Similarly, in Terengganu (Malaysia), students and families owned the devices. Although students were supposed to bring them to school everyday, the research found that most did not. Teachers never knew how many machines they would have in class on any given day, which complicated planning for 1:1 eLearning lessons.

Terengganu (Malaysia) does, however, offer an interesting hybrid model that suggests ways to encourage students to bring their personal devices back to school. All students were given a Classmate PC of their own, but in a subset of pilot schools, the state department of education also established a set of high-tech classrooms shared among teachers. The combination of dedicated ICT resources at school encourages teachers to use more technology, and the fact that students use technology everyday in school encourages them to bring their own devices.

For school-based initiatives, two distribution models seem effective. Jurisdictions that could afford to distributed sets of computers for every classroom; others distributed multiple sets of laptops that could rotate around the school. Both have been successful, especially in the earlier phases of integrating

technology when the goal is to expose teachers and students to the devices and develop some basic IT skills and interest. Once children and teachers are using technology all the time, of course, each child will need to have continuous access to a device.

eLearning Initiatives Organized by Device Ownership

Country	Device Ownership	Education Reform	Social Inclusion	Workforce Development	Economic Development
Argentina	Child	•	•		
Brazil	Child	•	•	•	
Terengganu (Malaysia)	Child	•	•		•
Portugal	Child	•	•	•	
Kocaeli (Turkey)	Child	•	•	•	
Rep. Srpska (Bosnia)	School	•		•	
Korea	School	•			
Macedonia	School	•			•
Shanghai (China)	School	•		•	•

Table 3

In contrast, distributing laptops outside of the school setting is the most effective approach to achieving social inclusion objectives. Not surprisingly, all of the initiatives that counted social inclusion as one of their main goals distribute the laptops directly to children and their families. This means that across socioeconomic lines, all students and their families are given access to the same tool and resources. Initiatives in Kocaeli (Turkey) and Argentina show impacts across family members, not just on the child who owns the machine. In Malaysia, it was hoped that "through 'a computer to every home,' parents and siblings would have access to the outside world and at the same time enhances their businesses" (Hoon et al. 2012, p. 21). When the laptop is available in the home environment, parents have access to both the pre-installed educational resources as well as the Internet (if the latter is available). Computers in the home close the digital divide not just for young people but for the generations that come before and after them.

Laptop distribution to teachers enhances the use of technology in the classroom and therefore the initiative's ability to achieve its education reform goals. In Kocaeli (Turkey), the goal was to have the computers used in schools, but only a few of the teachers were given a computer. Similarly, in the first year of the initiative in Terengganu (Malaysia), grade 5 students were given laptops, but the grade 6 teachers initially received the machines. The state education department of Terengganu explained the discrepancy by hoping that teachers without laptops "could borrow from those who received the laptop since not all computers will be used at the same time" (Hoon et al. 2012, p. 34). Researchers reported that this was in fact a challenge for teachers.

In contrast, in Republika Srpska (Bosnia), Korea, Macedonia, and Shanghai, the laptops reside at the school where they can be charged, updated, and maintained by teachers and other technical support staff. While storing the machines at the school can present other challenges in the areas of security and electrical capacity, teachers know how many computers will be available for classroom integration.

What additional hardware or other digital technology infrastructure might be needed at school to support the educational goals of the 1:1 eLearning initiative?

If one objective is to promote the use of ICT in the classroom, the initiative needs to think carefully about the classroom's other ICT resources. The Education Transformation Research series and other case studies conducted by Intel (Intel 2013; Light & Pierson 2012) show that student devices become much more powerful learning tools when they are embedded in a full technology ecosystem. In addition to student machines, four other components create a powerful technology ecosystem for learning: teacher computers, interactive whiteboards or projectors, Internet access, and virtual learning environments or learning management systems.

First, teachers should have their own computers if they are expected to plan, prepare, and deliver ICT-rich lessons. If teachers lack their own computers, it is difficult for them to plan and develop lessons, or to review and assess student work done on a computer. The teachers' lack of easy access to computers was found to be a problem in Kocaeli (Turkey), for example. Although students in that initiative have a teacher for every subject, only one teacher in each grade was given a computer. In contrast, Shanghai and Macedonia gave every teacher a computer, and hence teachers were better able to plan and develop lessons, explore the Internet for new resources, and use the computer to communicate with students and parents.

Second, interactive whiteboards and LED projectors can be important tools in helping teachers and students take full advantage of the eLearning environment. An IWB or projector allows teachers to easily display a variety of content to the whole class, which in turn can help set a common frame of reference for a class discussion. IWBs offer additional features, such as immediate feedback systems and support of multimodal resources (text, video, drawings, simulations, apps, etc.) (Hennessy & London 2013).

Third, having access to the vast amount of information available on the Internet can change the lives of students and their families both in terms of learning and increasing social inclusion. Across all the cases, access to the Internet was one of the most valued outcomes for students and their families. From a mother in Turkey who completed her high school degree using her child's computer to access the Turkish virtual high school program, to a Portuguese teacher who had his students create online videos about the solar system for their parents to view from home, the Internet exponentially expands the impact of the netbooks.

Fourth, a virtual learning environment (VLE) or learning management system (LMS) (in addition to Internet access) is the final cornerstone of a robust eLearning eco-system. A VLE or LMS creates a controlled virtual space for the school community where administrators, teachers, students and parents can communicate, access resources, and save and share work and projects. Typically, every class has its own virtual space with shared communication facility, and teachers can disseminate resources directly to students' folders. Some of the most advanced VLEs have assessment and data features built in. Not only do VLEs offer substantial logistic improvements that save teachers time and allow both teachers and students to spend more time on learning tasks, they can also make it easier for teachers to give students different types of work depending upon individual needs.

Korea offers an example of a country that has gone through multiple phases of ICT initiatives and now has all four of these components as part of its education system. Korean classrooms used a lot of technology even before the SMART Education initiative began. Instead of IWBs, classrooms have a wide-screen projection TV and Internet-connected PC to support whole-class activities, and Korea has established the EDUNET network to distribute teaching and learning resources for lessons over high-speed Internet. Since the use of digital learning resources in classroom lessons created homework that used ICT, parents naturally began to use the computer and the Internet at home. Korea has also created an eLearning system, Cyber Home Learning (Chun & Kye 2013).

CASE STUDY

Project Dositej, Republika Srpska, Bosnia – Building technology infrastructure that can grow overtime

Over the last decade, Korea has invested tremendous resources and time into the development of a full eLearning ecosystem, but Republika Srpska (Bosnia) has pursued another strategy to achieve many of the ecosystem's core aspects. Each e-classroom in Project Dositej has a laptop cart with a wireless hub, 25 Classmate PCs, and a teacher laptop. The teacher's laptop can connect via cable to the wireless hub and use classroom management software to connect to student devices regardless of whether there is Internet or not. This configuration allows teachers and students to share resources easily. If the teacher has Internet access, she can download resources to her laptop and distribute them to students later, thus bringing a diverse set of resources into the classroom. Some of the schools in Project Dositej used their own funding to purchase LED projectors and Internet connectivity.

Learn more Project Dositej in Bosnia

Will the initiative need to provide Internet access at schools?

Although PCs can be used as a standalone or through local networks for meaningful education, one of the biggest factors in the success of these ICT initiatives is Internet access; in fact, in order for an initiative to be able to meet its goals, access to the Internet is vital. This is particularly true for the educational improvement and workforce development goals. Yet the ability of students to access the Internet varies across countries. The most successful initiatives dealt with this issue in different ways. Planners should consider the issues of school access separately from those of home access since each requires distinct solutions.

One country that faces big challenges is the Republika Srpska (Bosnia), where many schools do not have Internet access. For the most part, students are limited to the use of software and programs that have already been loaded onto the machines. Unfortunately, the education minister's goal of developing a highly skilled digital workforce is unlikely if students cannot easily access the Internet to begin building technical skills (Nikoloski & Samardzic Jankova, 2013b). Argentinian schools also struggle with securing sufficient bandwidth to make the use of the laptops meaningful and consistent. Without a reliable and robust Internet connection, teaching and learning are limited to what already resides within the distributed devices (Artopoulos & Beech 2012).

In Terengganu (Malaysia), the state government realized that it would need to establish free WiFi in rural areas to meet its goal of bridging the digital divide between rural and urban areas. However, there are still issues for schools with the poor Internet access where, researchers noted, "the slow network connectivity hinders the use of the web in teaching and learning" (Hoon et al. 2012, p. 74).

In contrast, schools in Shanghai (China) and Korea have had high-speed Internet since 1997. Shanghai, now in its third current stage of ICT integration under an initiative named Shanghai Medium- and Long-Term Development Plan for Education Reform and Development (2010–2020), is focused on building a comprehensive public e-education platform to support individualized and ubiquitous learning both inside and outside schools. It is also promoting cloud-computing technology (Zhang et al. 2013).

Will the initiative need to provide Internet access at homes?

Most of the eLearning initiatives that give computers to students envision home Internet access; however, home access can be the challenging to provide. Some countries already have robust telecom environments and Internet access, but many do not. In this area, Korea has advantages over initiative sites: the country has been systematically implementing a master plan for the use of ICT since 1996. Homes, schools, and business are saturated with computers and other mobile devices, and all are wired for Internet (Chun & Kye 2013). With the creation of a robust cloud-computing network, Shanghai seeks to create ubiquitous access allowing "students to learn anywhere, anytime, and anyhow" (Zhang et al. 2012, p. 13). Shanghai's e-School Bag Project explicitly assumes students already have home access. Other countries, like Turkey, have relatively affordable ISPs, and many families in Turkey are able to afford home access. But initiatives in countries without inexpensive and widespread access, such as Portugal, had to take comprehensive measures if they wanted to promote home access. In Brazil, the municipality of Piraí set up a free WiFi network in town through the Piraí Digital program. Similarly, state officials in Terengganu (Malaysia) attempted to address the issue of low laptop usage by providing free WiFi to families in the most rural areas.

3. Create Digital Curriculum and Resources

The existence of relevant curriculum and assessment resources impacts the long-term success of a 1:1 eLearning initiative. The new opportunities created by netbooks, laptops, tablets, or other devices are best served by new curricular resources. Furthermore, if an eLearning initiative seeks to promote pedagogical innovations, the curricular materials should align to that new model. Teachers need to be trained in how to integrate technology into the new pedagogical model, and they need to be provided instructional resources that align to the expectations of the new approach. Finally, classroom and national assessments should be updated to align with the pedagogical goals of the initiative. All of initiatives included in this report updated at least a portion, if not all, of their curricula and accompanying assessments to meet the goals of the eLearning initiative. This section highlights a number of important questions to consider when planning to revise or align curricular resources to an eLearning initiative.

What other digital resources (such as software or educational web sites) may be needed to make the initiative successful?

As mentioned above, computers can give students access to a wide variety of resources, and most 1:1 eLearning initiatives provide certain types of resources along with the devices. The experiences of the nine initiatives reviewed suggest there are different questions policymakers should consider as they decide what other digital resources to make available.

The first question to consider is whether the initiative will provide substantial curricular materials or whether teachers are expected to create resources. Most initiatives used both strategies. For example, Macedonia provided a number of learning resources preloaded on the devices and over its VLE, yet it also trained teachers to design and develop their own technology-rich activities. The language of instruction will influence decisions in this area: for countries where instruction is in a world language (e.g., Spanish or Arabic), there is often a great selection of pre-existing resources, whereas initiatives in other language communities may have to develop their own resources. One way is to translate resources into the local language. In Portugal, for example, the Ministry of Education selected a few free resources from edubuntu.org to translate into Portuguese. A more costly approach would be to establish local curriculum development programs. This is more expensive, but allows the resources to be more closely aligned to local curricula, culture, and needs. In the early stages of its educational technology initiatives, Korea established the Korea Institute for Curriculum and Evaluation (KICE) to create digital resources.

Many initiatives also encourage teachers to create their own materials. The initiatives from smaller language communities like Republika Srpska (Bosnia) and Macedonia are expecting local teachers to begin developing resources over time to be shared to make up for the lack of materials in Macedonian and other local languages. Also, initiatives that are promoting pedagogical innovation may also expect teachers to develop activities since there may be few innovative resources available. Korea's SMART Education and Shanghai's e-School Bag initiatives both expect teachers to develop new student-centered activities using multiple devices.

However, initiatives that envision teacher-made resources need to seriously consider the teachers' professional development needs. Although all teachers are able to adapt resources to fit their students' needs, adaptation is different from designing an entire instructional activity. Most teachers are not trained in instructional design, and they will need support to generate quality activities that are worth sharing and distributing. Korea and Shanghai both have intensive supports for teachers who are learning to develop and pilot innovative activities.

Clearly, most policymakers developing a 1:1 eLearning initiative strive to ensure that the curricular resources align to the national curricula, but they also need to consider the extent to which the resources and activities provided through the initiative align with existing teaching practices in their schools. The introduction of new pedagogical practices on top of the introduction of technology slowed down the success of some initiatives. The teachers more quickly adopted technology resources that closely mapped to the old ways of teaching. Portugal's Magellan Project was relatively successful in helping teachers use the IWBs and other multimedia tools, but guiding teachers to encourage student projects that used the computer was more complex. In its Computer for Every Child Program, Macedonia has evolved a two-phase approach: first integrate ICT into the classroom and then promote innovative pedagogy once teachers are familiar with the technology and used to using it everyday in the classroom.

Does the current curriculum support or impede ICT integration in schools?

Technology brings new capacities and new opportunities for learning, but the curricula may need to change in order for students and teachers to get the full benefit of these new tools. The Korean SMART Education initiative provides a positive example of the importance of government involvement in opening the doors to greater technology integration among teachers. The challenge in Korea was not the absence of curricular content for teachers to utilize, but rather the absence of materials in the proper digital format. Because one of the principal goals of the SMART Education initiative is to develop digital textbooks, the government needed to make major overhauls to the current copyright laws in the country. As a result, the legal and copyright systems were improved to allow teachers and students to make easy and convenient use of copyrighted works while in school settings. The government established educational content management centers to manage the copyrights of educational resources. Additionally, in the future, the initiative plans to secure high-quality copyrighted works through the donation of educational content, digital sharing campaigns, and joint production of content for educational use through various collaborations.

Project Dositej provides a cautionary tale that underscores the importance of deploying an updated and technology-friendly curriculum in conjunction with the new hardware. In the local researchers' view, the traditional curriculum is content-based rather than standards-based and as such needs to be fully revised to allow more comprehensive use of technology. Teachers and principals are unanimous in the conclusion that the current curriculum does not offer a lot of space for technology integration. And yet, Project Dositej requires that teachers use technology differently than they have in the past, incorporating it more frequently throughout the curricula and integrating it into daily planning. If the national curriculum had been updated to be more flexible and able to accommodate the use of technology, teachers would have been more likely to integrate it into their lessons.

In Piraí, Brazil was already engaged in a nationwide process of revising and adapting the curricula to be more student-centered before the initiative rolled out. As Un Computador por Aluno got underway, the revision process was expanded to include more technology use. Shanghai also created a new curriculum and is promoting a new teaching paradigm.

How does the initiative align to the needs of the grade and age of students targeted?

This set of case studies offers a number of good examples of how different initiatives aligned their implementation to meet the needs of the grade level of the students they were targeting (Table 1). The Classmate PCs come with helpful pre-installed parental controls, but there are other ways that age and

grade should influence the design of the initiative and the resources selected. Macedonia, for example, had two different deployment models: one called for using desktop thin clients for upper primary students in grades 5 to 8 and portable solutions for grades 1 to 4 (Nikoloski & Samardzic 2013c). In the end, because of the portability of the netbooks, the latter model was the most successful.

Conectar Igualdad, which gives computers to high school students, required more advanced resources. The distributed netbooks come with a student web portal that links to curricular resources in each area as well as games and activities for older students. Additionally, the portal links to online courses for older students in such subjects as web design and programming.

In the case of the Republika Srpska (Bosnia), the government made a deliberate decision not to introduce the Classmate PCs until grade 3 since this is when students start learning the Roman alphabet; this measure reduced the cost of the units by avoiding the expense of installing a Cyrillic alphabet. Bosnian students start learning to read and write in Cyrillic and expand to the Roman alphabet in grade 3. This is an example of different educational organizations working together to implement a coherent plan.

Are there linguistic or cultural concerns that need to be addressed in the curricular resources before the initiative rolls out the devices?

The resources need to be culturally and linguistically appropriate—for example, Terengganu includes a digital copy of the Koran on its netbooks. This was a bigger issue for some initiatives than others; big countries and countries that speak a language like English or Spanish generally have more choice among existing resources. For countries with other languages, finding software can be an issue. The open source website edubuntu.org was a popular option in the latter case.

There are very few resources in the Bosnian languages, so the computers in Republika Srpska (Bosnia) do not come loaded with content. The content, donated by Intel, is available at www.skoool.com and will be translated into the local languages once the ministry secures the funds to do so.

Will any resources be preloaded on the devices, and are they aligned with the goals and needs of the initiative?

All of the Intel devices used in these initiatives came with a selected set of software and resources preloaded at the factory. This measure can be a great logistic benefit since it means that the Ministry of Education does not have to set up a system to install these resources itself.

All the devices are also equipped with productivity tools, browsers, and other applications standard for any computer. Many of the countries selected educational resources from edubuntu.org, which has resources available in many languages; ministries can translate the open source resources without licensing costs. And some initiatives also created their own resources. In Terengganu (Malaysia), the national textbooks were digitalized and loaded onto the netbooks as PDFs so that students could each have their own copies and not have to carry so many books back and forth to school. This approach brought a number of benefits as well as some challenges. Some teachers said that the textbooks on the netbook make preparation of lessons easier as they need not "cut and paste" pictures or illustrations into charts to display on the board. They could just ask students to look at the illustrations or text on the computer. It also made it easier for the students to follow the lesson.

Another type of educational resource that can be preloaded onto the devices is a predesigned interface that can connect the user directly and easily with a VLE and online learning resources. For example, Conectar Igualdad preloads student machines with a "student desktop" that serves as a portal and organizer to access an extremely rich set of digital resources as well as student folders and communication spaces. There is also a "teacher desktop" that does the same for educators.

Finally, the devices can come preloaded with other tools like assessment software to allow teachers to design and send tests over the computer or parental control software to help parents manage their children's Internet use.

4. Build a Strong Leadership Team and Cultivate Partnerships

Government officials, whether at the national or provincial level, launched all of the initiatives researched. But 1:1 eLearning initiatives also often intersect with other areas of government oversight such as telecommunications policy, intellectual property rights, or infrastructure issues. Like any large-scale policy initiative, 1:1 eLearning initiatives need clear-sighted and steady top-level leadership. Successful initiatives need to understand beforehand what other areas may be relevant and to work in coordination with ministries and government departments, if needed. Even provincial initiatives need support from national-level ministries and advocates.

Which is the most suitable agency to lead the initiative?

Sometimes initiatives like these are established by the prime minister's office; in Macedonia, for instance, the Computer for Every Child Program was part of the prime minister's campaign platform. But the prime minister's office does not have the institutional capacity to run this type of initiative, and in such cases, the leadership is often passed to a ministry that has the necessary capacity. In Argentina and Portugal, the initiatives were originated by the president or prime minister's offices and supported by key government agencies that are responsible for planning and coordinating activities.

It is also important to base operations within the correct ministry. Although Portugal's Magellan Project was initially overseen by the Ministry of Public Works, Transportation, and Communications (MOPTC), it was quickly moved over to the Ministry of Education. Even though laptop initiatives are ostensibly about technology, the technology is actually the easiest part; the more complex aspect concerns integrating ICT into schools and supporting children and families in their use. Those initiatives that had education ministry support tended to be more successful.

The national leadership may sometimes be a partnership of agencies. The Argentinian initiative, for example, was planned as a multisector implementation with distributed ownership and led by an executive committee that facilitated communication across multiple agencies.

Are there other partners outside the education sector who could support the initiative?

The assistance of government entities and stakeholders beyond the education sector can be critical to the long-term success of an eLearning initiative. Given the technology focus of eLearning initiatives, many of them can benefit from collaborations with ministries for technology and for workforce development as well as ICT companies. In Portugal, a key partner is the Ministry of Public Works, Transportation, and Communications (MOPTC). Since Project Magellan can only benefit from improved ISP services in homes, its work falls under the MOPTC's area of interest. Conectar Igualdad is an alliance of the Ministry of Education with Argentina's National Administration of Pensions and Retirements and the Ministry of Federal Planning, Public Investment, and Services (MPF) (Artopoulos & Beech 2014). For example, the MPF was an important player in upgrading the electrical infrastructure in many schools.

In all of these initiatives, private companies can be key allies. Intel has been a strong supporter, but other companies can play a role. In Terengganu (Malaysia), for example, the initiative works closely with the Terengganu Skills Development Centre (TESDEC) to train technicians. TESDEC is a now private company, but it started as a training program at the provincial unit for economic planning (http://www.tesdec.edu.my/v4/en/about-us/profile/background-info.html). The province also works with the private firm Top IT Industries to train and provide technicians.

If this is a provincially organized initiative, what national-level ministries or other organizations need to be involved?

The next challenge for the leadership of provincial initiatives is building effective partnerships with relevant ministries at the national level. All eLearning initiatives involve topics and concerns that are under the jurisdictions of different ministries and agencies. The provincial agency that is driving the effort needs to think carefully about what national ministries are relevant and what degree of involvement they should have.

Sometimes the local initiative aligns with national objectives, but even then the specifics of the effort may require support from national ministries and modifications of national policies. The e-Book Project in Terengganu (Malaysia) is a state-level initiative that fits within the larger national ICT strategy of bringing more technology into schools. Though the goals of the state initiative to distribute laptops to primary students align with the national goal of creating high quality, technologically advanced schools, there were two major disconnects when it came to implementation. First, the national policy prohibiting students from bringing electronic devices into schools created obstacles to implementing the e-Book Project in Terengganu state. Second, the state has no authority to direct the compulsory use of e-books in schools, which are under federal jurisdiction. States can only encourage schools and teachers to use e-books in teaching and learning.

Provincial initiatives may also need to cultivate support from both the national ministry and the regional leadership. The Kocaeli (Turkey) initiative was launched by the mayor's office with public support from the national minister of education and the prime minister's office, but the provincial directorate of education did not have a strong commitment. The national Ministry of Education was not involved in the planning and execution processes and was not invested in ensuring that the school-based components of the initiative were successful.

CASE STUDY

Conectar Igualdad in Argentina – Leveraging Regional Experience to Inform an eLearning Initiative

The collaboration between Argentina's Ministry of Education and the Technological Laboratory of Uruguay (LATU) grew into a close relationship with bilateral meetings and seminars. The Uruguayans warned Argentine policy makers of the importance of having a clear educational proposal and recommended that pedagogical elements such as educational content and teacher training be prioritized. As a result, Conectar Igualdad focused its goals on educational reform, rather than digital inclusions as the Plan Ceibal program had. The collaboration with Plan Ceibal also helped Argentina decide what machines to purchase. Argentina also chose different computers with bigger screens, more powerful processors, and enhanced memory. The Classmate PC and netbooks used in Argentina also included peripheral devices that facilitated use for students with disabilities.

Ultimately, Conectar Igualdad as a program is very different from Plan Ceibal, but engaging in open, substantive dialogue with their counterparts in Uruguay enabled the Conectar Igualdad to design a program that was in line with their priorities and goals.

Learn more about Argentina's Conectar Igualdad

5. Learn From and Leverage Past eLearning Initiatives

A number of leaders and planners in this study took the time to review previously established 1:1 initiatives in their own countries and elsewhere. Both Argentina and Terengganu (Malaysia) visited initiatives in their regions, and Brazil and Portugal researched ongoing laptop initiatives within their borders. State officials in Malaysia visited virtual schools in Singapore and Korea to get a better sense of how those initiatives could be adapted to work in their own schools.

What lessons can be learned from past experiences?

Because of the abundance of ICT integration programs in the region, policy makers in Argentina were able to gather rich information about best practices and challenges prior to the roll out and implementation of their Conectar Igualdad initiative. Red Enlaces in Chile, ProInfo in Brazil, Colombia Aprende in Colombia, Red Escolar in Mexico, and One Laptop Per Child in Peru all influenced the design of the Conectar Igualdad program. But no program was more influential than Plan Ceibal in neighboring Uruguay, that offered vital lessons around Internet distribution, 1:1 learning, digital content development, and teacher training. The Uruguayan experience offered rich lessons for a country seeking to transform its education systems and bridge the digital divide by delivering Classmate PCs to families. Representatives from Argentina's Ministry of Education visited Uruguay to exchange practical lessons, insights, and perspectives related to the use of ICT in education. The Argentinian team saw what was and was not working for Plan Ceibal, and designed its initiative in response.

One of the great strengths of Argentina's initiative is that it builds upon a body of digital educational resources that the country has been developing through its well-known educational portal, educ.ar. Pedagogical software and educational resources were created for students—including those with disabilities—as well as for teachers and parents.

In Portugal, ICT in educational institutions has been implemented for decades, although on a smaller scale. Portugal's Magellan Project builds on previous in-country eLearning efforts to create a comprehensive initiative for educational transformation through the widespread distribution of Classmate PCs to all primary school children.

How can past and current technology initiatives be leveraged?

An initiative is not guaranteed success simply because it is connected to a broader national ICT policy. The nine initiatives presented in this report represent the varying degrees to which a smaller effort can be imbedded within a larger state or national ICT initiative. The 1:1 eLearning initiatives in Argentina and Republika Srpska (Bosnia) were not strongly connected to any other ICT or education plans or policies. In contrast, the initiatives in Terengganu (Malaysia), Shanghai, Brazil, and Korea had deep roots in national programs emphasizing and supporting technology in schools.

A success strategy for many initiatives was to carefully leverage prior ones. Malaysia provides a good example of the ways in which different branches of an education ministry can work together to create a policy ecosystem that can support a set of educational initiatives. In its drive to make the country an ICT hub, the Malaysian government has extended ICT to all parts of government, established a multimedia supercorridor, and is seeking to place ICT at the core of education. Within the context of these larger national policies, the state of Terengganu decided to take an additional step and create the e-Book Project to push the reforms further in its own schools and to serve as a demonstration project for the rest of the country. Because the entire country was thinking about increased integration of ICT and moving towards a knowledge society and knowledge economy, the environment was ripe for innovations in schools.

Similarly, Shanghai's e-School Bag Project is part of an 18-year, three-stage policy that has been developing technology infrastructure and supporting technology integration in schools since the late 1990s. The successful introduction of a digital curriculum environment, the creation of digital resources, and the promotion of student-directed and project-based learning are only possible because of the successful implementation of the two previous policy initiatives.

Piraí, Brazil's Um Computador por Aluno (UCA) initiative has connections both nationally and locally. From 2007 to 2011, the government implemented a plan aimed at strengthening the role of science, technology, and innovation throughout the country. With the support of four different government agencies—including the ministries of Education; Health; Science and Technology; and Agriculture, Mines, and Energy, the plan is aimed at improving educational infrastructure, expanding human resources in scientific inquiry, and improving research. UCA is also embedded in municipal initiatives, including Piraí Digital (also known as Digital City), which brought wireless Internet to all corners of the city, and the UCA pilot program, which brought 500 computers into one elementary school as part of a national-level pilot effort.

The SMART Education initiative in Korea is embedded within a larger educational technology reform effort that has been going on since 1996. Acting on a national consensus that the "informatization" of the country was needed to bring prosperity and to keep the nation strong, the government placed a high priority on the use of ICT in business and formal education. For example, the plans to build nationwide high-speed Internet began then.

6. Create a Coherent Policy Ecosystem

In order for a large-scale laptop initiative to be effective, it cannot stand alone as a single policy decision. Ministers from various departments at both the national and local levels need to work together to create an ecosystem of policies to support the initiative from inception to implementation. A number of countries described below have made changes beyond the education sector.

Which policies might need to be adjusted to support the success of the initiative?

The diverse areas in which the nine initiatives may need to be modified—either by the creation of new policies or the revision of existing policies—concern issues of technology or telecommunications infrastructure, curriculum development, and copyright and legal issues.

For the past few decades, Korea has been systematically implementing a master plan for the use of ICT in education. Homes, schools, and businesses are saturated with computers and other mobile devices, all wired for Internet. This established infrastructure supports the SMART Education goal of providing ubiquitous technology access in order to promote anytime, anywhere learning. Similarly, as much of Korea's educational content moves to the cloud, the Korean government is working to improve the copyright system to allow teachers and students to quickly and easily access certain works while in the school setting. By establishing and operating educational content management centers, the government is preparing a policy that will guarantee rights to the copyright holder under the current Copyright Act.

As described earlier, because of the Malaysian government's ban on mobile devices in schools, the Terengganu state government needed special approval from the Ministry of Education to allow mobile devices in its schools in order to implement its e-Book Project. While this measure fixed the issue in Terengganu, the local researchers recommend that the government make the restriction more flexible in order to facilitate the implementation of classroom eLearning in other states.

Despite the distribution of Classmate PCs to students in the Republika Srpska (Bosnia), the government has not provided new technology-enhanced lessons in local languages. This lack of digital content in the local language is forcing teachers to translate and/or prepare their own teaching materials, which is time consuming and difficult given the minimal amount of relevant training that teachers have received.

7. Cultivate the Support of Stakeholders

A large-scale 1:1 eLearning initiative requires a broad coalition of supporters and partners throughout the system and not just at the national level; leadership at the provincial, municipal, and school levels is also crucial. The Korean policies supporting the educational use of ICT are a good example of using both a top-down and a bottom-up approach to create a complementary and interactive implementation. The government took strong policy actions and successfully gained the willing commitment from schools, teachers, parents, and students.

CASE STUDY

SMART Education, Korea – Value of multiple governmental organizations in supporting deep educational transformation.

Since 1990s, Korea has been transforming its education system. First, emphasizing local education autonomy and responsible management of each school, then promoting students' active engagement and initiative in their learning. Now with SMART Education, the Ministry seeks to further develop the learning paradigm to implement self-directed learning and personalized learning. But, to support these transformations, the government has also established a range of new institutions to provide research and guidance that is relevant for Korean education. After Korea established EDUNET in 1996 to design and distribute digital learning resources, the government realized it needed to create the Korea Education and Research Information Service (KERIS) in 1999 to research and evaluate all these new materials.

Other organizations are the Korean Educational Development Institute (KEDI) in charge of creating and researching education policy, and the Korea Institute for Curriculum and Evaluation (KICE) in charge of curriculum and assessments like the college scholastic ability test. These organizations cooperate with MOE and metropolitan and provincial offices of education to help with planning, R&D, and business practice. Finally, the government established the National Education Information System (NEIS) to reduce teachers' administrative work.

Learn more about Korea's SMART Education program

What local support is needed and how do initiatives encourage ownership?

The degree of local support needed for implementation of a 1:1 eLearning initiative will vary depending on the level of decentralization in the overall education system and the extent to which the initiative targets schools reform. However, the best approaches for promoting local buy-in appear to be the same for centralized and decentralized systems. Across the nine cases, local support and commitment to the 1:1 eLearning initiative was connected to local stakeholders' involvement in the decision-making process. For example, both Argentina (decentralized) and Portugal (centralized) struggled to get buy-in and to coordinate their efforts at the municipal level because the initiative was federally funded, envisioned, and executed.

CASE STUDY

Um Computador por Aluno, Piráí, Brazil – Giving local stakeholders a voice in the process

In Piraí, Brazil, relevant stakeholders from the state of Rio de Janeiro as well as the municipality of Piraí were involved in each level of the design and implementation process. Stakeholders ranging from school-level personnel to parents were involved in discussing how the initiative would be implemented in their towns. Stakeholders at even the local level could make substantive decisions. "There is a sense of ownership and pride among community leaders, due in large part to their collective decisions to invest in Piraí's future by giving computers to all students and preparing them to be competitive—and bring about progress from the bottom up" (Rockman 2009, p. 11).

Learn more about Brazil's Um Computador por Aluno

In Argentina, Conectar Igualdad received lukewarm support from some provincial governments because coordination and decision making during the planning stage was concentrated at the federal level. Those provinces that already had their own eLearning programs were more receptive to the school-based component because the initiative aligned with their objectives and capacities. But for other provinces, there was more of a disconnect between Conectar Igualdad's implementation model and what the province was able to do. Provincial and municipal leaders did not have a strong understanding of the initiative's goals, which resulted in limited local support and uncertainties about implementation specifics.

How do you cultivate the support of local educators?

As a policy implementation cascades down the system, the reception and buy-in of the frontline personnel at the community level are important and need to be carefully cultivated. If integrating ICT into teaching and learning is a prime goal of the 1:1 eLearning initiative, planners and administrators need to consider how to get principals and teachers to understand the goals and take ownership. In the end, transformation will only happen if teachers and principals make the changes.

In Korea, for example, leadership at the school level was an important component in ensuring the effective rollout of the SMART Education initiative. Two factors contributed to success in the case study schools: the principals' openness to and understanding of the value of ICT in education, and autonomy in managing teachers to create a school culture that valued ICT and was willing to experiment with implementation and integration. Supporting and nurturing school leadership in understanding the complexities of ICT installation, integration, and maintenance from the outset can help foster a more open and accepting school culture and environment.

Teachers, however, remain the single most important constituency. Motivating teachers to understand and take ownership of the educational goals of the 1:1 eLearning initiative is critical. Piraí, Brazil's UCA provides an example of a unique approach to fostering teacher buy-in. From the beginning, municipal and district administrators included teacher buy-in as part of their two-pronged approach to professional development. Before the initiative was introduced, teachers participated in an "awareness training" (sensibilização in Portuguese) to reduce resistance to the introduction of technology. The goal of the trainings was to showcase the computers as a valuable tool for instruction and to reassure teachers that the computers would not be replacing them or the textbooks. They also emphasized that teachers be open to learning from their students, particularly in the area of technology use.

Argentina, though, is an example of the complexities of recruiting teacher support. The Argentinian teachers recognized the value of improving digital literacy but were disappointed in their preparation and training. In the end, many teachers considered Conectar Igualdad and ICT integration a burden and felt unsupported by the Ministry of Education during implementation.

To help smooth the way for teacher engagement, some initiatives formulated and clearly communicated goals that were meaningful for teachers, and provided comprehensive training. In order to increase teacher ICT literacy in preparation for the Computer for Every Child Program, the government of Macedonia provided basic ICT training for secondary and primary teachers; it also ensured that many teacher administrative tasks were moved online. Teachers have reported that their administrative work is now done a lot more quickly and that the deployment of technology in schools has motivated them to improve their ICT skills, and to use the newly gained skills to improve their teaching practices and make their teaching jobs easier. Surveys suggest that teachers in the Macedonian initiative see technology not only as an aid to classroom teaching and learning but as a tool that can be used in their own professional development.

Does the public know about and support the initiative?

There is typically a high level of public interest in 1:1 initiatives because they are complex and expensive undertakings. Public awareness and support can be crucial for the long-term success of such initiatives, especially those with educational reform goals or those that promote home use of technology. It is therefore important for the leadership to cultivate public support and understanding of the initiative. Argentina has been very effective at communicating with the public about the goals and ideals of Conectar Igualdad, but other countries have struggled. In Shanghai, because the e-School Bag Project was seen as a still-evolving pilot effort, the Shanghai Education Commission could not present a clear and consistent vision to the public. Parents are now not sure about the value and intent of the initiative.

What role does the leadership have in communicating the vision and goals?

The research across these nine cases suggests that the schools by themselves are not able to educate the public sufficiently. Prominent national and local figures can play an important role in generating public enthusiasm and support for 1:1 eLearning initiatives by using their public position to talk about the initiative, its goals, and what the public can do to support those goals. Conectar Igualdad provides a good example of the role political leaders can assume; since the initiative's launch coincided with national elections, the president was able to highlight Conectar Igualdad in speeches all around the country. Her public statements played an important role in framing the eLearning initiative as a social inclusion initiative as well as an education initiative. In contrast, although the Shanghai Municipal Government was the key force in developing the e-School Bag Project, it did not conduct a public education campaign. The research on Shanghai found that a lack of public understanding of the goals of the e-School Bag Project made it harder for the schools to convince parents of the benefit of the proposed changes.

Initiative Implementation

IN THIS SECTION

Even the most carefully developed policy initiative can encounter challenges when people begin implementing the new policies. The complexity of any 1:1 eLearning venture all but guarantees that every initiative will encounter surprises and challenges as it deploys netbooks to schools or families. While it would be impossible to avoid all implementation surprises, this chapter covers key issues and lessons learned from the implementation phase of these nine cases that are important for policymakers to consider while they are designing their own initiatives. The research on these nine cases suggests at least seven implementation principles that 1:1 initiatives should plan for and be ready to respond to once the initiative launches.

This chapter covers such key implementation issues as piloting, rollout and setup, creation of curriculum and assessment resources, professional development, technical support, research and evaluation, and sustainability. The seven implementation principles are as follows:

1. Conduct infrastructure studies and pilot projects
2. Plan logistics of mass rollout
3. Provide professional development and ongoing support for teachers, administrators, parents, and students
4. Provide ongoing technical support
5. Provide opportunities for feedback, evaluation, and self-reflection
6. Plan for sustainability
7. Navigate the changing environment created as a result of the political context generated by the initiative

1. Conduct Infrastructure Studies and Pilot Projects

Across these nine cases, most initiatives carried out some sort of preliminary study or pilot before launching at scale. At the very least, many countries undertook a review of the infrastructure available to schools to see if they would be able to accommodate having hundreds of new ICT devices enter the buildings. Additionally, some countries ran pilot projects with the devices in schools. Piloting and researching other programs and initiatives is a valuable opportunity to learn about what works and what does not.

What are the benefits to conducting an infrastructure analysis?

For many of the countries planning 1:1 eLearning initiatives, the effort represents a major step forward in the modernization of school infrastructure. A preliminary study of the state of the infrastructure in schools can be a vital step in ensuring that they will be able to use and benefit from 1:1 eLearning environments. Of course, this is particularly important for those eLearning initiatives in which devices are to be given to schools, which may need electrical upgrades or more outlets to support the increased demand for electricity.

The initiatives in Macedonia and Republika Srpska (Bosnia) both reviewed school conditions before the launch and upgraded schools that needed it. Municipal and school leaders in Brazil also realized the importance of setting up the technology infrastructure before the start of the initiative and the deployment of computers. In order to meet the technical requirements already established by the pilot program, the Piraí school district developed a comprehensive technology infrastructure review plan that involved stakeholders at the district and school levels as well as students, parents, and community leaders. The types of issues countries encountered and were able to address as part of the implementation plans range from technical infrastructure, IT infrastructure, physical spaces to put computers, human resources to support the technology, and Internet capabilities.

The issues are different for the initiatives that sent computers home since detailed research on the home environment is usually not possible, but some of those initiatives have attempted to compensate for the challenges many lower-income families might have in obtaining Internet access.

Improving technical infrastructure: The influx of dozens if not hundreds of new machines can place a tremendous strain on a school's electrical grid or create other technical issues. Schools frequently do not have enough sockets to plug in and recharge so many devices; more important, the electrical system in the school may not have sufficient voltage to power so many machines and peripherals. In anticipation of bringing laptops into schools as part of Project Dositej, Republika Srpska's Ministry of Education, along with the private sector, did a complete analysis of the infrastructure in its schools, from the condition of the hardware, the types of available networks, and the availability of Internet access and power supply. This preview and analysis gave the policymakers and initiative leaders a sense of what technology infrastructure was already available so they knew what they needed to prepare before the machines arrived. Many schools, for example, were upgraded by the Ministry of Education with new electrical grids to meet increased demand.

Upgrading IT infrastructure: The experiences of the nine eLearning initiatives show various ways that the existing IT infrastructure in schools can impact implementation in the long run. For example, schools with prior technology experience will use new ICT resources differently than schools with no prior experience. Argentina's decentralized education system meant that Conectar Igualdad provided netbooks to students in 24 different provincial education jurisdictions. Conectar Igualdad's implementation, therefore, varied substantially across the provinces, and the central administrators were not prepared to provide different supports to each province. Some provinces were in the very early stages of technology adoption, so integration focused on technology infrastructure. Other provinces with a longer history of technology and a strong infrastructural foundation were able to concentrate on professional development and support teachers in integrating the technology into the classroom.

Enhancing Internet capabilities: The preliminary study is an opportunity for the planners of an eLearning initiative to think through the challenges of providing Internet access and to find possible solutions. Some initiatives, like Shanghai's e-School Bag Project, may already have sufficient access; the planners of Macedonia's Computer for Every Child Program, on the other hand, knew that one wireless hub in a building seldom provides sufficient bandwidth or signal strength, and the Ministry of Education sought support from the other donor agencies to provide wireless access points in each lower primary classroom (Nikoloski & Jankova 2012).

Even for eLearning initiatives that are not providing Internet access, it can be important to explore the possibility in a preliminary study so that the initiative can plan future capabilities. Project Dositej in the Republika Srpska (Bosnia) did not have the resources to finance Internet access to the schools; if available, Internet access would have to be funded by the school or local community. However, with the knowledge from the preliminary study that every school has a

teacher lounge, the initiative was able to develop an installation strategy: all of the eLearning classrooms in the Project Dositej schools are cabled to the school's teacher lounge. Therefore, schools would only need to connect the teacher lounge to connect the classrooms.

Improving security and storage: The issues of the availability of physical space in schools and the distribution of rooms within school buildings are highly relevant, particularly for initiatives in which the netbooks stay in the schools. There may also be a need for new rooms to serve as computer labs or for new classroom furniture such as computer tables or storage cabinets. The deployment model developed in Macedonia called for a storage rack with built-in charging units to be placed in each elementary classroom. These carts can be locked as well.

Classrooms that will receive the devices may need to have increased security. In the Republika Srpska, the Ministry of Education put bars on classroom windows and created special carts for charging the units with locks. Schools were asked to choose upper floors for e-classrooms and equipment storage to make break-ins more difficult. Also, in order to discourage theft, the Bosnian government did not publicize the number of machines being delivered. The only number that the government publicly announced was the total number of units entering the country.

Training additional human resources: Human capacity plays a vital role in maintaining the various components of technical and IT infrastructure, so an analysis of the infrastructure can also reveal weaknesses in the school's or state's maintenance and technical support programs or capacity. In Malaysia, due to a lack of school-level IT support, Top IT Industries, a local technology company—along with the state Ministry of Education—trained approximately 500 individuals in the maintenance of the netbooks and virtual classrooms. These tech support personnel work at both the school and district office level to provide such basic technical support services as reformatting programs, updating software, and cleaning viruses. An analysis of the available human resources in Republika Srpska (Bosnia) showed that some support positions such as librarians and office administrators were being eliminated. In order to continue their employment at the school (and to prevent the government from having to pay additional outside technicians), these individuals were asked to retrain as IT administrators.

What are the benefits to conducting a pilot?

A pilot is the 1:1 eLearning initiative implemented for a short period of time at a very small scale, perhaps at just one school, or a small group of schools, or a small town. Pilot projects can offer the opportunity for initiative planners to investigate a number of areas—perfecting the technological infrastructure schools need, developing a 1:1 learning model, demonstrating that 1:1 eLearning works, or cultivating broader stakeholder support.

Highlighting infrastructure needs: The preliminary study discussed above is based on expected usage and needs, but a pilot will help identify unforeseen challenges to the infrastructure given actual use. For example, planners at the Korean Ministry of Education learned that each classroom needs to have two Internet access points to support smart devices on top of the existing computer network. This is valuable information to share with other schools as the initiative scales up. In Brazil, the technology infrastructure had been renovated at the pilot school, which helped the Piraí school district administrators understand what infrastructure updates they would need in the other schools.

Developing a culturally appropriate 1:1 eLearning model: A pilot is also an opportunity to develop an eLearning model that is appropriate for the national context. In Shanghai, a central focus of the municipal Ministry of Education during the pilot of the e-School Bag Project was to develop a 1:1 eLearning model adapted to the municipal context. Through the Shanghai pilot research, the ministry came to understand that there are two models of viable 1:1 eLearning approaches: one model, which evolved from traditional practices, moves students towards creating their own products and making more of their own learning decisions, although students still tend to work individually; and a second 1:1 model that is highly project-based and uses a collaborative group learning approach (Zhang et al. 2013).

Korea followed a similar strategy. The SMART Education initiative was piloted in a small number of SMART experimental schools. Since the Korean schools had autonomy in deciding what type of smart devices to purchase and how to distribute them, the pilot phase allowed schools to develop and test different usage models and find the one that worked best in the local context. Most of the schools purchased Android-based devices and, even though the devices stayed at school, two usage models emerged. Some schools used a 1:1 model in which every student would have a smart device, and other schools developed a one-per-group model in which groups of students would share the smart device (Chun & Kye 2013).

No matter where a country is on the road to integrating ICT, developing a locally relevant model is always helpful. For example, Republika Srpska was just beginning the process of integrating ICT into its learning model when Project Dositej started. The pilot in Republika Srpksa was used as a chance to experiment using technology for content learning, and it helped teachers realize that computers could be integrated into coursework beyond skills-based, technology-focused classes. (Nikoloski & Samardzic Jankova 2012). Previously, a few schools in Republika Srpksa taught computing as a subject, but no schools used ICT to support the core content areas in regular classrooms. Their 1:1 eLearning pilot used a donation of 30 Classmate PCs from Intel in a primary school to allow teachers to try out integrating computers for learning in their regular content classes.

Fostering stakeholder support: In Piraí (Brazil), Um Computador por Aluno actually started in a single pilot school financed by the federal Ministry of Education in 2007. That school was so successful that the mayor of Piraí led an effort to get the whole city involved and brought in the provincial government to extend the project to the entire municipal school system.

In Shanghai, policymakers, teachers, and the public were all skeptical of the e-School Bag Project. No one could clearly explain its components or articulate its goals. After recognizing the numerous positive results of the two-year pilot, stakeholders are embracing the initiative and are supportive of larger-scale implementation. Teachers have changed their teaching approaches as they realize the capacity of students to ask their own questions and drive their own learning. They are also embracing alternative assessment methods through projects and peer reviews. Additionally, based on the success of the pilot studies, Shanghai's 2011–2015 e-Education Development Plan uses the e-School Bag Project as an approach to promote the construction of digital curriculum and that can foster 21st century learning (Zhang et al. 2013).

Improving teacher professional development models: The Um Computador por Aluno initiative in Brazil also provides an example of the way in which conducting a pilot can lead to reform of standing teacher professional development (PD) models. In the case of Piraí, the current model of teacher PD was expanded

to include training for school administrators and pedagogy, ICT, and content area coordinators in addition to teachers. During the 1:1 pilot, the training was brief with little follow-up support; before the citywide rollout, however, a train-the-trainer model was used in which school-level coordinators were trained on the machines and then replicated the training during teacher preparation time during regular school hours.

Are there strategies that justify delaying full-scale launch while the pilot is undertaken?

While a pilot study is a good idea because it can help avoid costly mistakes and build a better initiative in the long term, pilots can encounter resistance from the public and government leaders because only a few schools or children are involved; there is often public or political pressure to distribute devices on the largest scale possible. The nine initiatives used at least three simple strategies to create the political space to run a pilot: conduct a small, quick pilot that does not substantially delay the large-scale home distribution; nest a school-based pilot within the initial widespread distribution; and mandate that schools must apply to pilot and meet clearly established criteria.

Small pilots: The One Computer Per Child initiative in Kocaeli (Turkey) that was launched in 2009 was based on a pilot conducted in four schools by the national Ministry of Education in 2008 (Aydin, Kumtepe, Colak, and Kumtepe 2010).

An education pilot within widespread distribution: In order not to deprive any students and families of a netbook while they piloted how to integrate ICT into the classroom, Terengganu (Malaysia) created an educational pilot that coincided with a mass distribution of netbooks. The administrators of the e-Book Project distributed netbooks to all grade 6 students from the beginning, but they also piloted another related ICT component that sought to promote deeper change. The goal was to support interactive teaching and learning with the use of technology in the classrooms rather than a computer lab. Before engaging in a full-scale rollout of the virtual classrooms, the education department of Terengganu wanted to test the concept's viability with a pilot (Hoon et al. 2012). An historic school that was on the verge of being shut down due to low student enrollment, poor student attendance, and below-average performance was selected. The pilot was successful, and the province planned to set up similar classrooms in one school from each of the 32 state assembly constituencies. The Malaysia pilot was critical in helping the policymakers and program developers understand the value of investing in more classroom technology.

Requiring school buy-in: Another strategy for avoiding charges of favoritism is to require schools to apply to be part of the pilot and to establish clear criteria for participation. The Korean Ministry of Education uses this approach to pilot the SMART Education initiative in schools throughout Korea. Schools can ask to be designated a SMART Education experimental school by the ministry, but 80 percent of teachers need to agree with the designation (Chun & Kye 2013).

2. Plan Logistics of Mass Rollout

Since the media is likely to focus on the launch, the startup and rollout of a 1:1 eLearning initiative can be critical to its long-term success; for most recipients, the delivery of devices to students, parents, or teachers will represent their first encounter with the eLearning initiative, and first impressions are powerful. The launch is an important opportunity for the initiative to generate excitement and communicate the overall goals for the initiative to public and participants alike. The research on these nine cases suggests that logistical problems during the rollout can have longer-term consequences if the initiative's momentum is lost or if stakeholders misunderstand its goals.

Given the size of most of the 1:1 eLearning initiatives described in this report, initial delivery and distribution of the hardware is a complex logistical challenge requiring large warehouses, many trucks, detailed timing, and extensive personnel. Additionally, it is often the case that ministries or agencies that are not accustomed to this type of process are undertaking this endeavor. Although a phased approach to distribution can let ministries develop effective logistics and strategies, this may be hard to do for political reasons.

Especially in federal or decentralized countries, initiative designers should also keep in mind that the distribution will roll out across provinces, and regions that may have different local administrations that will need to coordinate efforts. Argentina and the Republika Srpska (Bosnia), for example, both encountered initial problems coordinating the distribution to ensure that students and teachers in the same schools received laptops at the same time, a problem that served to counteract the social inclusion goals of both initiatives. In Brazil, the rollout timeline was not carefully scheduled, and computers were distributed to students before the schools had the infrastructure to support them. Officials actually had to take the computers back in order to redistribute them at a later date.

When should each group of stakeholders receive their devices?

For initiatives with a strong focus on classroom use, it is particularly important that teachers and students receive their devices at the same time. Teachers should receive the machines—as well as technical and pedagogical training—before the start of the school term, if the initiative is school based. This step allows teachers to get acquainted with the basic functions of the computers and to begin planning technology-rich lessons. Distributing computers to students at the beginning of the school year allows maximum opportunity for usage and integration throughout their classes. The experience of certain initiatives highlights how problems can result from ill-considered decisions about distribution.

Portugal's Project Magellan had a unique model of distribution: families were required to either purchase netbooks at reduced prices or receive them completely subsidized, which had two consequences. One consequence was that there was no coordination of when students actually obtained their computers, so the schools lost valuable momentum from the process of setting up and incorporating the devices in the

classroom. For months, teachers were not able to use technology in their classrooms because only a few students had computers, and student excitement about having a new device dissipated before teachers could capitalize on it. This loss of momentum aggravated another consequence of distributing computers via the families: many children and parents did not see the netbook as a school initiative. The research found that many parents and children thought the computer was for home use and did not take it to school.

In Terengganu (Malaysia), the chief minister or the state assemblyman of the district gave out the computers to students and families at each school during "e-book ceremonies," but the ceremony did not include distribution to teachers, which proved problematic for classroom integration. Because the teachers of these students did not have their own computers, they were not able to use ICT-based lessons in the classroom. Additionally, students took the computers directly home. They were supposed to bring them back to school, but most seldom did. This delivery approach is in line with the initiative's focus on social inclusion, but proved to be a barrier to integration in the school setting.

Although Conectar Igualdad in Argentina generally had very positive media coverage during the launch, logistical challenges in some provinces resulted in negative attention. The national Ministry of Education had to coordinate distribution with 28 provincial systems, creating space for many delivery challenges. In some areas, not all students received machines, and in others, certain schools received too many. In some provinces, students even staged protests demanding their computers; some students waited almost three years to get theirs.

How should events surrounding the launch support the overall goals of the initiative?

In addition to the media attention that the national launch will receive, the degree of personal excitement among students and parents on launch day at each school or village are important moments that shape the public's vision of 1:1 eLearning. This is a chance to help students understand that the netbook is for more than just games and chatting—that it can be the gateway to a world of learning. During the rollout, the initiative needs to build excitement around goals and not just around the machine's presence.

Initiatives may actually have multiple launches: the first public launch often gets national attention, and then local launches take place as the initiative reaches each school or village. In Kocaeli (Turkey), the opening ceremony drew national attention. The prime minister of Turkey participated via teleconference, addressing the first group of students about the importance of the 1:1 computing model. He encouraged students to email him questions, suggestions, and concerns about their experiences with the computers. The ceremony was broadcast across the country.

Argentina was very effective at using multiple launch events to raise public awareness and excitement and to communicate the importance of digital inclusion. The president was at the main ceremony to distribute the first batch of computers, but she also appeared at many other launch events in the provinces, using her presence to get media attention and to talk about the government's expectations for the initiative.

3. Provide Professional Development and Ongoing Support for Teachers, Administrators, Parents, and Students

Professional development and training for all stakeholders is vital to the ongoing success of any 1:1 eLearning initiative regardless of whether the goal is education reform, social inclusion, or economic

development. Without proper training and planning that enables recipients to actually use the new tools, the introduction of new technology into the classroom or home can weaken the core goals of an initiative. The following questions present some of the lessons learned about training for teachers, students, administrators, and parents.

Teachers: What topics should teacher professional development focus on?

Reports from these nine cases highlight the importance of three broad professional development topics: technology, pedagogy, and instructional design. Teachers will need support in each area and, more important, in the overlap of these areas; they need to know not only how to use PowerPoint, but how to use it for teaching. In many eLearning initiatives, teachers are expected to create their own activities, so they will need to learn how to design instruction that uses ICT in the most effective ways. For all three training strands, content needs to be adapted to the local educational context and frameworks as well as the local technological infrastructure.

Technical Training: Countries that start with minimal ICT infrastructure in schools often overestimate the importance of technically focused training. Obviously teachers need to know some of the basics, but if the training fails to immediately show teachers how these tools are relevant for teaching, they will not see the computer as a valuable classroom tool and they will not use it. For example, in the Republika Srpska (Bosnia) the content of the first training was focused on the technical functions of the Classmate PCs and the classroom management software rather than on using the technology to teach. The teachers complained that they would like to have instruction on how to conduct ICT-integrated lessons (Nikoloski & Samardzic Jankova 2013b). There were no manuals or prepared lesson plans on the effective use of technology in the classroom available for teachers at the start of the initiative. To overcome this issue, the initiative had to offer another round of trainings focused on teaching.

Pedagogical Training: This is the most frequently overlooked aspect of ICT training. Many of the school-based eLearning initiatives have the ultimate goal of changing teachers' approach to teaching, but rarely do they provide the deep and sustained training courses required to get teachers to think differently about how they deliver content and how students learn it.

Although the Korean SMART Education initiative is an advanced and largely successful model, its planners are only beginning to push for pedagogical reform after 15 years of ICT policy reform. Researchers there laid out a comprehensive approach to increasing teachers' SMART Education competencies by diversifying curricular development and training methods (with a focus on the goals of the SMART Education initiative) at provincial and municipal educational training centers and teachers' training colleges. These facilities will also be updated with "SMART Education experience halls" and improved teaching and learning centers. Also, more SMART Education support personnel will be deployed to schools to support teacher professional development. With improved access to technically advanced facilities and highly trained support personnel, Korea hopes to fundamentally change the way teachers and students interact and create a more personalized and flexible learning environment in which students become producers and collaborators.

Similarly, Shanghai's focus on improving teacher pedagogy is also a novel endeavor stimulated by the outcomes of the recent Education Transformation Research series supported by Intel. After many years of using technology in schools, policymakers are just now focusing on pedagogy as a means to transform

classroom learning. They recognize that access to the technology alone will not ignite major changes. In their four-point roadmap, researchers highlight the use of the Technological Pedagogical Content Knowledge (TPACK) framework to guide teacher professional development. In 1:1 eLearning classrooms, teachers are encouraged to use the TPACK framework to analyze learning needs, design lesson plans, and determine assessment approaches. Researchers, policymakers, and educators now realize that teacher training is a factor that will have major influence on whether or not a country is able to transform its education system.

Instructional Design Training: Many of these initiatives, implicitly or explicitly, expect teachers to develop their own instructional materials, either because there are few digital resources in the national language or because there are few resources using ICT in innovative ways. To enhance teachers' knowledge and skills in the area of innovative instruction, the Ministry of Education in Terengganu (Malaysia) organized workshops for selected teachers on how to prepare teaching materials in a variety of subjects. And, after learning from the early research on their initiative, the Ministry of Education in Macedonia is planning on providing more support in instructional design and innovative pedagogy (Nikoloski & Samardzic Jankova 2013a).

Apart from these two examples, the research across these cases found that few initiatives helped teachers learn to be instructional designers. For example, in the Republika Srpska (Bosnia), the Ministry of Education currently does not have plans to develop or localize ready-made content in the local languages, which means that the ICT integration must rely on teacher-developed content. Most of the interviewed teachers stated that they translate content from Serbia and Croatia into the local dialect, but they believe they lack the skills needed to create quality curricula. Furthermore, the research on Project Dositej suggests that most teachers have scant knowledge of innovative pedagogical approaches (Nikoloski & Samardzic Jankova 2013b).

Shanghai's e-School Bag Project is an interesting example of an initiative involving all three levels of training. Shanghai's Ministry of Education has been using the Intel Teach program for many years to help teachers learn to use ICT to support project-based teaching. With the introduction of 1:1 computing for students, the ministry began providing intensive ongoing support to teachers in the pilot schools to help them create learning activities. From this base, the Shanghai research team created a virtual community through which pilot teachers can work with other teachers to refine, share, and improve these activities and create many more (Zhang et al. 2013).

When should teacher professional development take place?

Years of research on technology integration has made clear that teacher training and professional development is fundamental to the long-term success of any initiative, but this finding leaves unanswered questions about when and how much training should occur. The answers will be unique to each 1:1 eLearning initiative and depend on the level of training teachers currently have, the reform goals of the initiative, and other considerations. But the experiences of these nine cases suggest that the teachers should be trained when they receive their computers, not significantly before or after.

For example, teachers and administrators in both Terengganu (Malaysia) and Republika Srpksa (Bosnia) noted challenges due to the disconnected timing of computer distribution and professional development trainings. In Republika Srpska, the training was done well before deploying the Classmate PCs, and the teachers did not have the opportunity to immediately start practicing. In Terengganu, many teachers had

the reverse problem: researchers found that teachers at many schools received their first training one year after the netbooks were given to the students. Not surprisingly, local researchers report that teachers found it difficult to use the netbooks in their classes (Hoon et al. 2012).

Especially for the initial teacher training—which also may be the most technical—some initiatives had success in distributing computers to teachers and training them before distributing computers to the students. This strategy worked very well for the Um Computador por Aluno initiative in Piraí, Brazil (Dias Coelho & Horta Jardim 2010).

How much training will teachers need?

The previous sections covered the need for professional development that ranges from the technical to the pedagogical and for careful timing of the training to coincide with distribution of the computers. But the experience of these cases also shows that teachers will need more than a one-time training. Aware that full integration of ICT and deep reform of pedagogy are slow processes, planners of the most successful initiatives built ongoing support and training into their efforts. As teachers become more comfortable with the computers, they will begin incorporating technology into lessons, and the more they do, the more they need to know pedagogically to continue deepening their practice. Courses will need to be repeated as new teachers come into the school or district, and new trainings will need to be created as software and hardware are updated and as pedagogical shifts are introduced.

Many of these initiatives used Intel teacher professional development resources to create master teachers or ICT coaches that reside in each school to support other teachers. They provide ongoing technical and pedagogical support for colleagues within their school settings. In Terengganu (Malaysia), one or two teachers in each school were selected to become Intel Teach Master Teachers. These master teachers were expected to provide ongoing training and support to their colleagues when they returned to school.

Macedonia is set to launch another round of professional development that is focused on innovative pedagogical uses of technology. This is a follow-up training for the teachers who had the first trainings for the One Computer Per Child initiative, to keep moving the work forward and to build off teachers' current base of knowledge.

In Shanghai (China), the Ministry of Education is moving its teacher professional development and support in the e-School Bag Project to the next level. Since the success of the pilot schools, the ministry is developing a professional learning community (PLC) that combines face-to-face meetings and virtual communication to connect the best teachers from the pilot with their peers in other schools. Pilot teachers will mentor and foster innovation as the initiative expands, mentees will be able to view videos of the best innovative lessons developed by the pilot teachers, and all PLC participants will be able to share lesson plans.

Who should be responsible for providing teacher professional development?

It is critical to ensure that all personnel who work with students have the knowledge and skills to use technology in ways that will improve learning. Clearly establishing who should be responsible for teacher training is a very important step to complete before the launch of any 1:1 eLearning initiative. All key organizing agencies need to be clear about their responsibilities for teacher professional development and willing to take on the challenge.

For large-scale initiatives, it is likely that many entities will need to share the responsibility, but initiatives can fall apart if some of these entities do not follow through on their responsibilities. In Argentina, professional development was left to the provinces in the first years of Conectar Igualdad, but many provinces offered little training. The failure to provide adequate training resulted in teacher dissatisfaction, which in turn led to limited impact on teaching and learning (Artopoulos & Beech 2012). As Conectar Igualdad moves into its fourth year, the federal government has increased its role in professional development (Artopoulos & Beech 2014).

For long-term success, initiatives should consider having multiple trainers and professional development support available to teachers. The e-Book Project in Terengganu (Malaysia) has master teachers in each school, offers trainings from the provincial Ministry of Education and state-owned training agency, and Kolej Terengganu Skills Development Corporation (TESDEC) provides continual support and training to both teachers and students.

Korea provides perhaps the best example of well-timed, high-quality, relevant, and sustained teacher professional development. Over the many years of Korea's successive policy initiatives to build the role of ICT in education, teacher training has always been one of the most important issues. While a structured training system operates at the central level (Ministry of Education and KERIS), teacher training has also systematically taken root at the school level, where schools conduct their own content-area trainings through collaborative or "subject study" activities (Chun & Kye 2013). The SMART Education initiative plans to increase support personnel at each level of schools to have one person per school for large schools, and one person per five schools for small schools. Digital assistants will be retrained to serve as additional supports, and the provincial and municipal educational training centers and teachers' training colleges are being upgraded with infrastructure updates, the creation of "SMART Education Experience Halls," and the diversification of curricular development and training methods. The goal is to provide professional development on SMART Education to 25 percent of teachers every year.

What strategies work to encourage teachers to use more technology?

Given the many demands placed on teachers, it can be hard to induce them to change long-standing classroom strategies, so eLearning initiatives must consider how to encourage teachers to actually use the new technologies and tools in the classroom.

In Korea, the government's aggressive reform policies toward the use of ICT in education over the last decade have meant that teachers were almost forced to learn the technology for themselves. The government demanded that teachers use ICT in any form for at least 10 percent of each lesson; as a result, they could not carry out their lessons without attaining ICT literacy. In addition, computer literacy had been designated as a prerequisite for primary school teaching, and related certificates were required for the promotion of teachers. The National Education Information System (NEIS), which was introduced on a full scale in 2004, digitized school administrative tasks in all areas, from student attendance and academic performance, to college entrance and transfers, to school budgets. Korean teachers could not perform any administrative duties without using the computer and going online, and this state of affairs naturally pressed them to raise their ICT literacy.

In Bosnia, teachers are certified for life and no longer have to maintain a certain number of professional development training modules. While teachers are supposed to accumulate hours, these numbers are not being tracked. There are no longer incentives to push teachers to participate in more professional development in the area of ICT.

Administrators: What training is appropriate for directors and other administrators?

Like teachers, administrators will probably need multiple types of training. They will need training on the pedagogical use of ICT to be able to provide support and encouragement for teachers trying out new and challenging teaching strategies. Since they will likely be the key decision-makers on how and where ICTs are located in the building, basic technical training would help them to better support the maintenance and long-term sustainability of the ICT infrastructure. One of the outcomes from the research on

CASE STUDY

Computer for Every Child, Macedonia – Supporting teacher professional growth over time.

In its Computer for Every Child Program, Macedonia has evolved a two-phase approach to technology integration and promoting deeper pedagogical reform. In the first phase of the initiative, the Ministry of Education created a set of digital resources, such as ToolKID, that are closely aligned to the curricula and to traditional teaching practices. For example, ToolKID offers interactive worksheets and bank of digital math problems. The education ministry also translated over 80 open-source educational programs into local languages. For many teachers it was relatively easy for them to integrate technology within these traditional lesson plans and learning tasks.

Once Macedonian teachers are familiar with the technology and students are used to using it everyday in the classroom. For the next phase of the initiative the Ministry of Education is planning more professional development to help teachers explore new pedagogical paradigms and learn to design their own activities using more innovative approaches.

Learn more about Computer for Every Child in Macedonia

Shanghai's e-School Bag Project was to create a leadership training program so that school directors and others will understand the full roadmap for implementing e-School Bag and creating new learning environments (Zhang et al. 2013). School directors need to develop a long-term view in order to make informed decisions throughout the process.

The research across these cases suggests that the implementation of these initiatives can benefit if school leadership has training on issues related to introducing ICT into their school buildings and knowledge about the implications of the use model for the spatial distribution of devices within schools. This need may be particularly important in countries were the schools do not have a lot of ICT prior to the launch. In the Republika Srpska (Bosnia), for example, directors were not given any training on infrastructure issues before launch. This first phase of Project Dositej gave each school ICT resources to create a handful of ICT-rich classrooms, and the designation of e-classrooms in each school was left to the director. However, the task of e-classroom designation had long-term implications for success: those directors with more ICT experience and knowledge selected classrooms on criteria such as ease of access to the Internet or equal distribution across grade levels, which made it easier for those schools to share e-classrooms among teachers or bring in Internet connectivity (Nikoloski & Samardzic Jankova 2013b). Other principals designated classrooms with little forethought, and the first phase of the initiative has not provided the same base from which to grow the efforts within each school. The researchers suggest that the initiatives inform, involve, and engage school leaders, perhaps by organizing study visits to showcase successful or model schools that have adopted the technology on a higher level.

Changing teacher practice is hard and requires coordinated and sustained efforts from school leaders to encourage teachers and support them as they experiment with change. Strong school leadership can propel broader change within a school and expand innovative ICT use beyond a few pioneer teachers. The research on Korea's SMART Education initiative highlights the importance of nurturing the vision, commitment, and understanding of the school director. In Korea, the researchers emphasize the role the school director plays in creating a SMART learning culture in the building. Their findings suggest that the directors who had the will and competency to understand technological changes and connect ICT with education were the most successful at supporting teachers' ICT integration in their classrooms (Chun & Kye 2013).

Parents: Should parents receive training?

This is an interesting question, and one where the research on these initiatives found few examples of parent training but many challenges that arose from its absence. All of these initiatives impact the parents of the children who receive the computers. Regardless of whether the devices go home or stay in school or whether the goal is social inclusion or workforce development, training parents can help the overall initiative. Helping parents learn about technology and allay their fears and concerns will enable them to help their children take advantage of the technology themselves. Like teachers, parents must be educated on how to use the computers available to them. There are two topics that are relevant for parents: digital parenting (or how to be more involved in your child's digital life), and being a digital user oneself.

Digital Parenting: Parents often have a lot of fears about technology, especially those who are not familiar with computers and the Internet. With the increased role of home computers in children's lives has come increased concern about how children may be affected. Parents generally recognized the ben-

efits of having computers and Internet access at home and at school; however, they want to be able to control their children's online activities—to be aware of what their children see and hear on the Internet, who they meet, and what they share about themselves online. In the home visits that were part of the research in Kocaeli (Turkey), parent concerns ranged from students being distracted from their studies by the Internet, to students accessing inappropriate web sites, to Internet safety. That research clearly found that parents who were more tech-savvy felt better able to guide their children's online use, while parents with no technology experience felt they had little control (Aydin, Kumtepe, & Kumtepe 2013). The Kocaeli initiative takes advantage of parent's new interest in technology to encourage parents to improve their own digital literacy.

In Portugal, the Magellan Project offered orientations to ease parent anxiety by showing them how to monitor children's computer and Internet use. Offering free Internet security software or filtering programs on the computers to block certain sites or other programs that can monitor and track online activity is another potential approach to assuaging parent anxieties about their children's Internet usage.

Even for initiatives that do not send computers home with students, it is important to educate parents about the digital world. In Macedonia, the researchers found that, as the least informed stakeholders, parents are not very familiar with the benefits of technology and often see the computer as a toy rather than a tool to enhance learning (Nikoloski & Samardzic 2013c). Macedonia now offers parent workshops to relieve parent anxieties about technology and to promote engagement and excitement about the Computer for Every Child initiative among the public.

Digital Users: If the computers go home with the students, this is an opportunity to promote digital literacy among the larger population. The province of Kocaeli (Turkey) has an extensive network of public adult learning centers that began to market their computer and technology courses to the parents of children in the One Computer per Child initiative. In interviews, coordinators at the adult learning centers said that many women in particular took advantage of their children's netbooks to learn more about computers and the Internet (Aydin et al. 2013).

CASE STUDY

One Computer Per Child in Kocaeli, Turkey – Leveraging the child's computer to help parents

The province of Kocaeli's One Computer Per Child program gives a netbook to every sixth grade student to take home. The program has been able to leverage that device to help get parents tech skills, by using an adult education program, the Kocaeli Metropolitan Municipality Crafts and Art Education Courses (KO-MEK), to host Internet Centers and technology Information Houses and offers free computer classes to parents. KO-MEK has numerous centers throughout the province. One of the parents who participated in the research explained how the computer and the KO-MEK training help her open up tailoring shop: "I search for patterns and dress designs on the Internet and show them to my clients. We than decide on design and colors looking at some pictures. It has been great for me to use the laptop for my work. I also use it for watching movies and crossword puzzles."

Learn more about One Computer per Child in Turkey

CASE STUDY

eBook Project in Terengganu, Malaysia – The value of providing multiple levels of technical support

The eBook Project in Terengganu, Malaysia, created a system that offers both technical support and pedagogical support. In order to address the lack of computer technicians in the schools, the state-owned company, Terengganu Skills Development Corporation (TESDEC), trained unemployed IT-trained graduates to work at schools. At the school, the EIOs provided the first level of technical support such as reformatting the laptop and cleaning viruses, while more complicated issues such as physical damages or problems with server are addressed by the factory.

In addition to the EIO's, each school supports an ICT coordinator who is a current teacher appointed to manage and coordinate IT facilities such the computer lab, access room, and Internet. The ICT coordinator helps teachers to integrate ICT in teaching and learning activities that will enhance classroom instructions. The ICT coordinators are experienced teachers trained in the use of ICT in schools. Typical activities for the ICT Coordinators involve teaching, preparing lessons, managing school data, helping teachers with ICT and maintaining the ICT facilities.

Learn more about the e-Book Project in Malaysia

Students: Should students receive basic ICT training?

Students are of course the primary beneficiaries of 1:1 eLearning initiatives, and the question here is not whether students should learn with technology but whether students need specific training in ICT skills. Students' level of ICT proficiency will impact the success of the initiative, so policymakers should consider student skill levels prior to launch. The experience across these nine cases on this issue is mixed, and much probably depends on how widespread digital devices and tools are within the society and in the schools. For example, the teachers in Argentina were surprised that students were comfortable using their computer for games and social media, but were not able to use the computer to produce a report or do web research (Artopoulos & Beech 2014). Yet Korea and Shanghai report different experiences: teachers in both initiatives felt that students did not need specific ICT training and were able to learn what they needed through the content-focused activities (Chun & Kye 2013; Zhang et al. 2013). Technology is already widespread in both these societies and their school systems have had robust ICT infrastructure for many years, so most students are comfortable and proficient with technology.

Macedonia perhaps offers a good example of an approach that simultaneously honed students' technical skills while providing valuable support for the initiative. Students were trained as technical support providers, which allowed them to troubleshoot computer problems for teachers and their peers.

4. Provide Ongoing Technical Support

Much like professional development for teachers, the provision of technical support needs to be systematically designed, and initiative developers need to plan for technical support to continue beyond the beginning of the initiative. Technical support will need to be ongoing even when the initiative comes to an end.

Who should provide technical support for the eLearning initiative?

As a long-term solution, technology support will need to become an integrated component of the district or school system. But because these eLearning initiatives are often the first time that so much technology has been introduced into the schools, most initiatives need to plan to provide more intensive technical support at the outset. Over the course of

the initiative, teachers and students will need differing degrees of technical support. Basic tech support such as updating software or connecting printers and troubleshooting small problems should be available at the school on a daily basis, but more challenging issues can often be handled most effectively by technical support staff outside the school. The nine cases offer examples of the various approaches to procuring and sustaining both internal and external technical support.

In Macedonia, the One Computer per Child initiative designated one teacher in each school to be the educational technology support teacher, who provides some basic troubleshooting and pedagogical support (Nikoloski & Jankova 2012). These teachers are classroom teachers, not IT teachers. They receive extra training and a reduced class load.

In the Republika Srpska (Bosnia), former school librarians became responsible for overseeing the new IT infrastructure and providing basic troubleshooting. Project Dositej does have to provide training since the majority of these individuals did not have technical skills when they assumed their new positions. In certain instances where the volume of work is too great and the librarians/IT administrators cannot manage to do it on their own, schools have signed contracts with an outside IT company that is responsible for the maintenance

In Korea, as more devices entered classrooms with the SMART Education initiative and the duties of operating and managing the technology grew, some schools started to employ computing assistants from outside the school. Teachers applauded this effort because it reduced their burden of technical and maintenance responsibilities. Budget limitations, however, meant most schools could not hire computing assistants.

5. Provide Opportunities for Feedback, Evaluation, and Self-Reflection

Evaluating and adapting policies and activities are central aspects of the process of achieving and maintaining a successful eLearning initiative. In fact, research and evaluation is one of the five key dimensions of Intel's Education Transformation framework. eLearning initiatives are incredibly complex, intersecting with so many aspects of school and home life and dependent on other ICT elements that it is impossible to plan for every eventuality. A good evaluation plan can allow an initiative to self-correct, and the implementation agency can improve and redesign as it learns more about what works and what new opportunities are emerging.

What is the best model for researching and evaluating an eLearning initiative?

Having a third-party evaluation is the best strategy, but even if that is not possible, it is important to have a process for feedback and self-reflection. Just as Intel conducts research on its own initiatives, the country-level initiatives should invest in an opportunity to reflect on implementation and outcomes. This section highlights examples of ways in which initiatives developed internal monitoring teams or partnered with external groups to assess implementation and practice throughout the rollout.

Over the past decade, Korea has provided the best example of the integration of ongoing research and evaluation into an eLearning initiative. The Korean government actually established multiple research entities to provide a research base for technology in schools: the Korea Institute for Curriculum and Evaluation (KICE), which is in charge of curriculum and assessments like the college scholastic ability test, and the Korea Education & Research Information Service (KERIS)(Chun & Kye 2013). Metropolitan and provincial offices and the Ministry of Education have all commissioned ongoing evaluations of the policy's results and effectiveness at different levels of administration.

In Terengganu (Malaysia), the e-Book Project does not have its own external evaluator but holds quarterly stakeholder meetings to monitor progress, debate challenges, and make changes. The large committee, headed by the state's executive counselor, also includes representatives from the various offices of the State Education Department Terengganu (SEDT) (including committees on education, higher education, science, technology, and human resources), the netbook vendor, and representatives from institutions of higher learning. However, this model means that little or no research is done in individual schools to monitor the integration of ICT.

In Shanghai, the government spearheaded research led by a diverse team to monitor the initiative and suggest revisions. For the rollout of the e-School Bag pilot, six project groups were set up to not only complete their own assigned tasks but to support each other during the implementation. The six groups included 1) a technology support group to help with infrastructure construction and setup; 2) a curriculum and classroom teaching group to design the curricula and assessments; 3) a student health group to do research on computers' impact on students' health; 4) a professional development group to design teacher and principal professional development programs; 5) a resources integration group to collect information on e-school bags and technology development; and 6) an industry and technology group to monitor technology development and to purchase necessary software and hardware. These groups worked together to supervise and monitor the pilot and eventually use what they learned to inform the rollout of the full-scale initiative.

In Piraí, Brazil, coordinators monitored progress, which helped fine-tune planning and implementation over the course of the initiative. Feedback was collected from a variety of stakeholders, including school leaders, teachers, parents, and city officials and this feedback shaped initiative operations.

6. Plan for Sustainability

From the very beginning, planners need to think about and plan for the initiative's sustainability, a keystone concept linked to all of the areas described above. This section reviews some of the lessons about sustainability learned from the nine cases and some of the challenges that can emerge.

Are there strategies in place to foster a long-term stakeholder commitment?

ELearning initiatives propose complex and challenging goals that require commitment and persistence from many stakeholders. The initiative planners need to think ahead on how to maintain that commitment. The following strategies have helped the nine initiatives ensure their own growth and continuity.

Cultivating public support. Initiatives should be sure the public sees value in the initiative and are aware of how positive the technology can be for children and parents. The Shanghai study (Zhang et al. 2013) found that the e-School Bag Project was having difficulties because they had not clearly and consistently communicated to parents the value of ICT and the new learning model. But other initiatives have been more successful. Connectar Igualdad, for example, has strong support from the president of Argentina, who has often commented publicly on the value of the initiative. In Kocaeli (Turkey), the collaboration with adult learning centers has been essential to cultivating community support since it enables parents to understand how the initiative benefits the entire family.

Developing a long-term vision. To sustain themselves and maintain stakeholder buy-in as the initiative grows and technology changes, eLearning initiatives need to develop a long-term vision that extends beyond the simple idea of providing devices to schools or students. If the initiative's vision is limited to providing devices, it has little reason to continue once technology changes or every child has a computer. All of these initiatives have set forth large visions: Shanghai (China), for example, is seeking to transform teaching and learning with ICT, and Republika Srpska wants to develop a tech-savvy workforce.

How can the initiative create local champions at each school?

Another important strategy for long-term sustainability is to foster long-term commitment at the school level and to keep extending the use of ICT beyond the classroom of a few pioneer teachers. One strategy to support sustainability as well as to achieve short-term success is to develop advocates for ICT within each school. This measure promotes usage, and usage helps sustain the initiative because teachers continue to demand it. In Macedonia, one classroom teacher in each school also serves as an educational technology support teacher, who both provides basic tech support and acts as an advocate for technology. They coach and encourage colleagues to experiment with ICT, and in exchange for this role, they receive extra training and a reduced class load (Nikoloski & Jankova 2012).

How does the initiative plan to keep the technology infrastructure functioning and available?

A clear challenge for schools and families is the ongoing maintenance of infrastructure and devices to ensure continual use. Typically, technical staff connected to the eLearning initiative install and set up devices and other infrastructure components, but in the long run, the responsibility reverts to the schools. So policymakers need to think through how to support that transition. For example, in Terengganu (Malaysia), the initiative included the training of school-level technical staff to provide the first level of support, such as reformatting netbooks and deleting viruses. Students can seek the assistance of the school tech person whenever they have problem with their netbooks. For Conectar Igualdad in Argentina, the national government required that each province provide technical support to the schools in each jurisdiction. The technicians helped teachers and students with basic device maintenance and solved problems like keeping the batteries charged (Artopoulos & Beech 2014). Providing technical support can be more complex for initiatives in which students take the computer home. As in Argentina, tech support can be provided through the school, but as students move schools or graduate, providing such support becomes more complicated.

How can an eLearning initiative help schools assume the recurring costs of technology?

Acquiring new tools can bring added or new costs for schools. Expenses for connectivity or consumables like toner, paper, and peripherals can begin to mount. Schools will also eventually need to consider replacing machines or updating other infrastructure. Many initiatives cover those costs in the beginning, but afterwards the costs need to be assumed by other entities. The first step is for initiative planners to be aware of the issues and to try to develop affordable ways of managing maintenance expenses or financial reversals. For example, in the Republika Srpska (Bosnia), the designers created a basic ICT infrastructure that can still support critical functions even if the school cannot afford the Internet. All e-classrooms can use a local area network built into the Classmate PCs to support a virtual learning environment even if there is no Internet.

Another important component is leadership training to help school directors understand the costs involved, learn to plan a technology budget, and comprehend the value of maintaining the infrastructure.

Is Bring Your Own Device (BYOD) a viable solution?

As smart devices and other mobile technologies spread throughout the community, a BYOD approach may become a viable means for schools to lower costs by utilizing the devices that students already have. However, because students can own a wide variety of devices, schools may be challenged to create an infrastructure that can support and connect different platforms, software, and operating systems. Of these nine cases, only two are even beginning to think about this issue. With the success of the e-School Bag Project, Shanghai is just beginning to explore whether BYOD can be support the next phase of their ICT integration efforts (Zhang et al. 2013). Korea's SMART Education initiative already assumes that students will have cell phones and smart phones; many of the initiative's digital resources are accessible online so that any web-enabled device can retrieve them.

What strategies can be activated to help ensure ongoing connectivity?

Besides asking schools to bear the costs themselves, there may be other ways that governments and initiative designers can help schools connect and stay connected to the Internet. Sometimes other levels of government can step in to help. In some initiatives such as Republika Srpska's, individual schools have gotten financing for the Internet from town or village governments. In Piraí (Brasil), the municipal Digital Piraí program helps provide connectivity throughout the town.

In Portugal, the government worked with ISPs to offer discounted service to make connectivity affordable for more families. The government also supports community centers where children can connect to the Internet.

How does the eLearning initiative connect to preservice teacher training programs?

An important component that many eLearning initiatives have trouble addressing is to incorporate the new pedagogical paradigm and the new ICT tools into future teacher preparation trainings. Otherwise, initiatives will need to retrain even new teachers as they arrive at schools.

7. Navigate the Changing Environment Created as a Result of the Political Context Generated by the Initiative

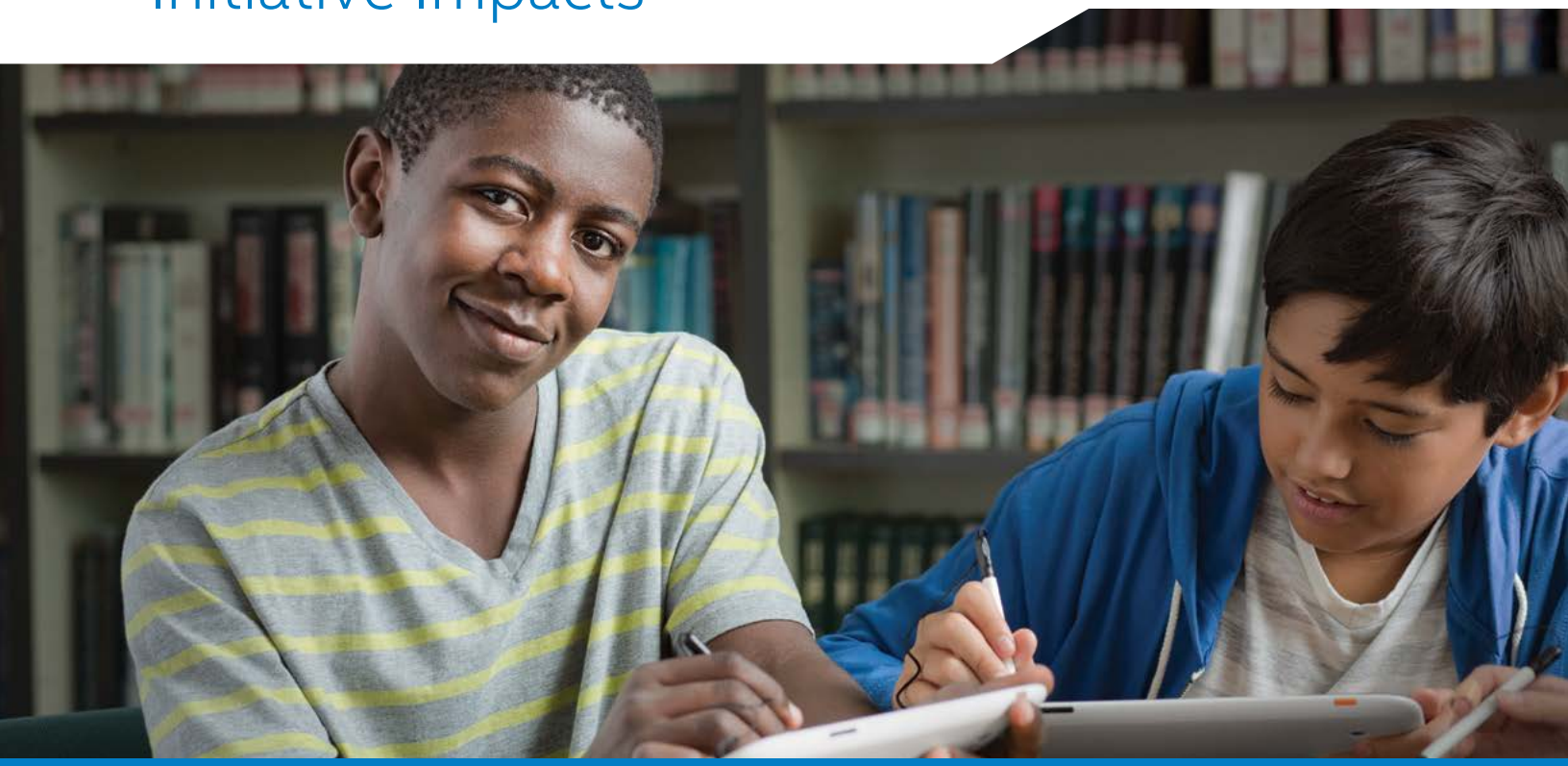
Policies exist within a political context that can shape how initiatives roll out, but that context will begin to change in reaction to the initiative's progress. Large-scale education reform efforts tend to raise high-profile issues, and it's important for planners to understand the complexities and conflicts that can affect the initiative over the long-term. Policymakers need to be prepared for political challenges during the nascent policy creation phases as well as during rollout. The nine case studies offer a number of examples of successes and obstacles related to the political landscape in specific countries.

Macedonia and Argentina offer examples of instances in which politics impeded the planning process. In Macedonia, the recently elected government was highly motivated to fulfill its commitment to 1:1 eLearning, and the need was so urgent that it had to move fast and some level of careful planning was lost to expediency. In Argentina, the rollout coincided with presidential elections, which shaped how the public viewed Conectar Igualdad, the laptop initiative proposed by President Cristina Fernández de Kirchner. With her full support, the federal government was able to leverage participation from various government agencies. Many stakeholders believe that she launched the initiative for political reasons and failed to follow through with communication of the vision and goals to key players such as school administrators, teachers, and parents.

In Bosnia, despite years of social and political strife, the implementation of Project Dositej was unaffected by recent changes in leadership. Republika Srpska's previous minister of education, who initiated Project Dositej, has recently been replaced; the future of the initiative has not been jeopardized, however: the government has announced the rollout of the second phase, which is expected to provide an additional 55 to 60 schools with approximately 9,000 devices.

However, specific events in a country may reduce the need for the specific 1:1 eLearning initiative. The initiative in Kocaeli (Turkey) was a municipal effort that is now being superseded by the FATIH Initiative, a nationwide program, so Kocaeli can now consider where it wants to redirect its efforts toward economic growth and education reform.

Initiative Impacts



IN THIS SECTION

The 1:1 eLearning initiatives covered in this research promoted long-term visions for social change and educational transformation that encompassed four dimensions: education reform, digital inclusion, workforce development, and economic development. Each of these visions is very broad, achieving change is a complex process, and the nine countries met with varying degrees of success.

Across the nine initiatives, the most consistent impact has been on teachers' and students' access to technology at school. Teachers and students are using more technology for teaching and learning in the classroom, and the distribution of computers has also helped reduce the digital divide in many countries by giving entire families access to hardware, software, and the Internet. Finally, in a number of countries, the initiative helped increase local manufacturing and employment rates. This section will outline in more detail the specific impacts observed in the nine initiatives.

Education Reform

All of the nine initiatives in this study had a goal of improving education, and each initiative was able to accomplish this goal to some degree, whether by expanding or transforming the current system. The depth and longevity of those impacts depends on many of the factors discussed in the preceding sections, including state and national policy and leadership, partnership involvement, reliability of technology infrastructure and Internet connectivity, school administrative support, ongoing teacher training, ICT support, stakeholder engagement, and sustainable funding. School-level impacts can be categorized in five areas: technology access, technology integration, student learning and engagement, assessment, and school and classroom culture.

Teachers and students have access to more technology hardware and software at school

Not surprisingly, countries with school-based initiatives—Republika Srpska (Bosnia), Korea, Macedonia, Terengganu (Malaysia), and Shanghai—saw the biggest increase in access within the school buildings. With more technology available in the schools, both teachers and students are able to take advantage of opportunities to engage in enriched, hands-on learning experiences.

In the Republika Srpska (Bosnia), a total of 248 classrooms in 62 schools were equipped with teacher laptops, classroom laptop sets (approximately 25 per class), educational software, and virtual learning environments. Before Project Dositej, these schools had only a few outdated machines donated by places like China and other more developed countries that were upgrading their own hardware.

After nearly five years, the One Computer per Child initiative in Macedonia has produced positive changes in classrooms throughout the country. The ratio of computers to students, which was 1:45 at the beginning of the initiative, was reduced to 1:1. As a result of increased access, more teachers are using ICT in their daily instruction, and all teachers report using an ICT-based activity at least once per week across all subjects.

The schools in Terengganu (Malaysia) had limited access to sufficient and up-to-date hardware before the e-Book Project. While many schools had a computer lab, the computers were outdated and insufficient in number to serve an entire class of students. With the introduction of the e-Book Project, students can access technology from their own classrooms without losing precious time moving between locations. In addition to the laptops that were distributed to all grade 5 students, a group of 32 schools (one per town) were equipped with virtual classrooms that included an interactive whiteboard, a teacher laptop, and sufficient electrical plugs for all students to charge their netbooks. This is a shared room that teachers access with their class when they want to do a particular lesson. Local researchers report that the virtual classrooms have been hugely successful as a means for supporting technology integration into lessons.

Schools in Korea were already saturated with technology hardware and software, but the SMART Schools Initiative created a greater variety of tools for teachers to choose from. SMART Education implementation and the types of technology vary depending on the vision of the school leaders and teachers. Some schools chose a one-device-per-student approach, while others introduced a communal model in which devices were shared between students, classrooms, or both. For device storage, schools used boxes or carts stored in a common space or classroom that teachers could access when they wanted to do a specific lesson. The technology most commonly introduced at the various pilot schools includes wireless Internet and accompanying access points, smart devices (Android tablets), laptops, interactive whiteboards, mirroring equipment, 3D TVs, classroom video cameras, automatic control systems for teachers, and digital teaching platforms. Access to software for document editing cloud storage and mobile mirroring also increased.

Because schools in Shanghai are already saturated with technology—90 percent of schools have high-speed Internet, and most classrooms are equipped with multimedia facilities—the focus of the e-School Bag Project was on creating a ubiquitous learning environment enabled by technology. More specifically, the focus was on digitizing teaching and learning content (including e-textbooks and digital online courses), equipping students with mobile learning devices, and establishing a public education service platform. All 11 schools in the Hongkou district pilot were equipped with 2,500 mobile learning devices. Each school focused on one or two subject areas that would maintain a 1:1 learning environment for at least 30 percent of all class hours; 1:1 learning was also extended to afterschool hours.

Teachers integrate more technology into their instructional practices

In Korea, it is not so much the technology access that has been impacted, but the instructional approaches used by the teachers. In what the Koreans call an "innovative classroom," technology functions as an essential learning tool for students so that they can lead their learning for themselves.
– ICT Value in Korean Education: Technology and Pedagogy Report (Chun and Kye 2013)

With increased access to hardware and software in the classroom, it is not surprising that teachers were able to integrate more technology into their instructional practices. While most teachers were able to utilize technology to some degree with their students, the complexity of the activities and the quality of instruction varied across initiatives. Across the cases, its possible to distinguish four levels of impact on teaching and learning: lesson planning and preparation; classroom management; technology integration in existing practices; and technology to support new practices.

Each of the following sections documents how teachers are incorporating technology into their daily practice in many different ways. Technology enables changes in instruction and pedagogy, but as these cases highlight, it can help teachers at any starting point. With the right supports, technology is able to help teachers change their practices at any stage of the reform cycle.

Lesson planning and preparation: Researchers reported that in many 1:1 initiatives, access to technology made lesson planning easier for teachers. In particular, when the teachers have access to the information and professional networks on the Internet, they are able to make informed choices about what resources best meet their students' needs; they no longer have to settle for whatever they can find. In places like Macedonia or Argentina where teachers in rural schools face challenges finding curricular materials, the eLearning initiatives gave them access to a broad range of options. In Argentina, the teacher content loaded onto their computers allowed them to easily find teaching materials from the Argentinian education web portal (educ.ar) as well as other quality sites from the Spanish-speaking world. In Macedonia, the Ministry of Education had also preloaded a variety of educational tools onto the laptops; there is not a wide selection of resources in the Macedonian language, and so out of necessity teachers create curricula in the local dialect. The technology enables teachers who are creating their own curricular materials to go beyond the resources provided by the Ministry of Education and to share across a network of colleagues.

Access to digital resources also made it easier for teachers to design and create presentations. For example, in Terengganu, some teachers said that the textbooks on the netbook made preparation of lessons easier since they did not need to cut and paste pictures or illustrations into charts to display on the board. They agreed that this approach also made it easier for the students to follow the lesson.

In Project Magellan, many teachers quickly adopted the practice of creating multimedia presentations for their class lectures. The Portuguese researchers found that, "teachers feel more comfortable using rather than producing digital curriculum" (Paiva et al. 2012a).

Classroom management: By providing teacher and student devices and a Virtual Learning Environment (VLE) (or at least a classroom management program), many eLearning initiatives also impacted classroom logistics. The ability to easily share materials to student devices changed what teachers could do with students; in Republika Srpska (Bosnia), the classroom management software, which is part of the

deployed solution, has been fully adopted across classrooms. The classroom management program is used to deliver content to the students in the form of worksheets designed by the teachers and to then collect the work completed by the students. All of the teachers and IT administrators interviewed by the local research team said that classroom management software makes their jobs easier because they can distribute and collect materials to and from students with the click of a mouse.

In Argentina, the classroom management tool enables the teacher to control and manage the classroom effectively and to supervise students' activities. Teachers also use a variety of techniques and strategies to get students involved in their classwork. For example, one teacher creates a Facebook page every school year to facilitate student learning and encourages students to post to the class page. This teacher is leveraging a common space for teenagers to motivate her students to see themselves as a learning community. Also, in trying to contribute to their Facebook page, students are drawing on different skills: writing, searching, and sharing. They also get to learn collaboratively and sharpen their digital literacy skills.

Teachers in the Korean SMART Education schools also use software and mirroring hardware that allows them to manipulate what students see on their screens. Teachers can view student screens and distribute content or assessments when needed. Data is then easily shared back out to the group.

In Terengganu, access to 1:1 laptops for students in the classroom also means fewer scheduling conflicts arise from using the shared computer lab space, and less time is wasted moving between the classroom and the lab.

Integrating technology into existing teacher-centered practices: Much of the policy discussion around 1:1 eLearning initiatives tends to focus on promoting reform-based student-centered learning activities' however most teachers will continue using many of their current teacher-centered practices, at least part of the time. Introducing new technology hardware and software does not mean that teachers will completely abandon their old instructional practices. Lectures and teacher-centered lessons are a common practice in classrooms around the world; many of these practices will be changed, and even improved, by technology. In fact, across all the countries that had a school-based component in their initiative, teachers continued to deliver lectures to their students, but they increased the use of digital content in their discussions, lessons, and homework assignments. If integrated effectively, technology can improve teacher-centered practices. Lectures can proceed more quickly if teachers do not have to repeatedly write, erase, and rewrite notes in chalk during the lecture. The ease of accessing resources over the Internet and distributing resources to students via a VLE saves time, gives students and teachers more choices, and even encourages teachers to differentiate or personalize resources for students.

Teachers in Terengganu (Malaysia) maintained a mostly teacher-centered approach as they had students use their netbooks as text reference and for doing classwork and homework. The most common programs that teachers use with their students are for graphic drawing, presentation creation, and Qur'anic recitation. A typical technology-rich classroom activity in Terengganu would begin with the teacher asking students to follow along in their digital textbooks while she explains the main points of the lesson. When the teacher poses questions, students respond verbally or type their answers in the digital textbook; they can then move on to completing individual work in their digital textbooks. Access to a dictionary and other basic productivity tools makes schoolwork more efficient for students. Students who did not bring their netbook with them would work with a friend. Access to individual netbooks allows students to work in class and then seamlessly close the computer and complete the exercises as homework.

Interactive whiteboards (IWBs) or projectors offer students more ways to understand new concepts during lectures by employing multimedia presentations with video clips, visualizations, and simulations. Teachers can create their own interactive presentations for use with their students. In Republika Srpska, for example, teachers used the interactive whiteboard to deliver content, but the technology enabled them to use video and audio files as well as digital images and even interactive activities over the web. In one classroom, a teacher displayed math problems without the answers and had his grade 2 students go up to the board to solve for X and explain their answer, and then he would display the correct answer. This practice is much like a chalkboard, but faster, cleaner, clearer and more efficient. Teachers do not waste time writing up at the board, students do not have to decipher messy handwriting, and teachers can easily provide more problems and examples.

In Macedonia, all teachers interviewed were unanimous that drill-and-practice software, such as the Supporting pedagogical change in school-based initiatives Supporting pedagogical change in school-based initiatives, that are built around a traditional pedagogical model have been a driving force for the technology integration. Such software was seen as an easy way to for the teachers to introduce technology in their work even when they were not skilled enough to create new technology-rich lessons. They feel that the closely mapped content enables them to integrate the technology at a basic level while at the same time developing their own skills and exploring alternate uses of technology.

Integrating technology into student-centered practices: Many of the 1:1 eLearning initiatives also seek to promote more student-centered learning activities and reform-oriented pedagogies. First, some student-centered activities are ones that many teachers have always assigned, such as conducting research, writing essays, and creating drawings and presentations. Access to their own netbooks and to the Internet have fundamentally changed how students research and create reports and presentations. They are now able to find information from all over the world; create multimedia products; and edit, modify, and share their work in new ways.

For example, a teacher in Project Magellan had students create interactive videos on the solar system. Students used their computers and science textbooks to research the topic and shared their newfound knowledge with classmates. Student presented their completed videos to the class and shared them with their families at home. The most rewarding part of this activity, the teacher said, was observing the students making connections and using eLearning tools beyond the classroom. Another teacher from Project Magellan started an art project to teach her grade 9 students about the life and work of Brazilian educator and philosopher Paulo Freire, but the class project quickly turned into a school-wide project:

> **"With the social science teacher, they worked on phrases by [Paulo] Freire. Then with me, they drew those phrases. With another teacher they used Google Maps to see where he was born, where he worked, etc. We then found where our school is located. Then the media teacher helped in editing the different productions that the students had made: drawings, photos, recordings in Audacity. We produced a digital mural and then we got some paint and decided to paint the whole patio of the school, the bathrooms, and some classrooms. Everybody participated."** *– Art teacher*

The networking capacity of the technology-enhanced learning environment and the ease of sharing resources can also create other ways for students to become active and take control of their own learning.

The eLearning Initiatives in both Korea and Shanghai (China) had explicit goals to promote highly innovative pedagogical models. The teachers involved in both initiatives received ample professional development and other supports to be able to create new lessons that incorporated innovative pedagogies. Teachers were able to put students at the center of the class and allow them to research, collect data, analyze information, and come up with solutions. Students became makers, creators, and designers of knowledge, rather than merely consumers.

The Korean researchers noted that the SMART model enables teachers to move away from traditional teacher-centered practices to "operate diverse class models without being restricted by the blackboard" (Chun & Kye 2013, p. 15). In a typical Korean classroom, technology is used to display multimedia content as supplementary materials over the web or with LED projectors. A traditional class is largely conducted through teacher-centered instruction while students sit passively listening to the teacher's lecture or watching learning aids. In the most advanced classrooms, smart technology functioned as an essential learning tool for students so that they could lead their own learning. For example, in a grade 4 class, students recorded videos of each other throwing Frisbees and then compared their form to the optimal form they were supposed to be mimicking.

Students had already seen a video titled "The Proper Posture for the Flying Disc" before they attended a physical education class and recorded themselves playing. When they compared the video with their own video taken during the class, they could see at a glance the moments when they needed to correct their posture. The smart devices of the teacher and students were linked with the dedicated interactive class solution for the classroom so that the teacher could remotely control student PCs, share files, conduct a simple quiz, or vote. In this case, he sent his students an instant online questionnaire in which he asked them to assess whether they thought they had proper posture for Frisbee playing. The students typed in such self-assessments as "I should have placed the flying disc horizontally" and "I will have a better balance next time," and clicked the enter key. In just two minutes, the student responses appeared on the whiteboard in a clear table format. All expressed their opinion freely and communicated with one another in real time. Technology enabled this teacher and his students to engage in a new kind of learning that was hands-on, student centered, relevant, interesting, and analytical.

In Shanghai, one of the main goals of the e-School Bag Project was to increase students' critical-thinking skills. Toward this end, pilot schools worked to reconstruct the curriculum, combining classroom and extracurricular activities to provide students with more opportunities for project-based learning, authentic

scientific exploration, practical problem solving, and online collaboration. All of these activities were supported by the integration of technology into the learning activities. In one grade 7 science lesson, the teacher integrated eLearning hardware and software in strategic ways to increase student-directed learning and encourage exploration.

In the past, students were given the results of an experiment and expected to memorize experiment procedures and results, and then would follow along while the teacher completed the experiment. In the new instructional model, the teacher works as a facilitator to provide students with individual guidance and necessary instructional and technical supports while the students design the experiment themselves.

In one science lesson, the teacher used a whole-class instruction approach, but the demonstration was less than six minutes; the bulk of the time was used for students to engage in the learning activities. The students were active learners for almost 40 minutes of class as they worked in groups discussing their designs. They used a computer to design their experiments, with group members giving suggestions, providing feedback, and listening to each other. Finally, each group got feedback on its experiment design from the whole class.

"After I participated in a teacher in 1:1 eLearning project, I believe that I have changed in many aspects: (1) I have paid much more attention to the design of students' learning activities, not just the instructional procedures; (2) I have become open and democratic in the classroom; (3) I have spent more time to observe and support students' higher order thinking and knowledge sharing."
– Teacher, Jiading Experimental Primary School

The teacher didn't just show the process of scientific experimentation and tell the students the results (as she would have in the past), but rather gave them time to design, inquire, and discuss by themselves.

Technology changes the way teachers assess their students

Technology is also changing how teachers assess students: interconnected devices and virtual learning environments allow for immediate assessment and feedback. In Terengganu, the Republika Srpska, and Korea, for example, researchers noted big shifts in the ways in which teachers were able to monitor and assess their students. The most cited benefit of the technology is the immediate feedback that it provides, allowing both teachers and students to adjust what they are doing accordingly. In Terengganu, students complete exercises and homework assignments by typing directly into their netbook, and teachers can monitor student work and assign exercises directly through the network. In the virtual school, teachers have students write their answers on the interactive whiteboard to get immediate feedback from the whole class, with support from the teacher. The test preparation software for the national exams is built directly into the Classmate PCs, which provides extensive problem sets and solutions to support student learning.

In Bosnia, the school system is shifting to incorporate more digital assessments over traditional paper-and-pencil tests; assessing students using the classroom management software was the preferred method of evaluation among both teachers and students. In addition to the immediate feedback the online assessment provides, teachers like the fact that it takes less time to grade exams and tests. And in Republika Srpska where students traditionally have oral examinations, these digital assessments relieve the psychological pressure and fear students used to experience with traditional testing.

In Korea, the technology has allowed teachers to focus on developing new strategies, including peer assessment, digital portfolios, and clickers. Instead of considering which tool they will use in each session, teachers are spending more time developing appropriate indicators to help their students in the peer assessment process. After realizing that students were not very good at peer assessments, teachers devised a set of more structured questions and guided students in coming up with their own, such as "Was the cold feeling expressed well?" instead of general questions, like "Which group did a good job?" Teachers in some SMART schools also began developing digital assessment portfolios for their students. In one case, teachers took photos of students' various learning products, including three-dimensional works, and turned them into portfolios that they then managed by grade and theme. Finally, teachers (and students) are benefiting from real-time feedback through the introduction of TeacherKid software and e-Clicker questionnaire tools. Teachers consider these to be easy and effective tools that enable instantaneous changes in their teaching. Teachers can check on the learning and understanding of students in real time and give supplementary explanations about content that is not well understood.

Also, the Korean government is introducing Internet-based testing methods into the national academic performance assessments. With the new more efficient digital approaches, not only has the government been able to reduce the national assessment budget, but because teachers' assessment duties have been reduced, they now have more time for classroom preparation. Additionally, the new assessment system is more accessible and provides a more exact diagnosis.

Access to and use of technology impacts school and classroom cultures

The widespread access to devices, the creative capacities, and the socially networked communication that technology enables is impacting both the culture of schools and school-community relations. Across the nine cases, the presence of new technology has shifted student, teacher, administrator, and parent attitudes.

Students are more engaged in school:

> **Students are also engaged in school life more actively and joyfully as they make things for themselves and participate in class.** – *ICT Value in Korean Education: Technology and Pedagogy Report*

Teachers' enhanced access to technology tools allows for more visualization of ideas and concepts and supports student collaboration and peer communication, which means more student-centered activities and more hands-on learning. The examples below highlight various forms of student engagement, which can take the form of increased motivation, curiosity, and school attendance.

In Malaysia, students were eager and excited to explore their netbooks, and researchers reported that they preferred teachers to use netbooks rather than printed textbooks in the classroom. During the student interviews, they said that they could see pictures and listen to English pronunciation and recitation of religious lyrics. The students also enjoyed using the interactive whiteboard in the virtual classrooms. The Malaysian researchers reported that teachers also recognized the benefits of using technology in the classroom: "The teachers noticed the advantages of using ICT in teaching and learning in that it could attract the students to focus on teaching and learning in the classrooms. Even academically poor students are also interested to study when teachers use e-Book [the netbook]" (Hoon et al. 2012, p. 60).

Student attendance can also be a proxy for engagement, as students who are more interested in what they are learning are less likely to skip school. According to a number of stakeholders, attendance increased at some schools in Terengganu.

In Shanghai, researchers described the students as more motivated learners. Technology enables the visualization of abstract concepts and problems, which are more attractive and which can help stimulate student interest and inspire deeper inquiry, communication among peers, and creative expression. According to a primary school teacher, "Compared with traditional classrooms, students are more active and engaged in learning in 1:1 eLearning environments. They have spent more in participating in interactive activities, and obviously their learning abilities have been improved" (Zhang et al. 2013, p. 80).

Chinese researchers reported that the increased opportunity for students to communicate with each other helped improve learning. Technology enabled teachers to integrate more collaborative, interactive, and self-directed learning. According to the researchers, "When students have opportunities to communicate, express, and learn by themselves, they are able to more easily integrate new knowledge into their original knowledge framework" (Zhang et al. 2013, p. 52).

In Korea, researchers report that students are more curious in class and more engaged in what they are learning. During a number of classroom observations, researchers reported that the classes seemed to have a better sense of purpose, that students seemed more absorbed and eager to learn the content, and that the activities had elicited various ideas and questions from students.

Some of the technology lessons also introduced students to collaboration, thus challenging students' broadly held assumption that, in schools, using ICT means sitting in one's own seat with eyes focused on one's own device. In more than one school, students shared the device and were actively moving around the school collecting data, solving problems, and presenting their finished products. Students were able

to experience the difficulties and joys of working together, navigating on their own through the issues of competition between groups, cooperation within the group, and coordination of conflicts and opinions with each other in order to reach a sense of fulfillment and confidence. One Korean student reported, "It was good to foster teamwork and collaboration through the accomplishment of the mission. I had also a good time experiencing many things with friends while carrying out the mission and got to understand their character as well" (Chun & Kye 2013, p. 22).

Technology transforms school–community communication: Administrators, teachers, students and parents all reported changes in communication patterns as a result of the increased technology in schools.

In Korea, communication between teachers and parents increased through the use of the technology. The introduction of ICT enabled teachers to send reports on student attendance to parents in real time. Parents could check their smart phone or home email for important school-related correspondences, pictures taken on a school trip, or updates on the class community. In this regard, the use of ICT noticeably raised parents' satisfaction with the schools.

In Shanghai, teachers talked about opening up their lessons to ask students to share their opinions and perspectives more often. For example, one literature teacher explained that in traditional Chinese classroom, she would lecture the students about the meaning of a story before asking them to read it, but now she has the students read the story before class and then starts her lesson by gathering their perspectives and analysis.

In Terengganu (Malaysia), researchers reported that there appeared to be better communication between teachers and students both inside and outside the classroom. Students are encouraged to submit their work online via e-mail to their teachers, who can then review the work and share certain responses on the smart board. In this way, students are able to see the work of their friends, learn from their mistakes, and then make corrections.

The experience of one of the schools in the initiative also highlighted how technology can improve communication among teachers, administrators, and parents as well as students. At Paya Bunga's virtual school (a brick-and-mortar school with technology integrated in each classroom), communication improved among the school principal, teachers, and ICT coordinators after the implementation of the e-Book Project. The school principal could communicate rapidly with the teachers via e-mail, and teachers were able to share materials with each other by using a virtual cloud storage system.

Social Inclusion

The digital divide between the urban and rural people has been reduced as even the poor fisherman's family has access to an e-Book. – *Phase I Intel Education Technology Integration Research: E-Book Project, Terengganu, Malaysia Report*

In the Education Transformation Research, the term social inclusion refers to bridging the digital divide between rich and poor families by giving students school and home access to a computer and the Internet. Five of the countries involved in Intel's eLearning Initiatives (Argentina, Brazil, Malaysia, Portugal, and

Turkey) had an explicit goal of helping economically disadvantaged families become part of the digital world. All of these initiatives gave devices directly to students and greatly increased the technological capacity and information access of the participants. For most students and families, the laptops they received through the local initiative were the first computers they owned. At home, students are proud of their machines and take care of them; in many cases, it is one of the few things they own. Giving machines directly to students and their families helped create a more socially inclusive culture and environment in which students and their parents can learn and develop.

More children and their families have access to hardware and software at home

Across all these countries, the 1:1 eLearning initiatives allowed many poor families an initial foothold in the digital world. Respondents in Terengganu (Malaysia) reiterated that the e-Book Project has helped reduce the digital divide among the rich and poor families since they all have at least one netbook. In Terengganu, most students were very proud of having the netbook; as one of them stated, "This is my computer." They indicate their ownership by individualizing their screen saver and decorating the cover of their netbook with stickers. When students were asked what would happen if their netbook were to be taken back from them, two quickly responded that "things would be really boring without the netbook" and "I would die."

Because students can bring the netbooks home, they have more opportunities for learning outside of school. But access to technology does not mean the families will know how to use it. The local research team in Terengganu noted that the many children who have illiterate parents or parents with no computer knowledge learn to use technology by themselves or from their friends. For example, many students taught themselves or learned from friends about how to use certain functions of the netbook, such as how to set up an Internet connection, write e-mails, play games, download songs, or watch movies.

The initiative in Kocaeli (Turkey) developed an interesting strategy to respond to parental lack of computer knowledge. After the launch of the One Computer Per Child initiative, the municipal government increased its offerings of ICT and computer courses for adults through its network of adult learning centers (KO-MEK, or Kocaeli Metropolitan Municipality Crafts and Art Education Courses). Although the adult centers were previously focused on arts and crafts, they have expanded offerings to include technology. The Kocaeli initiative has had a major impact on providing technology access to low-income families. According to a study by the municipal Education Technology department, 82 percent of students participating in the initiative reported that their siblings used the computers; 55 percent reported that their fathers used them; and 33 percent reported that their mothers used them (Aydin, Kumtepe, Colak, and Kumtepe 2012, p. 10). Since the initiative began, DSL subscriptions have increased. According to Turkish Telekom's figures, Kocaeli now has the highest rate of home DSL connections of any city in the country. Researchers found instances of parents using the computers to conduct business over the Internet, read newspapers, down music and movies, play games, watch TV, pay bills, and chat. Siblings often use the computers for doing their own homework.

In Argentina, the computers were available at home when students and parents needed them. Students used the computers for research and homework and for leisure (typically social media and computer games). These computers provided new opportunities for parents and children in terms of how they interacted with each other and conducted various everyday activities.

But not all 1:1 eLearning initiatives gave free computers to all students, since doing so could favor wealthy families that already had technology. Project Magellan in Portugal charged parents a fee for the computer depending on their household income. Families from low-income households did not have to pay, while medium-income families paid EUR 20 and those with higher incomes paid EUR 50 (Paiva et al. 2012a).

Technology increases access to information in homes

Providing families with hardware is important, but the impact of a computer expands greatly once families can access all the information available online. However, providing Internet access continues to be one of the biggest challenges for governments.

In many countries, although WiFi connections are becoming increasingly common in public spaces like cafés, malls, and libraries, home access for children and parents provides a whole new level of connectedness to the larger world. But only a few countries were able to develop strategies to provide home access via their 1:1 eLearning initiatives. In Terengganu, the provincial government began providing free Wi-Fi connections in rural communities to increase the utility of the laptops, although this measure was not originally part of the initiative. Almost all students used the netbooks at home for playing games, completing homework, and finding information for their assignments. When asked what they used the netbook for, one student said, “If I don’t understand the meaning of English words, I can always refer to the dictionary in e-Book [the netbook].” According to the students, they also use the netbook and Internet for social networking sites like Facebook and entertainment such as playing games, watching videos, and listening to songs.

In Portugal, Project Magellan had arranged a low-cost Internet access option that parents could subscribe to, but it was not required. Stakeholders believed that the value of the initiative was diminished without this vital component (Paiva et al. 2012b). Some families subscribed to the broadband Internet service and were able to connect at home. Some of those who did not subscribe were able to connect regularly through community access points, but other families had limited or no access at all.

In Turkey, both parents and students have been overwhelmingly positive about the initiative. Students are thrilled to have access to a computer at home for homework and entertainment, and parents, especially those who did not previously own a computer, are encouraged by its newfound benefits to their families. While students relish the idea of having their own computers, having a computer in the home was also helpful for parents because it allows their children to spend more time at home rather than in unsupervised community access spaces. This was particularly important for mothers and daughters who did not feel comfortable in public Internet cafés. Parents also stated that the computers have improved the quality of schoolwork and assignments because children have access to more online resources.

Workforce Development

Although the eLearning initiatives were all focused on children and young people, some of them also aimed to support workforce development. We define workforce development as training and preparing young people to enter the labor market. In relation to workforce development, a number of initiatives were able to improve the digital literacy skills of students, and even some parents, to help them meet the needs of today's technology-rich work environments.

Access to technology increases students' digital literacy and ICT skills

It is clear from all nine case studies that most stakeholders believe these initiatives have all helped the students learn, at least, basic ICT literacy skills. Increased access to technology in their schools and homes means that students are easily developing the ICT skills needed to do the things they like doing. In all cases, children quickly developed basic ICT fluency for things like searching the web, watching TV and movies from around the world, connecting with friends and family, and doing their homework. According to an IT coordinator in Malaysia who is also a teacher, the positive impact of the e-Book Project was that the students now know the basic functions of the netbook. By giving netbooks to primary school students, they are able to acquire IT knowledge and skills from a young age, which will benefit them as they progress to higher levels.

The ability of children in technology-rich environments to acquire basic fluency has encouraged the Korean Ministry of Education to stop explicitly teaching basic ICT literacy in schools. The Koreans now believe that their students will develop the basic skills while they are using technology to learn in other areas.

The Turkish researchers spoke with two girls who had created and maintained a website for Turkish fans of one of their favorite TV shows.

Access to technology increases parents' digital literacy and ICT skills

A number of initiatives gave computers to students, but two countries in particular reported a positive impact on parents' ICT skills. In both Turkey and Portugal, researchers found that many parents were using their children's netbooks. Access to the netbooks was improving parents digital skills, enabling them to use the computer in a family business, find work, and attend virtual trainings or courses.

The research in Kocaeli (Turkey) uncovered how the netbooks were providing the mothers with more access to information helpful to themselves and their families. Mothers reported using the netbook to find information on topics such as health, nutrition, and government services. As a result of Kocaeli's One Computer Per Child initiative, more women and girls are being empowered through technology: they are learning to use its tools, like the Internet and computers, and are going back to school to learn a new trade. Distance education through online courses helps women who have to work a job and go to school at the same time better schedule their learning opportunities. Over time, the municipality evolved its support to provide courses to adults who want to improve their skills in various arts and professions via the adult training centers called KO-MEKs. In the words of one mother:

> **"I have been in the open high school program [a distance education program] for several years, but I could not go through it effectively. I was able to take only one course in each semester because I was working long hours and limited with the books only. But now I can download other support material online and study more efficiently thanks to the laptop. Furthermore, now I can go online and attend forums with other distance students. Most of all, I can download exams of previous years and study the questions. Before, I did not have time, but now I am studying about one to two hours every day on the laptop. It has been very effective for me and now I can take more than three courses in each semester... I am planning to complete high school this year. And then I will be able to apply for better jobs. And it would not be possible if we did not have the laptop."**

At home, Portuguese parents were using the computers to help their children with homework assignments. The entire family benefits from this experience: parents are able to find out more about what their children are learning in school, and it is an opportunity to communicate both with their children and with teachers. Also, parents were using the computers to reward good behavior and to punish bad or inappropriate behavior. Researchers reported that some parents were very concerned about Internet safety and made sure to set specific activity limits for their children, including when they were allowed to use the computer and which web sites they visited.

Economic Development

Beyond preparing young people for future work, many governments also hope that a 1:1 eLearning initiative can play a more immediate role in promoting economic development, even if on a small scale. We define economic development as focused on job creation, developing new markets, and growing national GDP. Of the four broad objectives that emerged in the review of these nine cases, economic development is perhaps the hardest to achieve, since it often lies outside the scope of most educationally focused initiatives. However, there appear to be three areas in which eLearning initiatives can promote economic development: supporting local manufacturers, developing IT technicians, and encouraging entrepreneurship.

Technology initiatives help promote local manufacturing

One potential benefit of the Classmate PC is that Intel provides the specifications and a local company can produce and sell the devices. Many of these eLearning initiatives are using locally produced Classsmate PCs: Argentina, Brazil, Malaysia, Turkey, and Portugal. In Malaysia, the Terengganu state government worked with Intel and the local assembler, ToP IT Industries, to open a factory capable of assembling 10,000 Classmate PCs a month. This factory can supply Classmate PCs not only for the Terengganu-based initiative, but also for any other initiatives in Malaysia. Building the modern factory has raised Terengganu's economic profile. In addition to providing employment to the local population, the factory has provided opportunities for skill building with the staff of Top IT Industries.

Conectar Igualdad created a local, sustainable economic model that generated jobs and trade opportunities. In Argentina, Classmate PCs were assembled locally by a number of companies, thus providing key points of growth for software producers, equipment manufacturers, and service providers. In Brazil, the investment in local manufacturing resulted in the creation of over 650 well-paid jobs.

In Portugal, the machines are built locally by JP Sá Couto. The company has built more than 750,000 Classmate PCs for the Magellan Project alone, but it has sold millions of units to South America. Additionally, the Portuguese government was able to craft a trade agreement with Venezuela to trade Classmate PCs for oil. Because most of the educational content, software, and services associated with the initiative were also sourced through local Portuguese companies, the broader domestic technology industry benefited: substantial job and revenue growth took place across the Portuguese technology sector.

Technology initiatives provide an incentive to train technical workforce

By spreading advanced technology to schools and families, eLearning initiatives also create the need for IT technicians to support the schools and families in keeping that infrastructure working. Some countries used the 1:1 eLearning initiative as an opportunity to train a cohort of IT technicians and other technical staff. The state of Terengganu used the e-Book Project to upskill the local workforce. The Terengganu Skills Development Corporation (TESDEC) is training technical support teams across the provinces that support the schools. Similarly, the Macedonian initiative generated 90 technology support positions in the ministry and the schools.

Technology access helps promote digital entrepreneurship

While all the 1:1 eLearning initiatives are deepening students' digital literacy, some of those that send computers into the home are also promoting the digital skills and even entrepreneurship of parents. Once parents develop sufficient skills, they can access a wealth of information and opportunities over the Internet. In Turkey, for example, the research found some parents who had created their own businesses with help from the computer and the Internet. As a result of increased access, some of the mothers in Turkey have been able to further their educations and strengthen their leadership and entrepreneurial skills to improve their lives. Two women were interviewed at their new tailor shop; they started the home-based tailoring business after a training course through KO-MEK and use the Internet to search patterns and dress designs.

One of the mothers described how she sits down with a new client:

> **"I search for patterns and dress designs on the Internet and show them to my clients. We then decide on design and colors, looking at some pictures. It has been great for me to use the laptop for my work."**

Appendix A: Conectar Igualdad, Argentina[1]

Intel Education Integration Research is conducted in various geographical regions and across a range of Intel-powered eLearning programs of differing maturity. The research addresses the specific successes, challenges, and policy implications of each government eLearning program and compares them across eLearning programs worldwide.

This report series analyzes grounds-up data (based on interviews with a variety of stakeholders) from ongoing eLearning integration efforts to provide rich detail on the status and success measures of each government program. From these data, the research team has identified four broad categories of implementation for eLearning programs—vision, planning, implementation, and re-informing vision[2]—and developed key program dimensions within each category. Using the categories and dimensions as an analytic framework, the research team is able to (1) describe and assess the progress of each eLearning integration program, (2) highlight each program's successes and challenges, (3) identify the most productive points of entry and engagement, both for Intel and for other stakeholder entities, and (4) recommend program-specific steps, including course corrections. In addition, these categories and dimensions enable the research team to compare government eLearning programs in different contexts and identify practices that have proven successful in one or more contexts that may be productively applied elsewhere.

The report is based on original data collection and analysis by researchers at the University of San Andrés in Buenos Aires, in collaboration with SRI International, EDC and Intel. In this report, we summarize key findings from the Intel Education Integration Research carried out in Argentina.

Background

The Intel-powered Classmate PC 1:1 integration in Argentina is known as Conectar Igualdad. It is a key initiative of Argentina President Cristina Fernandez de Kirshner and is planned and implemented by several federal bodies. The technology integration program is intended to improve public education and reduce the digital literacy gap in the country. Conectar Igualdad is seen as a means of increasing digital inclusion and educational equality and ultimately promoting economic development throughout Argentina.

The program builds on previous eLearning efforts in the region, including Uruguay's Plan Ceibal and Argentina's own smaller scale Educational Digital Inclusion program (IDE, its acronym in Spanish), which was incorporated into Conectar Igualdad. Different sectors of the national government are responsible for different components of Conectar Igualidad. The program, therefore, is an opportunity for horizontal alignment and cooperation across a number of different agencies.

In Conectar Igualdad, devices for students are being purchased in three phases, and a separate tender process is part of each phase of purchase and distribution. Phase I, which ended in December 2010, involved the procurement and distribution of 419,000 Intel-powered Classmate PCs to students in grades 10–12 and an additional 181,000 computers which included devices that were distributed to

teachers and teacher training institutes, as well as a few additional computers for each school, intended as replacements for malfunctioning computers. This accounted for 98% of the target number of computers intended to be distributed in Phase 1. Phase II, which extended from March through November 2011, involved the distribution of 1,371,739 netbooks (100% of the goal). Phase III involves further distribution of devices throughout 2012. The goal of Conectar Igualdad is to distribute a total of 3 million netbooks over 3 years.

Dimensions and Indicators

The Conectar Igualdad initiative is characterized by strong central leadership, a clear funding stream, and widespread support from the public. It is also seen as a program that is consistent with other social inclusion policies in Argentina that seek to bring educational and economic opportunities to rural and low-income families.

In October 2011, President Fernandez de Kirchner won a decisive reelection. In the campaign that led to her victory, Conectar Igualdad played a significant role, receiving visibility as an illustration of the government's effectiveness in promoting social inclusion. To maintain public support for the program and for the administration, the Kirchner government felt pressure to meet promised technology distribution targets. Therefore, the program moved forward quickly, without thorough implementation planning. The emphasis on distribution also prevented consideration of the structural reforms that the educational system that many believed were required in order to maximize the benefits of technology and to support teachers in using it in the classroom. In many cases, the government distributed computers to schools and regions without ensuring the presence of Internet connectivity. The different provinces in Argentina have very different contextual realities, and stakeholders reported that the government did not adequately take these differences into account in the implementation of Conectar Igualdad. Many stakeholders, particularly teachers, also reported that insufficient attention was paid to teacher preparedness and training.

Although the Conectar Igualdad program brought technology to students and teachers, the distribution of technology was not part of a broader educational reform effort. Therefore, the program has not yet had an effect on teaching and learning practices or the curricular materials being used. At the same time, the Kirchner campaign has presented Conectar Igualdad to the public as effective. This has brought about an important shift in how the program is positioned and described, in official reports. Most stakeholders interviewed in Phase I described Conectar Igualdad as a program focused on pedagogical reform and revitalization of the public education system. Stakeholders interviewed in Phase 2 and official reports (including government-sponsored media presentations) represented Conectar Igualdad as being concerned primarily with social equity and inclusion. The strengths of the program being highlighted now are features of digital inclusion, such as ownership of computers by low-income families and the promotion of digital literacy skills among parents.

Argentina Education Context

In Argentina, most features of the education system fall under the jurisdiction of provincial governments, but the federal government traditionally has set the country's education policy agenda. Since the 2001 financial crisis crippled the country, many provinces have become more dependent on the national government to execute policy priorities.

Secondary school improvement has been a primary theme of the current national administration. The Ministry of Education launched the Secondary for All initiative in 2006, which makes secondary education compulsory in Argentina and sets strategic objectives for educating greater numbers of students at the secondary level. Technology integration is a core part of that strategy.

The Intel-powered Classmate PC 1:1 integration in Argentina is aimed at educational transformation and digital inclusion. Since 1992, when Chile pioneered educational information communication technology (ICT) integration in Latin America, several countries in the region have launched similar high-profile efforts. Most recently, Uruguay, under its Plan Ceibal, achieved full 1:1 integration with a national laptop rollout in public schools. The plan for Argentina's current Conectar Igualdad program is to distribute 3 million laptops over the next 2 years to secondary public schools, technical schools, and teacher training institutes.

Integration Status

Outlined here is the progress of the integration along the four key dimensions of vision, planning, implementation, and re-informing vision at the time of the writing of this report. The Phase 1 Reports focused mainly on the vision and planning stages of the deployment. The Phase 2 report covers Conectar Igualdad and provides more depth on the implementation and re-informing vision stages of the process.

Vision

Conectar Igualdad is a nationwide program intended to improve public education and reduce digital inequality. With presidential leadership and a strong, sustainable source of funding, the initiative has strong public support and 2 years of on-track technology distribution.

Conectar Igualdad is a federal initiative proposed by President Cristina Fernandez de Kirchner. The program originally started as a smaller scale initiative under a different name (IDE) but has been expanded and rebranded. With the president's full support, the federal government has been able to leverage participation from various government bodies, including the National Ministry of Education (MoE); the Ministry of Federal Planning, Public Investments, and Services (MPF, in Spanish); the Chief Cabinet of Ministers, and the National Administration of Pensions and Retirements (ANSES, in Spanish), which also finances the program.

Conectar Igualdad was an important feature of the president's reelection campaign in 2011, and the newly re-elected Kirchner government is following through on promises of distributing technology to schools and students across the country.

The two priorities of the Conectar Igualdad program are equality and inclusion. By allowing students to take computers home and extending learning beyond the classroom, Conectar Igualdad supports other programs that are incorporating families into the education system.

The explicit goals of Conectar Igualdad are to (1) revitalize public education by improving the quality of teaching and creating equality of opportunity; (2) create learning spaces that are more adequate for the needs, demands, and interests of students at different educational levels; (3) expand the reach of social inclusion policies by involving more families in education; (4) diminish the digital literacy gap of the population; and (5) strengthen the role of the teacher. A salient objective of the program is to create equal educational opportunity for all youth in the country by closing the digital gap, thereby paving the way for improved economic development.

Indicators

In the short term, Conectar Igualdad's success will be measured by the pace of the rollout (meeting distribution targets), early progress at integrating ICT into the classroom, maintenance of teacher buy-in, and attainment of teacher training targets. Long-term measures of success are developing the education infrastructure, augmenting teacher professional development, increasing students' use of ICT for learning, and improving parent-teacher interactions. These longer-term indicators are expected to have multiplier effects that boost enrollment and graduation while lowering the rates at which students repeat classes.

Planning

An Executive Committee, presided over by the director of ANSES and including stakeholders from other key organizations, was convened to coordinate the activities of Conectar Igualdad. The Executive Committee has created several commissions, such as the Technical Advisory Commission, to assist with the implementation and monitoring of Conectar Igualdad. The Executive Committee meets weekly to coordinate activities, discuss the main issues, and make decisions.

The overall target for Conectar Igualdad is 3 million laptops, distributed over 3 years. Secondary and vocational schools, teacher training institutes, and special education institutions will receive laptops as part of the program. The countrywide rollout is occurring in three phases: In Phase I, which was in 2010, the government distributed 419,000 laptops that came originally from the IDE program. In Phase II, from March through November 2011, the government distributed 1,371,739 netbooks. In Phase III, planned for 2012, the remaining laptops will be distributed. According to several stakeholders, Conectar Igualdad is complemented by smaller provincial initiatives in some territories, including the city of Buenos Aires, Rio Negro, San Luis, and La Rioja.[3]

The Ministry of Planning (MFP) was responsible for the infrastructure and connectivity for the Conectar Igualdad program. To use the laptops for teaching and learning, all schools needed the "Technological Floor" including electrical infrastructure, Wi-Fi, LAN, and Internet networks. Every classroom was to be

equipped with two access points connected to the central switch and to a school server, enabling teachers and students to use wireless connectivity. When schools received computers, IT coordinators would link them to the school server so the computers would be part of the school network.

Conectar Igualdad has been planned as a multisector implementation with distributed ownership. Agencies within the federal government have clear responsibilities. The Ministry of Education (MoE) is responsible for teacher training; the National Administration of Pensions and Retirements (ANSES) provides funding; the Ministry of Federal Planning, Public Investment and Services (MFP) handles connectivity; and the Chief of Staff of National Ministers, through the Sub-Secretary of Management Technologies, provides safety measures for both hardware and software to minimize risks of theft and misuse. The distributed program oversight means that no single federal body can claim ownership of the initiative.

An important responsibility of the provinces has been that of providing teacher training for ConectarIgualidad. Again, the quality of the courses and the support offered varied considerably depending on the capacity for education reform and technological readiness. Some training programs appear to have been successful, according to principal and teacher reports. For example, teachers in Santa Cruz preferred the provincial courses over the nationally-offered virtual trainings because they found the local courses more "practice based."

Implementation

Under Conectar Igualdad, 3 million Intel-powered classmate PCs will be distributed to students in secondary public schools, teacher training institutes, and special education institutions. Distribution is occurring in three phases. The government has completed the first and second phases of distribution.

The government of Argentina distributed 1.4 million netbooks over the course of Phases I (2010) and II (2011). Two factors affected Phase II. First, President Fernandez de Kirchner highlighted the Conectar Igualdad program in her reelection campaign. After her reelection in October 2011, the government felt pressure to adhere to publicly-made promises by continuing to roll out technology for the program rapidly. Some stakeholders were concerned that this rollout was too hasty, sometimes occurring without sufficient planning or preparation.

Second, the 24 provinces of Argentina vary substantially in sociodemographics, technology infrastructure, education, and capability to support educational reform. Some individual provinces had local programs under way that needed to be integrated with Conectar Igualdad. Differences among the provinces meant that the Conectar Igualdad implementation varied across provinces. Some provinces were in the very early stages of technology adoption, so integration focused on technology infrastructure. Other provinces with a longer history of technology and a strong infrastructural foundation were able to concentrate on professional development and support teachers in integrating the technology into the classroom.

Interviews throughout Phase II suggested that technology problems were widespread. First, the prerequisite components were not always in place when they were needed. For example, teachers and students can use the netbooks with offline content, but they might not be connect to the Internet.

Second, IT coordinators unanimously reported having difficulty with registering the laptops, explaining that they did not receive the support they expected from the Conectar Igualdad local teams and that the process was more cumbersome than necessary. Third, schools experienced problems with repairing and replacing computers. ANSES was supposedly responsible for covering maintenance and replacement costs, but this guarantee had some important limitations, for example, it did not cover broken screens.

The Conectar Igualdad program also faces considerable Internet connectivity challenges. Research conducted by 11 national universities revealed that only 17% of Argentinian schools are connected to the Internet. Among those that are connected, the broadband quality is poor and in many cases, insufficient for school use. Given tensions between public and private Internet providers, it is unlikely that these connectivity issues will be resolved soon.

Teacher professional development

Teacher professional development and ongoing pedagogical support are critical for any educational program. Conectar Igualdad provided numerous opportunities for teacher professional development, both virtual and face-to-face with multiple agencies providing different types of training. The teacher training programs within Conectar Igualdad were intended to stimulate reflection on current instructional practice and inspire new ways to optimize technology in schools. The National Office of Education Management (DNGE), the National Institute of Teacher Training (INFD), the National Institute of Technology Education (INET), educ.ar, the Organization of Latin American States (OEI), and ANSES all provided training for teachers. An increasing number of NGOs also began providing teacher training related to Conectar Igualidad. Principals and supervisors each received 2 days of face-to-face training, with the goal of sensitizing them to the program. INFD, OEI, and educ.ar all provided virtual trainings for teachers, both about technology skills and integrating technology into teaching.

Impact on pedagogical practices

Teachers' integration of ICT into instruction was limited. They typically saw the netbooks as tools equivalent to a book or blackboard rather than as an important element in the transformation of teaching and learning. Most commonly, teachers used multimedia, particularly videos, in the classroom to make learning more engaging for students. Because connectivity was a problem in many schools, the use of pen-drives was typical: Teachers downloaded content off site and stored and distributed it to students on a pen-drive. Many teachers also reported that they saw the computers primarily as a way to improve discipline, since they helped to keep students' attention.

Impact on students and families

In contrast, students used their computers for a variety of academic and personal purposes. In interviews conducted during Phase II of Intel Integration Research, students told researchers that that their primary use of the netbooks was for leisure (typically social media and computer games).

Families registered strong support for the Conectar Igualdad program. Schools had high attendance at all the meetings associated with the program. One teacher noted that it was the first time she saw parents and students appreciate the school as a place that offered good opportunities for a better future. For most students and most families, the Conectar Igualdad netbooks were the first computers they owned. These computers provided new opportunities for parents and children in terms of how they interacted with each other and conducted various everyday activities. This strong support from parents and students—and the waning support from principals and teachers—may explain the shift in the positioning of Conectar Igualdad, from a program originally envisioned as a pedagogical reform project to a program that is now focused on social inclusion.

Re-Informing the Vision

Most stakeholders concluded that students' and teachers' increased use of ICT and an eLearning-mediated improvement of parent-school interaction would be powerful indicators of success. Additional success factors would be improved eLearning infrastructure in schools, improved ICT-oriented teacher professional development, and positive teacher attitudes toward the use of ICT for teaching and learning.

The evaluation and monitoring of Conectar Igualdad involve four lines of activity, coordinated by educ.ar and the Organization of Ibero-American States (OEI):

1. Follow-up and monitoring of schools to assess the use of laptops and ICT and evaluate the impact of computers on teaching and learning
2. Analysis of education experts' Conectar Igualdad implementation
3. Promotion of research on Conectar Igualdad by university-based researchers
4. Installation of "model classrooms" equipped with 2.0 devices (smartboards, netbooks, servers, access to digital content) to assess the concrete elements that could facilitate teacher professional development.

OEI and educ.ar interviewees acknowledged that plans for monitoring and evaluating Conectar Igualdad and using the findings to make course corrections must be made more formal as the program matures. Evaluators need to measure not only the quantity, but also the quality of students' computer usage to determine how the eLearning program is affecting teaching and learning, and students' attitudes about school. Stakeholders seemed more concerned about the implementation process and affective indicators rather than about student learning outcomes, such as PISA scores, as measures of program success. With the current model, educ.ar relies primarily on national universities to conduct the investigation of the Conectar Igualdad program. These national institutions depend on national funds to operate and therefore might not be strictly objective evaluators. Therefore, as the program matures, it might become necessary to involve third-party evaluators who might take a more objective view.

Citations

1 Based on report prepared by SRI International, based on original research by Jason Beech, Alejandro Artopoulos, and Ignacio Barrenechea, University of San Andrés, Buenos Aires.

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

3 The only OLPC integration in Argentina.

Appendix B: Project Dositej, Republika Srpska, Bosnia and Herzegovina[4]

Introduction

Republika Srpska is one of three main political entities that has comprised Bosnia and Herzegovina since the end of the Bosnian War in 1995. Through an initiative called Project Dositej (The Dossitey Project), the republic is introducing 1:1 e-learning in order to better prepare students for future job markets.

In this report, we summarize key findings from the Intel Education Integration Research enacted in Republika Srpska by local researchers, in collaboration with researchers at SRI International and Intel. Intel Education Integration Research investigates the successes, challenges, and policy implications for Intel-powered technology integrations in a variety of e-learning sites worldwide. The research is based on a common global framework, with instruments customized to meet the needs of each deployment setting.

Because the distribution of computers to students in Republika Srpska is just beginning, this report focuses on the initial vision and planning stages of the program. To collect data for this report, the research team conducted interviews with key personnel within the Ministry of Education and Culture as well as financial and strategic planning departments.

Integration Status

The following section outlines the process of the Bosnia integration in the initial phases of vision and planning.

Vision

The current implementation of 1:1 e-learning in Republika Srpska is known as Project Dositej (The Dossitey Project). The project was initiated by the Minister of Education, Antun Kasipovic. Goals of Project Dositej are to increase opportunities for students to learn skills that will prepare them for future job markets, and to modernize education in Republika Srpska's schools.

The integration of ICT in schools in the Republic was first promoted early in the 21st century, with a donation of 1000 computers from the People's Republic of China. In 2006, an experiment in distance learning connected an urban school with a rural one for sharing of resources. The project pointed to the need for ICT training for teachers, and resulted in basic ICT skills training through the European Computer Driving License program for 11,000 teachers.

The Republic has taken a number of additional steps to move toward readiness for ICT use in schools, such as:

- Inclusion of ICT classes in the national curriculum (currently in grades 6-9)
- School renovations, including wiring improvements
- Advanced IT training for 900 teachers, which generated the beginnings of an online lesson repository
- An online portal of educational resources, including an Electronic Gradebook accessible in some schools to facilitate communication between teachers and parents
- An Electronic Management Information System that currently allows email communication between principals and the Ministry, but is expected to expand to include email addresses for all teachers and free hosting for school web sites

From this starting point, Project Dositej intends to substantially increase the integration of ICT into teaching and learning in Republika Srpska.

Planning

The distribution of Intel-powered CMPCs to students in grades 3-5 is taking place during the spring and summer of 2012, with the intent of beginning to use them in classrooms in the new school year that begins in September. Overall, the government intends to distribute 10,200 CMPCs and 408 teacher laptops in selected schools, with 63 schools throughout the Republika Srpska participating in this initial rollout. Grade 3 was chosen as a starting point to coincide with students' introduction to the Roman alphabet in their studies, as the installation of the Cyrillic alphabet to the PCs would add both complexity and cost.

The plan for the project included a number of important preparatory steps that have been taking place over the last several years:

- A review and analysis of the current ICT infrastructure available in schools
- An early pilot of 1:1 e-learning, in which 30 CMPCs were used in a variety of subjects in grades 5-9
- Design of the network infrastructure, and the implementation of WLANs in the schools and classrooms that will participate in the initial program
- Advanced technical training for IT teachers in 2011, with plans to follow this with CMPC-specific training in 2012. The IT teachers will be responsible for training other teachers in their schools.

Initially, computers will remain the property of the schools, and content for student computers will come through teachers' laptops, which will be used as servers. Upgrades are being implemented in participating schools to offer security in the rooms that will house the computers. Schools are internet-ready, but the initiation of service is currently awaiting contracts with IP providers and content filtering provisions. Translation of Intel-provided Skoool content into local languages is planned to facilitate educational use of the computers.

Network design, deployment, and training are conducted through Lanaco, a corporate partner. Leveraging corporate resources and expertise are particularly important in this new republic, which does not yet have a mature system of capacities such as locally-based donor organizations and the external expertise they bring.

While the plan for deployment has many strengths, several areas are in need of strengthening in order to promote successful integration when the computers reach classrooms and students:

- Processes for implementation monitoring and ongoing improvement have not yet been defined. Communication is top-down, without provisions for collecting teacher- or classroom-level input.
- Digital content available in local languages is limited so far. In addition, steps have not yet been taken to create alignment between the digital content and the national curriculum. This alignment will be important in order to give consistent guidance to teachers as they begin to implement.
- So far, teacher training has focused primarily on technical skills. It will be important to offer more pedagogical training and models for powerful uses of the computers in the classroom in order to promote significant changes in teaching and learning.

Responses to the project have been positive: the importance of the project has been well recognized in the media, and teachers from the participating schools have expressed that they look forward to receiving the PCs and beginning the implementation.

Citations

4 Based on a report prepared for Intel Corporation by SRI International, based on original research by Petar Nikoloski and Olga Samardzic.

Appendix C: Um Computador por Aluno, Piraí, Brazil[5]

Introduction

Intel Education Integration Research is conducted in various geographical regions and across a range of e-learning programs to investigate the successes, challenges, and policy implications of Intel-powered technology integrations worldwide.

This report covers the Intel-powered CMPC rollout in Piraí, Rio de Janeiro, Brazil. Data are from qualitative stakeholder interviews and ethnographic observation. Detail is provided on the status and success of integration in four broad categories—vision, planning, implementation, and re-informing vision[6]—and associated dimensions. This analysis enables the research team to (1) describe and assess the progress of education technology integrations; (2) highlight success indicators and challenges; (3) identify the most productive points of entry and engagement, both for Intel and for other organizations, recommending possible course corrections for specific countries and best practices for future deployments elsewhere; and, most broadly, (4) make comparisons across integrations using a toolkit with standardized methods for identifying critical indicators based on a common set of dimensions.

Key Features of the Deployment

- 5,500 Intel-powered clamshell classmate PCs distributed to all municipal school students
- 560 laptops distributed to teachers and administrators
- Linux* disti Metasys CMPC Linux
- School owned
- Stakeholder experiences compared with those in a prior single-school experimental rollout

This report synthesizes two prior documents on the citywide 1:1 integration in Piraí, RJ: a report produced by the research consulting firm Rockman et al. using interviews and school visits carried out in the fall of 2009[7] and the program coordinators' 2010 progress report,[8] which relied partially on interview data obtained using early draft instruments from the Intel Integration Research Toolkit. Both data collection efforts were experimental studies informing the ongoing design of the Intel 1:1 implementation research.

Executive Summary

The Intel-powered CMPC rollout in Piraí, RJ, Brazil, was citywide, reaching all students and teachers in the 20 Piraí municipal- and state-run schools serving students at all grade levels. The program was modeled after a smaller scale experimental 2007 rollout in one of Piraí's municipal schools.

Piraí is one of five experimental sites for the federal 1:1 computing initiative, Um Computador por Aluno (UCA, or One Computer per Student), using Intel CMPC laptops. Piraí is also in the midst of Piraí Digital, an extensive digital inclusion effort aimed at addressing local economic development concerns that includes IT infrastructure development, access centers for adults, and other investments outside school. Intel program designers were interested in supporting the goals of Piraí Digital in general while including laptops in the overall education transformation effort.

In the rollout, 5,500 CMPC laptops for students and 560 laptops for teachers were distributed. The laptop rollout was accompanied by the introduction of project learning pedagogies in grades 1–9. The local vision for the 1:1 project is for students to become engaged autonomously in knowledge building while teaching changes from a didactic lecture approach to one in which teachers play the roles of apprentices, learners, and facilitators. In this sense, the rollout is regarded as part of an educational paradigm shift. These considerations place an emphasis on computers as tools that support students in developing individual agency and independence as learners.

Although the integration is in the implementation phase, the citywide rollout is still relatively new and most available information on student use comes from the experimental school. Outcomes from that school have informed the design of the expanded program, and careful attention to evaluation goals and methods is needed to ensure that ongoing program monitoring productively influences program course corrections. This report describes key dimensions, indicators, and challenges in detail, concluding with recommendations for further action.

Education in Piraí and Brazil

Piraí is a small city in the state of Rio de Janeiro, with a population of 24,170. In early 2000s, it suffered from economic development problems and job losses at a local utility company. The Piraí Digital program was inspired by a belief that the city would benefit from improvement in information technology skills and infrastructure. Piraí Digital is intended to contribute to economic development in the community by improving access to and use of information technology across the city. The CMPC 1:1 rollout is part of the education component of the Piraí Digital project.

Enrollment data from the national education census showed 6,566 students enrolled in Piraí's schools at all levels in 2009.[9] Elementary and middle schools (grades 1–9) are primarily run by a municipal school network that in 2009 employed 517 teachers. Most high schools fall outside the municipal system and are managed by the state.

Brazilian public education has a history of problems with high levels of student retention, failure, and dropout in early grades, especially among the poor. This has led to inflated enrollments as students repeat the lower grades and results in a relatively low return on public investment and unequal access to public secondary schooling. Several recent policy changes, including starting public education 1 year earlier,[10] aim to improve success rates in the lower grades. If they achieve their goals, these initiatives should improve education levels and lead to greater demands on the middle and high school systems.

Most schools have morning and afternoon shifts, with students enrolled for only half the day. This makes the most of available space and infrastructure but limits access to school resources such as libraries, recreation areas, and computer labs in out-of-school time. Teachers also participate in the multiple shift system, often travelling between schools to complete their schedules.

Several avenues for teacher preparation have existed in recent years, with different preparation standards required for teaching at different levels. Primary school teachers complete one of several higher education programs of varying lengths, including apprenticeship programs. Secondary teaching licenses are specific to each subject area and are earned through undergraduate programs combining subject area studies with pedagogy coursework. Many teachers lack the required preparation. According to the 2009 national education census (INEP, 2009), fewer than 70% of Brazilian teachers had completed higher education programs of any kind. This number dips below 50% in the poorest regions of the country. This can present a challenge to school change initiatives because teacher preparation must be designed with consideration to varied teacher education backgrounds.

Integration Status

This section outlines the process of the integration along the four key dimensions of vision, planning, implementation, and re-informing vision at the time the primary source report for this report was written.

Vision

Political Climate

In accordance with national goals, stakeholders in Piraí are seeking to address unemployment and inequality problems through technology integration, which includes the laptop rollout in schools. Brazil's investment in information and communication technologies (ICT) is intended to address the economic concerns of high unemployment and underemployment by improving education, job skills, and digital literacy. Education policy emphasizes workforce preparation, and skills connected to the information and knowledge economy are recognized as advantageous. The integration received both municipal and state support, the latter in part because the former mayor of Piraí is now the vice-governor of the state of Rio de Janeiro.

The Piraí citywide 1:1 computing program is part of two separate and larger policy initiatives, one municipal and one national. The experimental school rollout was part of the UCA program. UCA is one of many federal programs increasing the availability of communication technology in schools. Historically, getting technology into students' hands in Brazil has been difficult. Efforts to keep valued technology safe from theft and damage, along with lack of support, training, and maintenance funds, have often meant that educational technology resources wind up in locked storage closets or out of use.

The municipal Piraí Digital program has included the expansion of wireless Internet across the city, the extension of information technology (IT) capacity and human resources in municipal offices, and improved availability of publicly available Internet in the city. Although most components of the Piraí Digital program are for improving the job skills of the current workforce across all sectors of the economy, the program in city schools focuses on IT skills and education in general for the next generation. The introduction of technology was paired with changes to pedagogy policies intended to promote student autonomy.

Education Context

The 2009 citywide CMPC 1:1 rollout was modeled after the experimental program, with data on laptop use and implementation challenges informing planning and implementation.

The pedagogic plan associated with the rollout is a significant departure from the practices and intents of the teaching models most common in Brazil.[11] The transformation is an ambitious goal requiring coordination and professional development at many levels. Professional development and school change planning, activities, and outcomes at the experimental school therefore were key data sources in developing the citywide program.

Priority

The citywide school 1:1 rollout integrated laptops in schools as a component of the campaign for overall education transformation. The objective of the larger Piraí Digital initiative in and out of school is to promote economic development and broaden access to ICT in Piraí through a variety of initiatives in the education, business, and nonprofit sectors.

Goals

Some regard the rollout as part of an educational paradigm shift. The local vision for the project is for students to gain autonomy and authorship and for teachers to transition from central figures of authority to facilitators of learning processes. Teacher professional development at the experimental school included the introduction of project learning pedagogies across subject areas.

Financing

As the former mayor of Piraí, the vice-governor of the state of Rio de Janeiro was involved in early phases of the Piraí Digital program. As a result, Piraí was able to obtain state financing. Of the funds for the citywide 1:1 program, 75% were from the state of Rio de Janeiro and 25% were municipal funds. The agreement between state and municipal officials was that the state would help support the investment in devices and the municipality would pay for infrastructure and program and device maintenance. The total cost of the project was R$5.4 million,[12] of which the municipality of Pirai invested approximately R$1.5 million.

Funding for the initial experimental school came from the federal government UCA program.

Indicators

Ongoing monitoring of the program aims to capture the processes in which IT use supports or is congruent with the local pedagogical plan.

Planning

Geographical Scale

The Piraí rollout is citywide, serving all students at all levels. State funding of the devices ensured that all students living in Piraí in both municipal and state schools have access to a device during the school day and that evening adult education students have access as well.

Infrastructure Preparation

Improvement in infrastructure preparation influenced the decision to move forward with a citywide program. Before the rollout, the experimental school had a low score on the IDEB indicator of education efficiency,[13] leading the school to revise its pedagogical plan before the laptop rollout was announced. Eventually, many of the pedagogic restructuring policies were integrated with planning for technology use.

Preparation of additional infrastructure at the experimental school included remodeling of space before the rollout.

Stakeholder Engagement

Program coordinators facilitated two-way communication between municipal offices and school staff and teachers. School administrators and teachers were involved in planning, identifying community goals, and developing a pedagogical plan. Committees at the schools carried out elements of the planning and ensured stakeholder involvement.

Committees attended to pedagogical changes, especially adoption of project learning pedagogies, knowledge sharing strategies for program participants and institutions, and planning related to curriculum integration and change.

Feedback Mechanism

Data on the experiences of students, teachers, and administrators working with the laptops in the experimental school were used to inform decisions about the subsequent citywide rollout. As a result, ongoing planning, implementation, and reporting are closely linked to elements of the municipal program.

Perceptions of experimental program success contributed to the decision to move ahead with the citywide program. Indicators included stakeholder reflections on program success and on the evolution of technology over time, with increasing levels of student autonomy and authorship.

One local education official reported dramatic increases in the IDEB indicator of education efficiency. Although the increases the official cited now appear to be inaccurate, perceptions about improvement contributed to enthusiasm for developing a full citywide program.

Implementaion

Rollout of Elements

In the experimental school, many of the changes to the pedagogical plan predated the rollout. The introduction of technology was accompanied by an effort to integrate the technology with the new pedagogic vision.

In the citywide rollout, the 560 laptops for teachers and administrators were distributed and paired with professional development before student programming began. This two-tiered professional development program included elements to improve both teacher buy-in and training. The 5,500 laptops for students were delivered to Piraí schools in September 2009. The laptops were distributed to students during a ceremonial launch and afterward were removed from the classroom temporarily to allow time for logistical and professional development preparation.

Program Adoption

The school space was reorganized functionally. Where rooms had previously been assigned to grade levels, students now move across spaces organized according to activities such as research and creative projects. The curriculum was broadened to include citizenship, life skills, and self-esteem.

In the experimental school, students reported using class time to search for information on the Internet. At this site, it appears that at least some students were allowed to take laptops home and were able to use them outside class time.[14] According to some stakeholders, student use of technology has been increasingly aligned with the pedagogical plan. For example, students apparently transitioned from using laptops as simple word processors to using presentation software and Web 2.0 tools, something the program coordinators associate with greater student autonomy and authorship. Student have noted the advantages of being able to find information online over using sources that had been available in the past, and many students commented on being more engaged and interested in the more self-directed approaches available to them now.

Program Oversight

The program was controlled locally with involvement of stakeholders at multiple levels and with participation across the public, private, and nonprofit sectors. School leaders have control within each school site.

Ownership

The schools own the laptops and can leverage the multiple shift schedules by assigning the same equipment to different students at different times of the day. This has led to availability of the laptops for night school continuing education students.

In the experimental school, some or all of the students were allowed to take the laptops home.

Stakeholder Engagement

Teachers who were early trainees and early adopters served as "mulipliers" and were involved in imparting what they learned through their participation to other teachers. The multiplier model is used extensively in Brazil along with student leaders who share knowledge about technology. These programs formalize knowledge sharing and leadership roles in schools and provide incentives and support for leaders.

Not all teachers have embraced the technology and integrated it into their practice. Even at the experimental school, where laptops were originally distributed in 2007, some teachers, including all math teachers, were not using the laptops.

Re-Informing the Vision

During the municipal rollout, stakeholders at many levels were interviewed to report on laptop use, transformation in the schools, and overall attitudes and concerns about the rollout. Participants from the experimental school also commented on how use of the laptops has changed over time, with students exercising greater autonomy. Parents were included among stakeholders interviewed, and they provided information not only on the value of the laptops for education, but also on additional benefits not included among initial goals.

Course Corrections

Monitoring at the experimental school motivated design decisions for the citywide 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.

Teachers and administrators enthusiastic about the program reported that in the early phases, when the experimental school was first announced, they were anxious about adopting new technology and changing their approaches in classrooms. In the citywide rollout, the decision to conduct professional development aimed at teacher buy-in may have been influenced by these issues of teacher anxiety and adoption rates.

Summative Monitoring

Ongoing monitoring has not been well specified and is essential for supporting conclusions about future program success and potential course corrections.

Planned Change

As described, the professional development carried out in the citywide program was apparently a change in response to initial feedback. Additional information is not available at this time.

Citations

5 Based on a report prepared for Intel Corporation by SRI International.

6 This framework is also used to describe a parallel process of policy formation in Kozma, 2010, Briefing on educational policy, Intel Policy Briefing Series.

7 Rockman et al., 2009, Rollout of the Intel Classmate PC in Piraí, Brazil: Contextual factors.

8 Franklin Coelho & Maria Henela Cautiero Horta Jardim, 2010, Pesquisa Especializada em Avaliação Comparativa da Implementação do CMPC da INTEL no Município Digital de Piraí. The interviews quoted in the report include 14 with stakeholders from the experimental school and 7 from the remaining schools (including 1 with a school director). Four additional interviews cannot be connected with an individual school. Interviews at all sites included stakeholders at many levels including administrators, teachers, parents, and students.

9 Instituto Nacional de Estudos e Pesquisas Educacionais Anisio Teixeira (INEP) 2009 school census as cited in Rockman et al., 2009,s Rollout of the Intel Classmate PC in Piraí, Brazil: Contextual factors.

10 The old 1–8 system was replaced by the current grades 1–9 in 2006, with children starting school 1 year younger. Many current students started school before the new starting grade.

11 The contrast with prior teaching strategies is well documented in Brazilian constructivist education discourse. It is also evident in some of the interview data cited in Franklin Coelho & Maria Henela Cautiero Horta Jardim, 2010, Pesquisa Especializada em Avaliação Comparativa da Implementação do CMPC da INTEL no Município Digital de Piraí.

12 At the time, the Brazilian Real was worth approximately US$0.50.

13 The IDEB indicator is a measure based on standardized test scores that controls for student rates of grade level completion. Student scores are divided by the number of years it takes students to complete a grade. In a country where grade repetition is problematic the IDEB is used to set goals and make comparisons across schools, municipalities, and states. It addresses the problem of inflated scores for schools that hold students back unnecessarily.

14 Some student reports indicated limited access outside of school time. It is not clear whether the limited student access outside school is due to connectivity or whether some students did not always have the option to take equipment home. From a recent interview, it is clear that in some citywide rollout schools, students did not take laptops home.

Appendix D: One Computer Per Child Project, Kocaeli Municipality, Turkey[15]

Introduction

Since 2009, the Kocaeli Mayoral Office and the local Ministry of Education have been leading a 1:1 eLearning project, known as the One Computer Per Child Project, in the metropolitan province of Kocaeli, Turkey. The mayor of Kocaeli identified ICT as a top priority for the region, and invested in technology infrastructure and human resources to build ICT literacy among the local population. The One Computer Per Child Project is part of this effort, distributing Intel Classmate PCs (CMPC) to all public-school 6th grade students and their homeroom teachers throughout the province to enable 1:1 eLearning. The goal of the program is to support social, educational, and economic transformation by increasing ICT fluency and creating a career pipeline for future hardware and software professionals in the region.

Impacts

- Increase in technology access to students and families, especially low-income families
- Increase in DSL (digital subscriber line) subscription
- Increasing women's and girls' access to technology use and empowerment
- Development of ICT literacy and skills necessary to prosper in an increasingly technology-dependent economy
- Improvements in the quality of student work and assignments

This report summarizes key findings of the Intel Education Integration Research carried out in Turkey by a group of researchers from the Anadolu University Center for Research and Development in Distance Education, in collaboration with researchers at SRI International, Education Development Center (EDC), and Intel. Intel Education Integration Research investigates the successes, challenges, and policy implications for Intel-powered technology integrations in a variety of e-learning sites worldwide. Based on a common global framework, the research uses instruments customized for each deployment setting. The research was conducted in three phases over four years.

In Kocaeli, researchers conducted interviews with government and education officials, principals, teachers, students, and parents. Researchers also observed several classrooms for a deeper understanding of how teachers incorporate technology into classroom practice. In the final phase of the research, seventeen low-income families were interviewed in two neighborhoods in the towns of Çayırova and Kandira. In addition to providing information on computer use at home and perception of computer literacy, parents were asked about their general attitudes toward technology use.

Integration Status

The following section outlines the current status of the Kocaeli One Computer Per Child Project along four key dimensions: vision, planning, implementation, and re-informing vision. These broad phases define the process of significant eLearning deployment and outline the sets of factors that must be considered by stakeholders in each stage. Through research conducted in three unique phases over the course of four years (2009-2013), the local researchers documented the progression of the initiative from vision to deployment to impact in the classroom and at home.

Kocaeli Education Context

- Kocaeli is one of the most industrialized and wealthiest provinces in Turkey, with high rates of literacy and school attendance.
- A priority of the local government is to develop a technologically literate population and create a career pipeline for ICT professionals.
- The national government is currently planning a new nation- wide educational technology program, FATIH, which may build on many aspects of the Kocaeli initiative.

Vision

The Kocaeli One Computer Per Child Project is part of a larger effort to transform this former industrial city into a center for ICT and innovation, with the goal of becoming the "Silicon Valley of Turkey." As this goal becomes reality, the demand for ICT professionals will increase. One Computer Per Child Project is designed to meet this demand, and ultimately to support higher standards of living for Kocaeli residents.

The Kocaeli One Computer Per Child Project has three principal goals:

- To support ICT literacy and skills in order to create a pipeline of professionals for ICT-related positions;
- To eliminate inequality in education and narrow the digital divide; and
- To provide a model for similar deployments in Turkey, potentially including the new FATIH program currently being planned by the national government.

Planning

The Kocaeli Mayor's Office and the local Ministry of Education (MoE) jointly operate the One Computer Per Child Project, with other stakeholders involved in various aspects of planning and implementation. The Kocaeli Metropolitan Municipality funds the initiative with revenues generated by the municipality and with governmental support from the Ministry of Interior in Ankara. The Department of Culture at the Mayor's Office purchases the computers and gives them to the local MoE authorities for distribution. The MoE also is responsible for coordinating teacher training, while the Department of Public Relations and Media at the Mayor's Office conducts public relations efforts and the Kocaeli Municipal Vocational Training and Arts Courses (KO-MEK) offered adult education courses in ICT that were available to the parents.

Planning for the One Computer Per Child Project addressed infrastructure preparations at the school level. Intel provided guidance in hardware selection and software specifications to support the eLearning program. Some schools received wireless access points and technological infrastructure as part of the deployment.

Program planning also addressed computer safety, both regarding safe use of the Internet and security for the computers themselves. Municipal authorities and Intel staff knew that safety breaches involving Internet use could affect the success of the project.

The new nation-wide technology integration project called FATIH, or "Movement of Enhancing Opportunities and Improving Technology," is likely to have strong implications for the local 1:1 eLearning initiative in Kocaeli because the two programs are so similar. The FATIH project aims to increase educational equity and quality for all students by providing schools with the latest technologies, creating new e-content that aligns the existing curriculum with technology-supported education, and training teachers to support implementation. As a result, continued planning for the Kocaeli initiative is on hold awaiting further details on FATIH.

"One Computer Per Child" Plan

- Provide Intel Learning Series to all 6th-grade students and their homeroom teachers to enable 1:1 eLearning
- Provide teacher professional development to support teachers in leveraging the new technology
- Allow students to bring the computers home, providing technology access for families

Implementation

The Kocaeli One Computer Per Child Project targets all 6th grade public school students in the province and their homeroom teachers. In each year from 2009 through 2011, the government distributed approximately 27,000 computers to these students and their teachers. The first deployment cost about 14 million Turkish Liras (about 9.3 million USD).

Two key challenges for the Kocaeli eLearning initiative were facilitating communication and support across participating organizations. Many stakeholders believe that the Mayor's Office launched the initiative for political reasons and failed to follow through with communication of the vision and goals to key players such as school administrators, teachers, and parents. Stakeholders also describe weak coordination between the Mayor's Office and the MoE, which creates problems for many aspects of the program.

Infrastructure and connectivity problems have also posed significant challenges for the program's influence in schools. One challenge is that responsibilities for funding infrastructure are not clearly identified, leaving many schools without the Internet connections and other infrastructure necessary to support a 1:1 eLearning program. This issue points to underlying differences in how key stakeholders view program priorities: while ICT officials at the MoE and school-based personnel believe that classrooms should be a priority for implementation and infrastructure development, the Mayor's Office highlights students and their families as the top priority.

The Kocaeli program included technology-related professional development for teachers. All participating teachers received a three-hour training on basic ICT skills and a condensed version of Intel's One-to-One Transformative eLearning course. Because many teachers are complete novices with technology, however, instructors were unable to move beyond basic skills and did not cover important topics like teaching with computers, classroom management in 1:1 eLearning environments, or developing content for 1:1 eLearning. Many teachers still feel that they need more support to be able to effectively integrate the laptops into teaching and learning, and hope for training that presents ideas and skills that they can use directly in their classrooms. Teachers also noted the importance of ongoing technology support, rather than receiving support by appointment only, as is currently the case.

Challenges

- Need for a technologically literate population to meet new workforce demands
- Need to increase social and economic equity by providing equal educational opportunities and decreasing the digital divide
- Desire to create an exemplar for other 1:1 eLearning

In the classroom, teachers who are enthusiastic and knowledgeable about ICT have been integrating the technology into their daily lessons; however, for more typical teachers, the use of ICT for instruction remains limited. Most commonly teachers, use technology to deliver presentations and administer standardized test. Some teachers also assign homework that involves Internet research. The most common student uses of technology include listening to music, searching for keywords provided by the teacher, conducting Internet research, and preparing class presentations.

A number of factors hinder more widespread and more integrated technology use in the classroom. Teachers are not currently required to use the computers, and for those who aren't already familiar with the technology heavy workloads make it difficult to find and integrate new practices. Teachers noted that preparation would be easier if they had access to curriculum materials that are ready for direct classroom use. In addition, since computers are distributed to homeroom teachers, some subject-matter teachers did not initially receive computers and were frustrated that they were not able to engage with the program or the technology that their students are using.

Outside the classroom, however, students and their families use technology more frequently and are satisfied with the program. All members of the family, including siblings, mother and fathers are using the laptops for a variety of activities related to school, work and entertainment. Issues around religious beliefs, traditional gender roles, perceptions of cyber safety, persist, but overall, parents and students view computers as useful tools—and the more they use them, the more benefits they enjoy.

Re-Informing the Vision

The Kocaeli One Computer Per Child Project serves as an early example of a 1:1 eLearning program in Turkey, with particular relevance for the upcoming FATIH program. The Department of Educational Technology at the national MoE conducted a study of the Kocaeli program in order to gain insights for the FATIH program.[16] The researchers found, for example, that schools need adequate Internet connectivity

and that teachers need guidance for how to use the computers in class. At the superintendent's request, local MoE inspectors also spoke with a few school principals and teachers to learn about the Kocaeli eLearning program. The inspectors found that teachers and students do not use computers as frequently as intended (partly because of infrastructure limitations) or in the intended manner (e.g., students spend too much time gaming).

Beyond these ad-hoc research efforts, few processes have been implemented to help program planners evaluate program implementation and success. Staff from the Mayor's Office recognizes the need to set short- and long-term success criteria, and to develop an evaluation plan to assess how the program is achieving those criteria.

Impact

The Kocaeli One Computer Per Child Project has had a major impact on providing technology access to low-income families. Since the program began, DSL subscriptions have increased. According to Turkish Telekom's figures, Kocaeli now has the highest rate of home DSL connections of any city in the country. According to a study by the Education Technology department, 82% of students participating in the project reported that their siblings used the computers; 55% reported their fathers used the computers; and 33% reported their mothers used the computers. Parents typically use the computers for conducting business over the Internet, reading newspapers, downloading music and movies, playing games, watching TV, paying bills, and chatting. Siblings often use the computers for doing their own homework.

Both parents and students have been overwhelmingly positive about the program. Students are thrilled to have access to a computer at home for doing homework and for entertainment and parents, especially those that did not have one at home, are encouraged by its new found benefits to their families. While students relish the idea of having their own computers, for parents, having a computer in the home was also very helpful because it allows their children to spend more time at home rather than in unsupervised spaces like internet cafés. This was particularly important for mothers and daughters who did not feel comfortable in public internet cafés. Parents also stated that the computers have improved the quality of schoolwork and assignments because children have access to more online resources.

As a result of the project more women have been able to further their education and strengthen their leadership and entrepreneurial skills to improve thfaeir lives. In the words of one mother,

> **"I have been in the open high school program [a distance education program] for several years but I could not go through it effectively. I was able to take only one course in each semester because I was working long hours and limited with the books only. But now I can download other support material online and study more efficiently thanks to the laptop. Furthermore, now I can go online and attend forums with other distance students. Most of all, I can download exams of previous years and study on the questions. Before, I did not have time, but now I am studying about one to two hours every day on the laptop. It has been very effective for me and now I can take more than three courses in each semester... I am planning to complete high school this year. And then I will be able to apply for better jobs. And it would not be possible if we did not have the laptop."**

In a similar vein, a mother who opened her own tailoring shop provided the following anecdote:

> **"I search for patterns and dress designs on the Internet and show them to my clients. We then decide on design and colors looking at some pictures. It has been great for me to use the laptop for my work."**

As a result of increased access, more women and girls are using the technology and are being empowered through it. However, it is also worth noting that there still exists a significant proportion of Turkish mothers who are reluctant to use technology due to their religious beliefs; fear that it will weaken the family structure and lead their children to spend less time with their families. Fathers, on the other

Key Areas of Education Transformation

1. LEADERSHIP

- Kocaeli Municipal Government
- Support from the local Ministry of Education (MoE)

2. POLICY

- The project distributes computers to all 6th grade public school students and their homeroom teachers to enable 1:1 eLearning.
- The project allows students to take the computers home, providing technology access for families.
- The project supports policy priorities to develop an ICT-literate society and a career pipeline for ICT professionals.

3. PROFESSIONAL DEVELOPMENT

- Most teachers have received basic technology skills training.
- Teachers need further professional development and support for integrating technology into instruction and teaching in an e-learning environment.

4. CURRICULUM AND ASSESSMENT

- The government is creating a digital curriculum that teachers and students will be able to access on their computers.

5. INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)

- To date, the municipal government has distributed three batches of 27,000 computers each to 6th grade students and their homeroom teachers for a total of 81,000 Intel Classmate PCs.
- Many Kocaeli schools lack the connectivity and other infrastructure to support eLearning.

6. SUSTAINABLE RESOURCING

- The Mayor's Office has promised resources to support the One Computer Per Child Project through at least 2013. The future of the Kocaeli initiative hinges on the outcome of FATIH.

7. RESEARCH AND EVALUATION

- Research efforts so far have been small and focused on lessons that could be learned for the upcoming FATIH program.
- The Mayor's Office recognizes the need to implement more systematic evaluation efforts, including identifying short- and long-term indicators for success.

8. STUDENT SUCCESS

- Increased access to technology in classrooms and homes
- Increased use of ICTs in homes

hand, are considerably more likely to use a computer and are more adept at the technology. Among the young people, aspects of traditional gender roles continue to manifest themselves in their use of modern technology; boys and girls use the computers differently. Boys tended to spend more time playing games, whereas girls use the Internet more creatively for creating fan Web sites, blogging, e-mailing or chatting with friends on Facebook.

Despite the overall positive benefits, parents do see some problems with computers and technology. Their most consistent concern about computers and Internet use was the potential to distract children from their schoolwork. Moreover, they are concerned about online risks that may result in harm to their children. Across the board, mothers are more concerned than fathers about potential problems of the Internet and even more likely to enforce rules about what their children can do on the computer. In general, parents' attitudes toward the Internet are heavily dependent on their own experiences and knowledge of using the Internet. Tech-savvy parents are more confident about ability to monitor their child's internet use while parents who are less knowledgeable about the computer and internet use are less convinced of the positive benefits. Likewise, parents who were more familiar with the computer and the internet were seen as less rigid and more open to the idea of having their children use the Internet. But one of the features to emerge strongly from the interviews is that parents overall do take an active interest in their children's internet safety. Many stakeholders believe that, taken together, these practices suggest that the city has met its goal of increasing technology literacy in Kocaeli.

Strategies for Success

The experience in Kocaeli municipality suggests several lessons and strategies for stakeholders in other settings who are considering 1:1 initiatives:

- When initiatives are jointly managed by multiple entities, active communication, involvement, and support from all parties is essential for smooth operations and successful program implementation.
- In order to ensure strong program implementation, government and program leaders must communicate a clear description of program goals and activities to educators and the public.
- Having an evaluation plan will foster transparency and ensure that stakeholders are on the same page with regards to the program's purpose and anticipated outcomes.
- The strategy of allowing students to take computers home can promote ICT literacy within communities.
- A robust technology infrastructure, including connectivity and hardware, is an important prerequisite for successful technology-based educational initiatives.
- Teachers need training on how to adapt their instruction for an e-learning environment, and processes that allow more advanced teachers to serve as models for their peers.
- Parents need training on how to support their children's use of the computer and the Internet and on how they can use the computers to support their own life-long learning.

Citations

15 Based on a report prepared for Intel Corporation by EDC and SRI International, based on original research by Cengiz Hakan Haydin, Alper Tolga Kumtepe, and Evrim Genç Kumtepe.

16 For this research, the MoE administered an 18-question survey to 1591 students in June 2011.

Appendix E: SMART Education Policy, Republic of South Korea[17]

Introduction

Motivated in part by students and parents who were unhappy with the overly competitive nature of college entrance exams, in 1996 the Ministry of Education (MOE) established three over-arching educational policy goals aimed a creating a more fair educational landscape: (1) normalize public education, (2) establish the foundation of ability-oriented society, and (3) reduce educational expenses. This drive towards education transformation was also motivated by the nationwide social consensus that the country did not want to return to external rule nor the poverty and unrest that it spawned. Based on these convictions, Koreans widely shared the policy vision of becoming the first country to achieve "informatization." The government placed a high priority on the use of ICT in business and formal education. The project for building the high-speed Internet began in 1995 together with the project for developing software applications, and education inevitably lay at the core value of these projects.

Impacts

- Increased access to diverse classroom technology solutions
- Increase in the use of cloud-based software
- Increase of student-centered, technology-based instructional practices
- More student-directed learning

In line with these intentions, in 1996, the Korean government established a four-part Master Plan for the use of information and communication technologies (ICTs) in the Korea the education system. This education technology integration policy is aimed at improving education, at promoting economic growth, and at extending ICT access. Phase I established educational technology infrastructure. Phase II focused on ICT use in the classroom and e-Learning platforms. Phase III increased customized and self-directed learning through mobile learning technologies.

The current stage of policy roll out, Phase IV, began in 2010 and will continue through 2015. At the heart of this phase of the Master Plan is the SMART Education Policy, which stands for Self-directed, Motivated, Adaptive, Resource-enriched, and Technology. This policy is currently in its pilot stage. The SMART education policy is designed to allow ubiquitous learning through information technology by creating a learning environment that diversifies teaching methods and guarantees students have access to multiple learning options.

This report summarizes key findings from the Intel Education Integration Research conducted in Korea by local researchers, in collaboration with researchers at Education Development Center (EDC) and Intel. Intel Education Integration Research investigates the successes, challenges, and policy implications for Intel-powered technology integrations in a variety of e-learning sites worldwide. This study made a selective use of Intel's toolkit, "Intel Guide to Monitoring eLearning Program," in accordance with Korean context and school environment. The research is based on a common global framework, with instruments customized to meet the needs of each deployment setting.

This summary is based a report written in 2013 that examines the SMART education policy from three perspectives: educational policy context, school level implementation, and classroom case studies. The first section summarized the four phases of the government's Master Plan for education technology from 2006 to 2010. The second section examined how the policy is implemented in schools by surveying stakeholders and doing observations in seven schools. Finally, the third chapter of the report looked at three successful cases of rich, meaningful technology use in classrooms. This report documents the progression of the initiative from vision to deployment to classroom impact.

Integration Status

The following section outlines the current status of Korea's SMART Education initiative along four key dimensions: vision, planning, implementation, and re-informing vision. These broad phases define the process of significant eLearning deployment and outline the sets of factors that must be considered by stakeholders in each stage. Though usually completed over the course of the policy rollout, this report is more akin to a retrospective that looks back at policy implementation in the past 15 years and reports on the impact in schools and classrooms today.

Korean Education Context

- Korea's basic school system is classified into six years in elementary school, three years in middle school, and three years in high school.
- Korea has a national achievement test called "Semi-Scholastic Achievement Test"—the MOE recently decided to reduce the burden of assessments on middle and elementary school students.
- It is a two-semester system, and the required number of school days is over 220 days a year.
- Since 1990s Korea has been trying to decentralize its education system, emphasizing local autonomy.
- There is excessive competition around the college entrance exam.

Vision

The SMART Education plan, which is being rolled out between 2011 and 2015, is nestled within Phase IV of the government's Master Plan for education technology. SMART Education is the first policy to attempt to overcome the limitations of existing ICT use in education. Since it is a policy to integrate ICT institutionally and culturally into educational practice and curriculum, SMART education promotes the use of ICT as a primary source of learning, rather than a supplementary resource. Above all, SMART Education offers an education that enables learning at any time and at any place through a teaching and learning system tailored to the needs of each individual student.

Specifically, the SMART education policy has seven major goals:

1. To change students' roles from consumers to producers of information,
2. To make teachers into facilitators of learning instead of knowledge deliverers,
3. To implement self-directed learning based on online diagnosis and treatment of academic progress,
4. To strengthen the flexibility of educational systems,
5. To create a customized learning environment based on students' levels and aptitudes as well as their personal preferences and future dreams,

6. To use various cloud-based content made by public agencies or individuals,
7. To practice cooperative learning through collective intelligence.

Through SMART education, the previous emphasis on the 3R's (Reading, Arithmetic, Writing) should shift to focus on a system more suitable to the 21st century learner. The world now demands the 7Cs (Critical thinking and problem solving, Creativity and innovation, Collaboration and leadership, Cross-cultural understanding, Communication, ICT literacy, Career and life skills) and the SMART education approach aims to meet those demands.

Planning

SMART Education is coordinated with many departments of the Ministry of Education, Science and Technology. Strategic planning for the SMART Education policy took place mostly at the MOE level, but the local education authorities and school leaders are in charge of education policy implementation, and administrative and financial support. Policy makers spent considerable time thinking through the outcomes they hoped the policy would accomplish and the preceding steps necessary to achieve those goals. By carrying out key projects based on the collaboration between related departments at provincial and municipal offices of education and directly supervised institutions, SMART Education should be able to expand to all schools in the final stages of the Phase IV rollout.

One of the main goals of the SMART Education policy is to extend the scope of learning beyond school to any place—including homes, hospitals, and anywhere learning takes place—allowing learning to take place anywhere and at any time. In order to do this, ministers and government officials took many steps to prepare the policy environment, as well schools and educational stakeholders. First, they improved laws and systems such as the Primary and Secondary Education Act and the Copyright Act to enable increased innovation. They built necessary assessment systems and strengthened teachers' competencies to enable individualized and customized learning. Also, to prepare for the SMART Education rollout it was necessary to change the physical environment of many schools and to increase awareness of where and how learning happens. In order to reduce information gaps and minimize the possible educational gaps that may occur within the SMART Education environment, policy planners gave more consideration to the less privileged sectors of society, including low-income and multicultural families. The ministry also implemented pilot programs to ease the transition from regular classrooms to SMART classrooms. Finally, they sought to create a positive public image of SMART Education through a public relations campaign.

Implementation

The SMART Education policy specifies what components make up a SMART classroom, but gives schools and teachers the flexibility to decide how the policy will best fit into their context. As a result, actual implementation has taken many unique forms in the schools where it has been adopted. In general, in a typical classroom, technology is used to show multimedia as supplementary materials while the class is largely composed of teacher-centered instruction based on textbooks as the main instructional resource. On the other hand, in an innovative SMART class, technology is not used as a supplementary medium, technology functions as an essential learning tool for students so that they can lead their learning for themselves. Although individual lessons are situated within the bigger frame of national curriculum and school's curricular operation plan, and teachers have full authority over lesson design or operation.

The general strategy for implementing SMART Education is composed of five key tasks: 1) Development and application of digital textbooks; 2) Institutionalization of online classes and introduction of online evaluation systems; 3) Creation of an environment for the public use of educational content and reinforcement of information and communications ethics education; 4) Strengthening of teachers' competencies to put SMART Education into practice; and 5) Integration of a cloud-based wireless Internet environment in every school.

SMART Education Plan

- Implemented between 2011-2015
- A flexible yet holistic solution to create a technology rich school environment that allows learning anytime, anywhere.
- Includes infrastructure upgrades, distribution of student devices, creation of digital textbooks, integration of cloud based software, and teacher training.

Because schools that choose to integrate the SMART Education model all have differing levels of established technology infrastructure, teacher interest, and principal support, rollout and implementation looks very different across schools. Some schools specialized in ICT and offer numerous courses, majors, clubs and activities for their students. Other schools first needed to install wireless networks and purchase smart devices before bringing in more technology focused programs. Principal support and engagement varied across schools with that individual sometimes pushing the SMART education integration or in other places, letting the teachers take the lead.

For many schools the first step is to make primary investments in changing the existing wired Internet environment to a wireless Internet environment and introducing smart devices. Building a wireless Internet environment is one of the most difficult issues in schools. A wireless Internet environment is created by installing one or two Internet Access Points per classroom. Because it is difficult to establish a robust wireless Internet, the transition to SMART classes is often delayed or cannot proceed as planned until a stable connection to the wireless Internet cannot be guaranteed.

For personal devices, a majority of the schools planned to introduce smart devices in addition to the existing standard personal computers. A high proportion of these schools introduced android smart devices. The use of these devices varied across schools depending partly on the size of the school's budget for introducing the devices. Some schools adopted a one-to-one approach, while other schools purchased class sets of devices. In schools that were trying to give more students opportunities to use smart devices despite a relatively low budget, smart devices storage boxes were separately installed and managed at a common space in school, or mobile carts were used as both storage and recharging boxes. The laptops and other smart devices were often used in conjunction with projectors and other interactive whiteboards.

Many teachers have also set up solutions to be able to control students' smart device and screen and share data between teacher and students and between students. With these tools, teachers can now put all devices in the classroom under their control. They can also push out data, webpages and other images from the teacher's device to the students' devices. Teachers who conducted SMART lessons mostly used general-purpose tools that were easy to find and purchase on the Internet according to their needs. Most of these learning support tools were free or low-priced and they were purchased at the personal cost of teachers. This suggests that the introduction or acquisition of new technology or software is not yet a formal part of the institutions or systems that schools use.

At the specialized schools the technology savvy teachers who already know how to use the tools are looking for more effective ICT rich lesson plans while other teachers require more basic use and methods training. In implementing any of Korea's ICT in education policies, teacher training has always been addressed as the most important issue. Teacher training has systematically taken root at the school level but a structured training system still exists at the central level (Ministry of Education and KERIS) in which well-trained master teachers conduct trainings for general teachers at regional levels (provincial and municipal offices of education). As training programs and online programs are separately offered for general teachers at provincial and municipal offices of education, teachers who want to receive training can, with the approval of their principal, apply for and participate in training individually through provincial and municipal offices of education. In addition to the training at the central, provincial and municipal levels, schools conduct self-training of the content necessary for school or to encourage participation by supporting group activity or subject study activity in the school.

Challenges

- High cost of infrastructure needs such as Internet and smart devices for schools
- Persistent and widening technological gap technological development and social adaptation
- Limitations in promoting 21st century skills within the context of traditional classroom and textbooks
- Education system too centered on academic assessment and test performance
- Over emphasis on teaching to the middle cohort of students while above and below average students are overlooked

Re-Informing the Vision

Under the initial Master Plan, the Korean government established a number of specialized education research centers charged to undertake basic research as well as evaluation and on-site consulting functions in order to assess the implementation of and evaluate the impact of the MOE's educational policies. Through regular investment on R&D of SMART education, the MOE is evaluating the policy's results and effectiveness as implemented by each school, metropolitan and provincial offices and the MOE.

The key organizations in charge of monitoring and tracking the policy implementation include the Korean Educational Development Institute (KEDI) which is in charge of education policy establishment, the Korea Institute for Curriculum and Evaluation (KICE) which is in charge of curriculum and assessments like the college scholastic ability test, and the Korea Education & Research Information Service (KERIS) which is in charge of education and science information. These organizations cooperate with MOE and metropolitan and provincial offices of education to help with planning, R&D and business practices.

Additionally, teacher communities, private enterprises, and academics are free to do research on the improvement of technology use in school. The government supports studies by private researchers by providing access to various data like achievement test results and publicized materials about elementary and middle schools. Most open materials about new technology are shared and accessible online, and research results are frequently distributed to major policy decision-makers like the National Assembly and other government ministries. In regular analysis of policy results, a lot of research is done on yearly levels of educational information and ICT literacy levels of elementary and middle school students.

Impact

From 1996 through 2010 Phases I-III of the government's Master Plan were carried out. These phases laid the groundwork of the technology infrastructure at schools and other educational centers, developed and distributed multimedia materials, created online learning platforms, introduced Web 2.0 tools, generated digital textbooks, and a trained teacher corps. The result of these first 14 years was a reduction in costs and educational gaps between urban and rural students, increased technology integration in classrooms, the creation of ubiquitous learning environment, increased collaboration with private institutions and international businesses, and the decrease of teacher administrative work.

Since the initiation of the SMART Education pilot in 2011, researchers observed that impacts on teacher and student technology use varied by school. ICT integration had varying success depending on a school leadership, teacher hiring practices and student body make up. Schools where the principal had the will and competency to understand technological changes and connect ICT with education were most successful. Similarly, schools such as private, autonomous and specialized schools where principals have more autonomy and decision making power around which teachers they can hire were more effective at integrating ICT into classrooms and lessons. Finally, schools that served more homogenous groups of students (i.e., private, autonomous, or rural community schools) had more success getting buy-in from them and their families.

Korean teachers already have a high degree of ICT literacy because the government put structures in place to ensure that they were using technology for teaching as well as administrative duties. The government initially "strongly demanded" that teachers use ICT in any form in at least 10% of each lesson. Technology competency certificates became required as part of teacher promotions. Similarly, the government introduced the National Education Information System (NEIS), which digitized everything from managing student attendance, to academic performance, to college entrance and transfers, and school budgets.

In terms of use of technology in the classroom, the initial school survey given to participating schools, stakeholders reported an increase in the use of digital content for teacher's presenting lesson materials. There were also changes in the frequency of using software in the student activity-centered classes. The survey found that software related to document editing and Internet search was used a lot. Also, with the introduction of smart devices, the use of cloud-based tools (like Google Docs and F-Desk) and mobile mirroring increased remarkably.

Based on the case study data, the impact of the SMART Education policy on teachers has been significant, particularly in the area of technology and assessment. The teachers are now no longer as concerned about which technology they will use in class. They are now spending more time thinking about how to genuinely integrate technology into the assessment process. Researchers observed an increase in the use of digital student portfolios. In one example, teachers took photos of all kinds of learning products, including students' three-dimensional products, and turned them into portfolios managed by grade and by theme. To overcome the challenges of providing individual instructions to each of their students, teachers are also using the resource "TeacherKit" to enter evaluation results and give feedback to students in real time. Similarly, various tools such as questionnaire tools and e-Clicker are being used in assessment. These tools enable teachers to make instantaneous changes in teaching by checking on the learning and understanding of students in real time and giving supplementary explanations around content that was insufficiently understood.

In terms of impacts on students, researchers observed that technology was being used as an essential learning tool allowing them to take charge of the learning process for themselves. Instead of the standard conception in schools that ICT use means sitting in their own seat, eyes focused on their own smart device, students in the pilot schools were engaging with technology in new and exciting ways. In one school, students walked around their school to collect evidence about the answer to a problem and created a video for role-play. In another school, students videotaped each other throwing a Frisbee and then analyzed their technique and posture. As students responded to a series of questions about their athletic skills, they watched as their answers were displayed in real time. Because ICT is so prevalent in Korean society, the researchers suggested that students of this "Net Generation" might no longer need to learn ICT literacy as a required subject in school.

Key Areas of Education Transformation

1. LEADERSHIP

- Korean Ministry of Education
- Korean Education Development Institute (KEDI)
- Korean Institute for Curriculum & Evaluation (KICE)
- Korea Education & Research Information Service (KERIS)

2. POLICY

- Implemented between 2011-2015 in pilot classrooms around the country
- The first policy to attempt to overcome the limitations in existing ICT use
- Promotes the use of ICT as a primary source of learning rather than a supplementary resource

3. PROFESSIONAL DEVELOPMENT

- Face to face and online teacher training happens at all levels including the central, provincial, municipal and school.
- At the central level, the MOE and KERIS train master teachers who then conduct transfer training for general teachers at regional levels.
- Some schools are able to hire computing assistants who reduce the burden on teachers and relieve them of the burden of handling IT-related miscellaneous affairs in school.

4. CURRICULUM AND ASSESSMENT

- SMART Education is developing digital textbooks, designing online classes, establishing an online assessment system.
- Curricular development and training methods are being diversified.

5. INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)

- Infrastructure upgrades
- Distribution of student devices
- Creation of digital textbooks
- Integration of cloud based software
- Teacher ICT training

6. SUSTAINABLE RESOURCING

- EDUNET allows teachers to share documents and resources.

7. RESEARCH AND EVALUATION

- KEDI, KICE, and KERIS are all responsible for monitoring and evaluating the progression of the SMART education policy.

8. STUDENT SUCCESS

- Increase of student-centered, technology-based instructional practices
- More student-directed learning

In addition to supporting direct teaching and learning environment, using ICT also showed a high effect on the communication with parents and students. The introduction of ICT enabled teachers to send students' attendance to their parents in real time on the smart phone or for parents to immediately check email for home correspondences or pictures taken on a school trip. In this regard, the use of ICT noticeably raised parents' satisfaction with school. This effect of communication was a great help to teachers in understanding and guiding individual students.

Remaining challenges include promoting communication between various stakeholder groups (teachers, students, parents), emphasizing engagement and self-directed learning, changing the teaching and learning paradigm, and closing the gaps in technological understanding and competencies between teachers, schools and professionals. Also, teachers' work burden needs to be monitored and regulated as it becomes heavier even during out-of-class hours.

Strategies for Success

1. The most essential factor for success in Korea's ICT in education is the government's policy leadership. Policy leadership is not static but should spontaneously change according to temporal and spatial situations.

2. In connecting and accepting technology, the first thing to do is to nurture the competency of the school leader. Schools where principals had more autonomy in hiring their own teaching staff tended to be more successful.

3. Schools were most successful at integrating ICT if principals were able to hand-pick teachers who shared similar values and vision.

4. What must be included in these technological requirements is the space for sharing educational content. Building a networked global brain where everyone can share the knowledge and technology of mankind unfettered by copyrights and technology should become the most essential task.

Citations

17 Based on a report prepared for Intel Corporation by EDC based on original research by Prof. SeYoung Chun, Chungnam National University and Dr. Bokyung Kye, KERIS.

Appendix F: Computer for Every Child,[18] Macedonia

Introduction

In 2008, as part of the "Computer for Every Child" initiative, the government of Macedonia made a nationwide commitment to distribute Intel Classmate PCs (CMPC) (part of the Intel® Education Solutions (includes products formerly named Intel® Learning Series)) to 53,000 students in grades 1-3. The initiative also includes the deployment of 55,000 seats within Thin Client desktop systems to students in grades 4-8. Schools report that they find the CMPCs more suitable for education purposes than the Thin Client infrastructure and the field data show that the laptops are used in other grades levels in addition to those originally targeted. As a result, this report will focus exclusively on the use of the Intel Education Solution resources.

The goal of the "Computer for Every Child" initiative is to promote regional economic development by increasing the use of ICT in teaching and learning and, hence, increasing ICT literacy among teachers and students. Macedonia is the first Balkan country to invest in the Intel Education Solutions on such a large scale.

Impacts

- Increase in computer access for students and teachers
- Increase of ICT-based activities in the classroom
- Increased student engagement
- More inclusive claassrooms for students of all learning abilities

This report summarizes key findings from the Intel Education Integration Research conducted in Macedonia by local researchers, in collaboration with researchers at SRI International, Education Development Center (EDC), and Intel. Intel Education Integration Research investigates the successes, challenges, and policy implications for Intel-powered technology integrations in a variety of e-learning sites worldwide. The research is based on a common global framework, with instruments customized to meet the needs of each deployment setting. The research was conducted in three phases over five years.

This summary is based on three reports. For the first report, the research team interviewed ranking officials at the Macedonian Ministry of Education and Science (MoES), the Ministry for Information Society and Administration (MISA), and at other organizations playing key roles in the project. For the second report, in 2010, they conducted interviews or focus groups with teachers, administrators, parents and students at 15 primary schools throughout Macedonia. Finally, between March and May 2013 the team visited twenty classes in 8 schools from selected model schools to identify technology usage patterns, teacher and student creativity, and the communication between the students and the teachers.

Integration Status

The following section outlines the current status of Macedonia's "Computer for Every Child" initiative along four key dimensions: vision, planning, implementation, and re-informing vision. These broad phases

Macedonia Education Context

- Macedonia's education system includes 334 primary and 94 secondary schools.
- The Government of Macedonia is responsible for all educational legislation and implementation of educational programs.
- Recent legislation is promoting a shift to a more decentralized structure for education.
- Primary teaching certification requires a 4-year bachelor's degree.

define the process of significant eLearning deployment and outline the sets of factors that must be considered by stakeholders in each stage. Through research conducted in three unique phases over the course of five years (2008-2013), the local researchers documented the progression of the initiative from vision to deployment to classroom impact.

Vision

The "Computer for Every Child" program began as a core component of the political campaign of the current majority party, the VMRO DPNE, for the 2006 election. Since then, the promise has driven important policy initiatives related to computers in education.

The government's 2006 strategy document[19], National Programme for Development of Education in Macedonia 2005 – 2015, positions ICT in education as a pathway for economic development. It promotes a long-term program of educational transformation designed to ensure that the country's youth acquire 21st century skills, enabling them to compete in regional and global marketplaces, and the development of an "IT society" characterized by ICT literacy for teacher and students and widespread access to and use of ICT in classrooms. Consistent with this vision, goals for the 1:1 program include immediate advances in the quality of education and ICT literacy for students and teachers. Longer-term goals include participation in the global economy, local economic development, and business growth.

Foreign organizations have also played key roles in supporting the initiative. For example, both Intel and the Academy for Educational Development (AED) have served as advisors to program planning, and aid organizations such as USAID and UNICEF provided financial support for localization of curriculum and wireless access points for classrooms.

Planning

National planning for the program took place without substantial input from stakeholders in local governments and schools, which resulted in limited buy-in. The rollout of 1:1 computing in Macedonia was planned as a simultaneous program across the nation, in an effort to achieve widespread impact quickly. This approach is in contrast with some nationwide deployments that begin with a pilot and take more time to scale. While goals of efficient distribution of computers were met, many stakeholders note that there was no time for thorough planning of all necessary components, including analysis of local infrastructure requirements, or for improvements based on early lessons learned.

The planning phase was also hindered by a lack of clear program ownership at the federal level and by lack of involvement at local levels. Recent legislation transferred responsibility for school management to municipalities, which have varying levels of financial resources to support operations. For the 1:1

program, the MISA purchases the hardware and software, but local municipalities are responsible for maintenance and ongoing technical support. Organizationally, the State Inspectorate of Education (SEI) was a logical group to provide oversight, but with just 70 inspectors to serve 15,000 primary school teachers capacity was an issue. As a result, while the initial purchase was fully funded, some challenges are expected in financing the ongoing costs of the program.

Implementation

"Computer for Every Child" Plan

- 2009 purchase of 53,000 CMPCs; 22,000 ASUS netbooks for teachers
- Focus on grades 1-8
- Infrastructure upgrades and professional development offerings that increased over time

The 1:1 e-learning environment for early grades in Macedonia's elementary schools is based on the Intel Education Solutions, a solution that consists of hardware, software, and services. Forty-three Open Source applications that focused on mathematics and science were identified, translated into Macedonian and Albanian, customized for the Macedonian context, and installed on the laptops, along with local-language versions of the operating system. In addition, the program equipped each school with ADSL Internet connections, peripherals such as printers and LCD projectors, and wireless access points for each lower primary classroom.

Lack of technological readiness in many schools strongly challenged the implementation. For example, existing wiring in older schools required upgrades to support the increased electrical demand of the technology, and because earlier programs had focused on desktop solutions wireless infrastructures had not been upgraded. These unplanned enhancements slowed implementation by almost 2 years, but eventually resulted in wireless Internet and intranet in every lower primary classroom in Macedonia.

Another early challenge was teacher readiness to integrate ICT into instruction. Because only slightly more than half the households in Macedonia possessed a computer in 2008, many teachers were not familiar with using technology, and their instructional use was limited to presentation software and to activities that could be conducted without ICT. Some felt that the new hardware hampered their teaching activities, and saw computers as intruders in their classroom. Early in the deployment, professional development was ad hoc and there were concerns about the capacity of the responsible agency (the Bureau for the Development of Education, or BDE) to reach all teachers.

As the program continued, a number of supports for teachers were developed. A variety of training options are available, including courses planned by the BDE and many offered through the donor community. These training modules address a number of instructional topics in addition to ICT skills, including classroom management, student assessment, and improving language skills among teachers. BDE also implemented a train-the-trainer model to supplement in-house capacity, with trained Educational Technology Support Teachers (ETSTs) based in each school who provide professional development and routine technical support for their colleagues. Teachers also have access to online communities of practice that allow them to share experiences and exchange instructional strategies.

A more controversial means of promoting instructional use of the computers is a nationwide policy mandating that 30% of each teacher's instruction must use technology, with high financial penalties for non-compliance. While government officials see this as an effective means of motivation, teachers tend to respond with minimum efforts to comply rather than motivation to transform instruction.

The most common application is the use of ToolKid, partly because it is an educational software option that has been approved by the BDE and has been mapped directly to the national curriculum. This enables teachers to integrate ICT into instruction without designing complex activities or of the digital content. Other widely used educational software include GCompris and Green Package, both of which are used in primary classrooms. Teachers also report using ICT for preparing documents, multimedia presentations, and for activities that require students to complete Internet research. Some report using the computers to expand learning beyond the classroom, on field trips or by using videoconferencing to connect to other classrooms or to outside adults with relevant expertise.

A number of significant challenges persist. Particularly in rural areas, electricity supplies remain volatile and Internet connections are unreliable, requiring teachers to have an offline "plan B" for every lesson. The battery life of the PCs has proven to be a challenge, particularly in schools that work two shifts so each computer must serve two shifts with limited time to recharge. Content management systems are lacking in the local languages, and there is limited availability of educational content, applications, and testing software. Some parents remain concerned about technology's effects on schoolwork and the overuse of computers as toys despite after-school classes in some areas to educate parents about the potential educational benefits of ICT for their children. Clear lines of oversight are still missing in many areas, hindering ability to implement meaningful strategies.

Challenges

- Low historical ranking in the region for internet connectivity and the use of ICT for development
- Need to accelerate economic development
- Traditional teaching practices that have not been restructured to support 21st century needs
- The lack of virtual learning environment makes it difficult to distribute and collect assignments, as well as share resources
- The shorter 40 minute class period in the upper grade levels is not conducive to technology integration
- Teacher integration quality varies across classrooms and by geographic regions

Overall, however, the initiative is increasingly seen as a positive influence in the classroom and a catalyst for teachers to rethink their approach to instruction. While depth of implementation varies widely across teachers, the 1:1 model is now commonplace among primary school classrooms in Macedonia.

Re-Informing Vision

Several specific studies of the deployment in Macedonia have been conducted by the donor community, including an early study of infrastructure and a later evaluation of a professional development program by USAID, and an evaluation by university students of the patterns of teacher integration of technology into teaching and learning. So far, more comprehensively designed studies and tracking of key indicators are lacking.

Impact

After nearly 5 years, the initiative has produced positive changes across classrooms in Macedonia. The ratio of computers to students, which was 1:45 at the beginning of the initiative, has now been reduced to 1:1. As a result of increased access, more teachers are using ICT in their daily instruction and all teachers report using an ICT-based activity at least once per week across all subjects. While the quality and complexity of technology integration varies across teachers and classrooms, the improved access has increased communication, collaboration, creativity, and differentiation across all settings. In classrooms with more advanced integration models, researchers are beginning to see changes in teaching practices to create a more student centered learning environment.

Key Areas of Education Transformation

1. LEADERSHIP

- Government of Macedonia (GoM)
- Bureau for Development Education (BDE)
- Support from local Education Ministries

2. POLICY

- Nationwide rollout of 53,000 computers for students in grades 1-3
- Policy shifts to a more decentralized educational management structure
- Policy mandates that 30% of each teacher's instruction be delivered through ICT

3. PROFESSIONAL DEVELOPMENT

- Professional development offerings were initially limited
- Over time, a broader range of training and supports are available through a network of training providers and school-based Educational Technology Support Teachers

4. CURRICULUM AND ASSESSMENT

- Edubuntu 7.04, Metasys V-Class, Toolkid, Skoool
- There is a varying degree of ICT integration quality across classrooms
- Challenges still remain around assessing student knowledge

5. INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)

- ASDL Internet connections and peripherals in each school, with wireless access points in teach lower primary classroom
- Upgrades of electrical systems and wireless infrastructures when existing systems were insufficient to meet increasing demand
- The program still needs to adopt a virtual learning platform to increase classroom efficiency

6. SUSTAINABLE RESOURCING

- Use of open source software which allows local communities to develop and upgrade applications in Ubuntu

7. RESEARCH AND EVALUATION

- Several focused studies of particular program elements by a variety of funders
- No comprehensive plan for monitoring, research, or data-driven course corrections

8. STUDENT SUCCESS

- Increased access to technology-rich learning environments
- Increased use of ICTs in classrooms

Teachers report positive student outcomes from the use of ICT. They cite higher levels of engagement in learning activities, self-regulation on the part of students, more time on task, more independent work, and a greater percentage of tasks completed on time. Teachers felt that the use of ICT allowed students more opportunities to experiment, learn by discovery, and express themselves in different ways. Students felt that activities were more interesting, interactive, and play-oriented.

The Classmate PC also opens up the classroom for a group of children who are often excluded from fully engaging in the life of the classroom. Some primary students need such technology in order to lead fuller lives as children and to assist them in their learning. The assistive technology on the CMPC supports those students' communication, interaction, mobility, and general participation within the classroom. The additional peripherals on the CMPC allow all students, regardless their physical and intellectual abilities, to be equal participants in the process of learning within classroom.

Strategies for Success

The experience in Macedonia suggests several lessons and strategies for stakeholders in other settings who are considering 1:1 initiatives:

- Smooth deployments require comprehensive up-front planning and infrastructure readiness which must be built into the expected pace of rollouts.
- Professional development can be a key enabler of adoption if programs are widely available, well coordinated and designed to support pedagogical goals.
- Translation and localization of operating systems and content can help to overcome the language barrier and encourage teachers to adopt technology.
- Programs for parent engagement are essential for widespread support of 1:1 programs.
- Even though providing ready-made, curriculum mapped content does not encourage teachers to be creative and innovative, providing such clear guidelines, it is the first step in the process of technology integration and encourages teachers to integrate technology in almost every class and every subject.
- Virtual learning environments are vital in a technology rich classrooms because they allow for increased efficiency for the distribution and collection of assignments and foster communication among the teacher and her students.

Citations

18 Based on a report prepared for Intel Corporation by EDC and SRI International, based on original research by Petar Nikoloski and Olga Samardzic.

19 Ministry of Education and Science (2006). National programme for the development of education in Macedonia: 2005 - 2015. Skopje, Macedonia: Author.

Appendix G: E-Book Project, Terengganu, Malaysia[20]

Introduction

In May 2009, the Malaysian state of Terengganu launched an ambitious new e-Book Project (Projek Buku Elektronik) to provide a Classmate PC to every primary school pupil in Year 4 (ages 10-11) and older, beginning with 15,000 e-Books for Year 5 students across the state. The project is taking place within the context of a nationwide imperative to develop a knowledge-based economy and offer digital access and skills to all citizens. Due to the comprehensive scale of this e-Book initiative and its goals of leveraging ICT to move into a 21st century economy, the first three years of the program offer important lessons for other jurisdictions hoping to follow a similar path.

In this report, we summarize key findings from the Intel Education Integration Research carried out in Terengganu by researchers at the Sultan Idris Education University in Malaysia, in collaboration with researchers at SRI International and Intel. Intel Education Integration Research investigates the successes, challenges, and policy implications for Intel-powered technology integrations in a variety of e-learning sites worldwide. The research is based on a common global framework, with instruments customized to meet the needs of each deployment setting. In Malaysia, data collection consisted of interviews with stakeholders in key education positions within the national Ministry of Education, the state of Terengganu, and Intel. The research team also visited four participating schools in Terengganu, where they interviewed principals, technology coordinators, and teachers; observed classes; and conducted focus groups with students.

Challenges

- National imperative to move toward a globalized society and 21st century economy
- Strong pressure for results on national examinations
- Limited ICT infrastructure and skills in most schools
- Lack of ICT access for families, particularly in rural areas

Plan

- Intel-powered Classmate PCs distributed to Terengganu children beginning in Grade 4 (ages 10-11)
- Content includes Intel educational software bundles, digitized textbooks and test preparation programs, Al Quran, dictionary
- "Virtual classrooms" in selected schools provide additional resources for ICT integration
- Technical support provided by locally-based Executive Information Officers (EIOs)

Integration Status

The following section outlines the process of the Terengganu integration along four key dimensions: vision, planning, implementation, and re-informing vision.

Vision

Projek Buku Elektronik—described in this report as "the eBook project"—began through the initiative of the Terengganu State Chief Minister in 2009. The Minister's intent was to increase computer literacy among Terengganu citizens, including students and their families, thereby producing tech-savvy, innovative citizens and reducing the digital divide between urban and rural, and between high and low income, households. Funding for the project is allocated by the state government as a strategic use of petroleum royalties in this oil-rich state.

Terengganu Education Context

- Centralized education system, with curriculum, examinations, and syllabi defined by national Ministry of Education
- 3 main standardized assessments in primary and secondary years, including exams that qualify students for subject specialization (Science or Art) and for higher education
- National Ministry of Education provides all schools with basic ICT infrastructure, including internet connectivity and a computer lab

This project takes place within the context of a number of important national initiatives aimed at moving Malaysia toward an ICT-rich global economy. The national Economic Transformation Programme (ETP) and Multimedia Super Corridor, for example, are intended to provide impetus and infrastructure for increased digital capacity in multiple sectors throughout the country. Terengganu also participates in the national Smart Schools initiative, which aims to equip all 10,000+ Malaysian primary and secondary schools with increased ICT capacity with the intent of catalyzing a reinvention of teaching and learning.

The Terengganu e-Book project also takes place within the context of an ongoing Intel partnership in Malaysia, with over 50,000 teachers trained through Intel Teach between 2000 and 2011, and 10 selected schools participating in 1:1 projects beginning in 2007. In addition, the Terengganu government has collaborated with Intel and Top IT Sdn Bhd (a state-owned assembler) to open a factory that will be able to supply 10,000 Classmate PCs per month, providing local high-tech jobs and training as well as economic revenues.

Planning

The stated goals of the e-Book initiative are to provide "an e-Book to every child" and "a computer to every home." The strategy is to begin with students in grades 4, 5, and 6 (starting at age 10), and let each child take the computer home for family use so that even poor families have access to technology. In future years they hope to make e-Books available to younger students as well.

The program design also includes the gradual establishment of "virtual schools" with classrooms fitted for ICT integration (including an electronic whiteboard, a teacher's workstation, and sufficient electrical outlets for children to charge their e-Books in class). Support services are provided through a partnership with a state-owned company (Top IT) and through locally recruited and trained Executive Information Officers (EIOs), who provide in-school support and gain valuable high-tech job skills.

Technology access and related training for teachers was included in the plan at a later stage. The first teachers began receiving e-Books a year after the rollout had begun for students. Through a partnership with Intel, training in Intel Teach Essentials was provided in 2010-2011 for 2-3 teachers per school, with the expectation that they would train others at their school.

The program is planned and managed by a state-led committee that includes membership from the state government and other participating organizations. The decision was made to distribute computers directly to students and their families through an "e-Book giving ceremony," at which students and parents take formal responsibility for the computer and its use according to guidelines. This initially enabled the goal of supporting ICT skills and access for each family, but left teachers and schools out of the communication loop: a factor that proved problematic for classroom integration.

Implementation

The rollout began with 23,512 Year 5 students across the state in 2009 and has added one grade-level cohort per year since, with Year 4 students added in 2012. As of 2012 a total of 93,000 Intel Classmate PCs have been distributed, supporting students from primary Year 4 through secondary Form 2 (students approximately 10-14 years old). The e-Books are loaded with digitized versions of the standard textbooks, test preparation software, Intel education bundles, the Koran and other religious resources, and a dictionary.

The initiative is seen as successful in its goal of bridging the digital divide, with low-income families now having access to computers. The government is working to expand WIFI access points, particularly in rural areas, so that students and families will be able to access the Internet within their communities. Students evidenced pride in ownership of the e-Book.

In schools, Paya Bunga virtual school offers a model of a successful early implementation. At Paya Bunga, e-Books are used with some regularity in classes, and some teachers make the experience interactive by using an electronic whiteboard to share students' work with the whole class, enabling group discussions and visibility of feedback. This degree of interaction is supported by the additional infrastructure available in the virtual classroom, by a very active and supportive headmaster, and by teachers who were hand-picked for their ICT experience and enthusiasm. With these and other important supports, this historically low-performing school experienced strong academic gains and was widely seen as a model of success for the e-Book program.

Other schools have experienced less classroom integration of the e-Books, and no substantial change from more traditional "chalk-and-talk" pedagogies. Educators describe a number of challenges to meaningful incorporation of the ICT into instruction:

- Teachers did not receive e-Books along with their students.
- Training was limited to 2-3 teachers per school, and many of these did not pass the training on to other teachers at their schools as envisioned. Pedagogical training and models for innovative instructional uses of the e-Books have been lacking for most teachers. Said one government stakeholder, "The big challenge is how to transform mindsets [of teachers] from hardcopy to digital."
- Lack of interactive teaching materials has also been a challenge. Digitized versions of textbooks are offered in PDF form, which does not encourage interactive use.
- In most schools, infrastructure challenges include a lack of outlets to charge computers, lack of a teacher workstation, and slow/unreliable internet connections.

- Schools also experienced policy disconnects: for example, a federal policy restricts the use of student-supplied mobile devices in schools, so only schools that received an exemption could use the e-Books for in-school instructional purposes.

Some students who received their e-Books while in primary school are now in early secondary. Reports suggest that some of these students are still using their computers at home for personal uses and for finding school-related resources. Negotiations with publishers have not yet succeeded in producing digitized versions of textbooks at these grades that would promote use of the resources in secondary schools.

Re-Informing the Vision

A state-level committee is tasked with ongoing oversight and monitoring of the program. The committee meets quarterly, and reviews progress and challenges. Based on early experience several program improvements were put in place: for example, computers began to be distributed to teachers, and attempts have been made to increase access to training and to pedagogical models for instructional use of the e-Books. However, not all decisions are made based on a fully-informed view of experiences to date. The program would benefit from a defined evaluation plan and data-based input into strategic plans.

Key Areas of Education Transformation

1. POLICY

- The e-Book project was an initiative of the Terengganu State Chief Minister in 2009
- The project leverages national policy initiatives such as the Economic Transformation Programme and the Smart Schools initiative
- Computers are funded by the state, while families are responsible for ongoing maintenance

2. CURRICULUM AND ASSESSMENT

- Curriculum is defined centrally through the national Ministry of Education
- Classmate PCs are loaded with digitized versions of textbooks and test preparation software, along with other resources

3. PROFESSIONAL DEVELOPMENT

- Intel Teach Essentials training offered to 2-3 teachers per school in 2010-2011
- In 2012, the government is gradually increasing provision and pedagogical focus of training offerings

4. INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)

- 93,000 Intel Classmate PCs distributed to Terengganu students between 2009 and 2012
- "Virtual classrooms" in selected schools with increased connectivity, Smartboard, and teacher station
- School-based support provided by local Executive Information Officers (EIOs)

5. RESEARCH AND EVALUATION:

- State-level committee vested with responsibility for oversight and monitoring
- Indicator tracking includes counts of computers and ratings of Smart Schools
- Comprehensive plan for ongoing monitoring and improvement of teaching and learning is lacking

Strategies for Success

The early experience in Terengganu suggests several lessons and strategies that should be considered by stakeholders in other settings who are considering 1:1 initiatives:

- In order to promote transformational changes in the classroom, a clear vision and goals for teaching and learning—not just for access and ICT skills—must be established from the time of early planning
- Policy alignment at all levels, from the national to the local, is essential for creating an environment in which innovation can flourish
- It is important for 1:1 planners to consider access and readiness (e.g., professional development) for teachers, not only for students
- Additional areas of readiness that must be considered in advance include school-based infrastructure, curriculum, and human resources that can provide support
- A model school can be an important way to demonstrate proof of concept and a vision for success. To replicate the model, conditions that support this success (such as resources and staffing) must also be replicated.

Impact

After nearly 5 years, the initiative has produced positive changes across classrooms in Macedonia. The ratio of computers to students, which was 1:45 at the beginning of the initiative, has now been reduced to 1:1. As a result of increased access, more teachers are using ICT in their daily instruction and all teachers report using an ICT-based activity at least once per week across all subjects. While the quality and complexity of technology integration varies across teachers and classrooms, the improved access has increased communication, collaboration, creativity, and differentiation across all settings. In classrooms with more advanced integration models, researchers are beginning to see changes in teaching practices to create a more student centered learning environment.

Teachers report positive student outcomes from the use of ICT. They cite higher levels of engagement in learning activities, self-regulation on the part of students, more time on task, more independent work, and a greater percentage of tasks completed on time. Teachers felt that the use of ICT allowed students more opportunities to experiment, learn by discovery, and express themselves in different ways. Students felt that activities were more interesting, interactive, and play-oriented. The Classmate PC also opens up the classroom for a group of children who are often excluded from fully engaging in the life of the classroom. Some primary students need such technology in order to lead fuller lives as children and to assist them in their learning. The assistive technology on the CMPC supports those students' communication, interaction, mobility, and general participation within the classroom. The additional peripherals on the CMPC allow all students, regardless their physical and intellectual abilities, to be equal participants in the process of learning within classroom.

Strategies for Success

The experience in Macedonia suggests several lessons and strategies for stakeholders in other settings who are considering 1:1 initiatives:

- Smooth deployments require comprehensive up-front planning and infrastructure readiness which must be built into the expected pace of rollouts.

- Professional development can be a key enabler of adoption if programs are widely available, well coordinated and designed to support pedagogical goals.
- Translation and localization of operating systems and content can help to overcome the language barrier and encourage teachers to adopt technology.
- Programs for parent engagement are essential for widespread support of 1:1 programs.
- Even though providing ready-made, curriculum mapped content does not encourage teachers to be creative and innovative, providing such clear guidelines, it is the first step in the process of technology integration and encourages teachers to integrate technology in almost every class and every subject.
- Virtual learning environments are vital in a technology rich classrooms because they allow for increased efficiency for the distribution and collection of assignments and foster communication among the teacher and her students.

Citations

20 Based on a report prepared for Intel Corporation by SRI International, based on original research by Chang Lee Hoon, Siow Heng Loke, Lee Siew Eng, Mohd Faris bin Dziauddin, and Zanariah binti Noor.

Appendix H: Project Magellan, Portugal

Introduction

The Faculty of Sciences of the University of Porto has been commissioned by Intel Corporation to investigate the educational, social and economical impact of the use of ICT in Primary education, in Portugal 2012—an especially attention being paid to Magellan initiative—in the common Intel framework to study education transformation through-out the world.

An ecological, constructivist and developmental model underlines both the research goals and method. Interviews have been specifically designed to give subjects (distal and proximal stakeholders, teachers, parents and students) and researchers an exceptional time to explore —in a reconstructive way—their personal investments concerning their relation with ICT and education.

This report presents a comprehensive balance and overview of the results and conclusions of the study.

ICT and Magellan integration in Portugal

Magellan was an unprecedented initiative by its framework, goals and scale. Furthermore, it has been implemented in a European, economically developed and industrialized society.

The Portuguese educational setting had been previously crossed by several technological initiatives, which introduced ICT to teachers and students, even if they were somewhat incipient and urged a coherent plan.

On the contrary, Magellan was part of a National Technological Plan, having a wider, national scope of action and effective means to pursue the proposed goals.

Magellan initiative

- Universal: Intel-powered Classmate PCs freely distributed to or purchased at low-cost by primary students (ages 6-10).
- Ecological: Magellan aimed to reach both school and families.
- Integrated: Magellan was part of a wider national Technological Plan.

Goals

- Approach the national educational policies to the European best practices.
- Promote the role of Information and Communication Technologies (ICT) as a basic skill in learning since the primary school level.
- Develop basic ICT skills in the Portuguese citizens.
- Generalize computer and internet use.
- Assure one computer with learning contents per student starting at primary school level.

Integration Status

The following section outlines the process of the Magellan initiative along four key dimensions: vision, planning, implementation, and re-configuring vision (monitoring and evaluation).

Vision

Between 2008 and 2011, every primary student (grades 1 to 4, ages 6-10), from both public and private school establishments, was given the opportunity by the Portuguese Government to acquire an Intel-powered Classmate PC, locally manufactured by JP Sá Couto, freely or at low-cost.

Magellan laptop was publicly presented as an educational tool, being delivered to families and aiming to generalize computer and internet use in early learning stages and to assure the access to the first computer to thousands of families (PTE, 2010). Initially, the project has been mainly funded by the mobile communication contribution and then directly by the State Budget.

Planning

Magellan has been delivered to students at school. By taking the computer to their houses, children would play the role of ICT gatekeepers in their families. Therefore, Magellan was not intended to be confined to school, but was expected to have a transversal effect in society, promoting digital literacy, social and status mobility both in students and their parents. Nevertheless, several stakeholders and field-actors perceived the initiative as monolithic, autistic and ex nihilo, regretting that it was present as a top-down political decision.

A training program has integrated the initiative, assembling the contributions of different stakeholders at a national scale. The main idea was to train master teachers whose local actions would empower their peers. Respecting the guidelines of Education Technological Plan and Lisbon Strategy, in 2009, a training plan amplified and intensified this effort, even if it was not specifically conceived to Magellan.

Attitudes, Values and Beliefs

- Children show a positive attitude towards Magellan. Furthermore, they reveal a sense of ownership.
- Social consensus about ICT value (social mobility, labor-market integration).
- Controversy about ICT impact in academic achievement. Teachers show ambivalent attitudes.
- Positive and negative attitudes are built upon beliefs related to time benefits/costs and students expected behavior (motivation vs. inattentiveness).

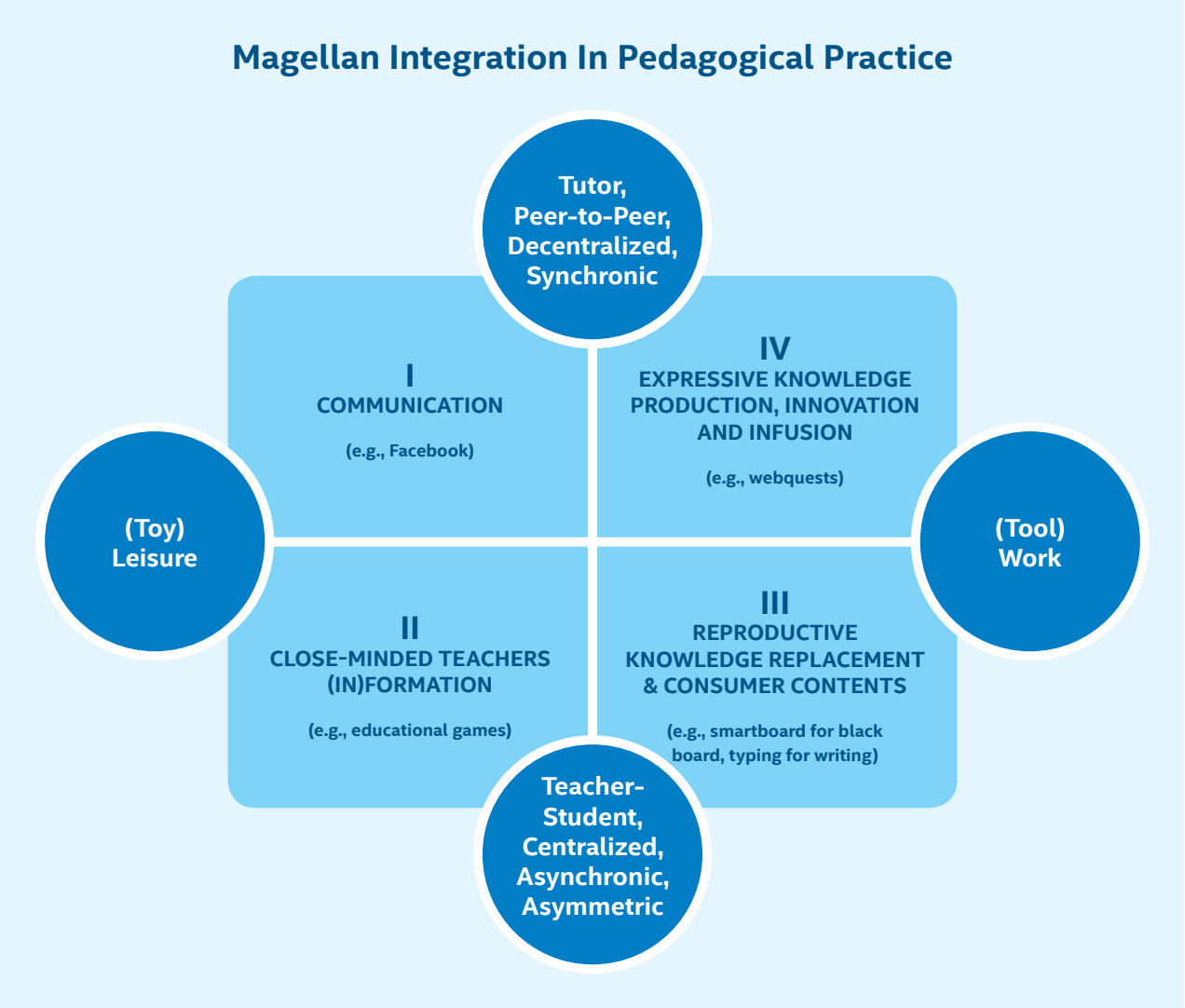


Figure 1

Implementation

According to recent data, from 2008 to 2011, more than 600,000 Magellan were delivered to families. Some delays in delivering generated anxiety among children, parents, and teachers.

Most teachers did not feel involved in the process. Novelty introduction, frontiers and scripts between family and school may have contributed to consider Magellan a somehow threatening object. Teachers did not have chance to get to know the device. This could have been prevented, by delivering some laptops to schools.

Magellan became a messenger of expectations and conceptions, a source of potentialities and concerns. Consider Figure 1.

ANCHORING

- **Leisure.** Home is to leisure as school is to work. If Magellan is given to the family and not to the school, than is more likely that it would be taken as a toy than as a tool.
- **Education.** Children and parents would expect teachers to use Magellan in classes. This may restrain the use of the device.
- **Politics.** Since teachers have been involved in a class struggle to contest the career and evaluation reform process, Magellan may have served identity processes.
- **Identity.** Considering the negative social image that has been associated to teachers, smartboards, more than Magellan, would help restoring teachers authority and prestige.
- **Childhood.** Magellan is so closely associated to children that it acquires children qualities. As a child, Magellan is unstable, not reliable, but more importantly its meaning changes as time passes. This vision may help to understand why the 5th and 6th grade children, in general, do not use computer and why parents, when they have the possibility, buy another laptop to their children as they leave primary school and why the 5th and 6th grade teachers do not use it in their classes.
- **Welfare.** As if the generalized access to the device overshadowed its value.

Apparently, the representation of the Magellan comprehends two opposed poles: on the one side, it is considered a learning resource (such as a book or a pen)—on the other, it is considered a recreational device (such as a toy).

In order to consider Magellan a toy, it is fundamental to distinguish it from other laptops. Some arguments are used to satisfy this requirement: children use it only to play; at a certain age, they do not seem to care and do not even talk about it anymore (they dropped it as a toy). On the other hand, the classroom computer (and the claim to have more computers available in the classroom), Internet connection and, specially, smartboard acquire an increased value in teachers perspective.

Such contradictions are merely apparent if Magellan is not a “serious” computer, if it is given as broken, if it disturbs class and if optimal technological conditions are not assured. Teachers may be favorable to ICT integration and still they do not effectively use a 1:1 solution. That is the case of some teachers, who do not use Magellan but use classroom computer and smartboard. A very common practice found in every school was the homework assignments which implied explicit or implicitly the computer and sometimes the Internet (e.g., writing or coping a text in Word – sometimes only if the child wants to – or making a web search about a given topic). This may configure a delegated attitude towards ICT educational integration.

Monitoring and Re-Configuring the Vision

The ICT integration panorama in Portugal is quite complex. Considering the impressive technological empowerment, the opportunities inherent to Magellan initiative were not fulfilled.

A heterogeneous scenario: different level-stages of integration

Previous initiatives had helped to build a basic technological setting to perform ICT integration activities in school. As competences over Primary Education are being progressively transferred from MoE to Municipalities, Primary Schools are sometimes *doomed to their own solitude*, the technological equipment reflecting a fuzzy, unclear cooperation.

Education as a natural set for ICT

Teachers are the keystone of the educational system: they did not feel involved and in some cases they even perceived their control and authority over the class threatened by Magellan. Undoubtedly ambitious, the training plan proved to be inefficient, because the snow-ball effect did not happen. MoE stakeholders suggested that a different training model should be adopted. Indeed, it is a major pedagogical challenge to implement a 1:1 technological solution, demanding specific, continuous, in-context training and fast, reliable support. Teachers, who make an educational integration effort of ICT, make it by their own initiative, means and interest. However important it may be, enthusiasm and good-will are not enough, as the quality of ICT integration activities is often low. It also true that best practices are to be found and its distinctive characteristics will be highlighted (see box above, Educational-scenarios).

Teachers and parents as ICT integration interlocutors

Most parents are aware of network security issues (even if their parental praxis do not always reveal it), but they are definitely less aware to other topics. For instance, by allowing or ignoring the illegal down-loading or plagiarism both teachers and parents may see their role as figures of influence deteriorate as new challenges rise from the rarefaction of time and place. Such inherent opportunities of collaborative and multi-support use of ICT are sparely referred. At this stage, it seems of prime importance to empower both parents and teachers—far beyond technological skill in order to promote generative digital literacy. Generative digital literacy mean the capability of continuously transform the personal potential relation with ICT, far beyond current concepts of instrumental efficacy of using, based on individual and social agreements about the usefulness and creativity of its employ and the improvement of personal opportunities access. Within this perspective it is possible to intentional aim integration goals as well as status and social mobility.

Magellan: from a technological to an ecological vision

It seems important to promote the communication among different settings in order to obtain genuine developmental gains, aiming generative digital literacy as a fundamental mean to promote inclusion and enlarging living opportunities.

EMERGING CHALLENGES AND OPPORTUNITIES

Educational-scenarios

- Educational-scenarios (i) aim curriculum goals and (ii) favor the signification of the learning process among students as appropriation of knowledge and personal construction of meanings and (iii) imply and involve parents. Teachers should be able (i) to monitor accurately the activities and (ii) to introduce changes when required. Some heurists may prove useful, at early stages of integration, as (i) settle a day per week to work with Magellan and (ii) include its use explicitly in the Curricular Project of class. As such, educational-scenarios are ecologically intentional, systematic, balanced and flexible.

Empowering teachers

- Teachers are the key-stone to the success of any educational initiative and education has long been a field for experimentation. Teachers are used to hear such words as educational modernization, change, and transformation and they cannot embark in every new project, which ignores their past experience and practices. If they are to be persuaded, they must acknowledge the suitability of integration in their own current practices. Therefore, one must not reset teachers experience.

Bring your own device

- The current Portuguese Government canceled the initiative. As Magellan may in a short time be unavailable in schools it is important to consider alternative models. ERTE-MoE sustains that a "bring your own device" may be the next step, Magellan being integrated in a welfare initiative.
- Portugal as a best practices example of ICT educational integration: a platform to South America and Africa
- Portugal is often given as a successful example of ICT educational integration. To keep the path it is important to acknowledge the black-holes and embrace coming challenges, identifying and creating best practices and educational-scenarios. Furthermore, Portugal is historical and culturally linked to Brazil and Africa and ICT Portuguese integration may be considered a well-positioned platform to approach emergent global market opportunities.

Appendix I: e-Schoolbag Project, Shanghai, China[21]

Introduction

In 2010, the Shanghai government launched the e-schoolbag project as part of the Shanghai Medium and Long-Term Development Plan for Education Reform and Development (2012-2020). The purpose of the project is to create an environment for "ubiquitous learning", where all students have access to individualized digital content through mobile devices that enable anytime, anywhere learning. The project has two key components: creating and implementing a digital curriculum environment and fostering technology-based self-directed learning for students (i.e. ,1:1 e-learning).

Impacts

- Increased ICT literacy and digital skills to help students prosper in a high tech society
- More self-directed learning activities in the classroom
- More opportunities for critical thinking
- Improved communication and collaboration skills among students

In this report, we summarize key findings from the Intel Education Integration Research carried out in Shanghai by a group of researchers designated by the Shanghai MoE, in collaboration with researchers at SRI International, Education Development Center (EDC), and Intel. Intel Education Integration Research investigates the successes, challenges, and policy implications for Intel-powered technology integrations in a variety of e-learning sites worldwide. The research was conducted in three phases based on a common global framework, with instruments customized to meet the needs of each deployment setting. For Phase 1, researchers conducted interviews with key education and technology leaders within the government, and with technology integration specialists in the district. The researchers also surveyed 94 educators about the key factors that influence 1:1 e-learning. Finally, the researchers collected relevant literature and basic data, and analyzed the discussion of technology and education in the media. For Phase 3, researchers observed 12 teachers in six pilot schools for a year and collected videos of 35 lessons from these teachers.

Integration Status

The following section outlines the process of the Shanghai integration along four key dimensions: vision, planning, implementation, and re-informing vision.

Vision

The e-schoolbag project is part of a collection of broad educational policies created by the Shanghai Municipal People's Government that aim to transform teaching and learning through technology integration in education. The overarching policy is called the Shanghai Medium and Long-Term Development Plan for Education Reform and Development (2010-2020). This policy introduced "ubiquitous learning" as its central goal and as a core strategy for advancing education throughout the city. The ultimate goal is to

Shanghai Education Context

- As part of the latest round of curriculum reforms, the Shanghai municipal government developed curriculum standards for multiple subjects and revised instructional materials for primary through secondary schools.
- Government supportive of expanding ICT in education, especially through development of digital curriculum.
- Current emphasis on "ubiquitous learning" to enable people to learn anytime, anywhere using individualized digital content.
- All primary through secondary schools connected to internet through "all schools connected" program.
- IT course provided as a coresubject in all primary and secondary schools.

promote self-directed learning in order to support students in developing 21st century skills such as critical thinking and communication. At the same time, the reform aims to ease the excessive academic burden that many students currently experience by shifting the emphasis from large quantities of assessment-driven schoolwork to creativity and innovative thinking.

The government has also created the Shanghai e-Educational Trial Program (2011-2015) that outlines precise short-term goals for technology integration in education. Specifically, the city aims to create a comprehensive technology infrastructure for the education system; establish an e-learning environment to support student learning; and catalyze widespread use of technology resources. The government recognizes that integrating these technology resources effectively will require educators to reform teaching and learning models, assessment methods, and curriculum development.

The e-schoolbag project builds on a history of strong technology integration in education across primary and secondary schools throughout Shanghai. During the first stage of technology integration (1997-2000), the government began to prepare for subsequent technology integration by creating an educational network, creating some key e-learning resources, and training educational technology leaders. During the second stage (2000-2010), the government brought educational technology to the schools. Specifically, through the "All Schools Connected" program, the government connected all kindergarten, primary, and secondary schools to the Internet. In addition, Intel Teach provided training to 1.7 million teachers during this phase. E-schoolbag (beginning in 2010) is the third phase.

Planning

Shanghai has a strong foundation on which to implement the e-schoolbag project. First, the technology infrastructure is well established throughout the Shanghai school system. All kindergarten, primary, and secondary schools are connected to the Internet, thanks to the "All Schools Connected" program; many secondary schools even have high-speed Internet. Also prior to the e-schoolbag deployment, the Shanghai municipal government provided technology training to 80% of primary and secondary teachers throughout the city to establish a baseline competency with technology skills. At the same time, schools began offering IT courses as a core subject in all primary and secondary schools.

Project leaders developed a 4-year schedule for the e-schoolbag program (January 2010 through December 2013) covering project planning and preparation, implementation, and final program revisions.

As designed, the e-schoolbag project has three key components: 1) implementing a digital curriculum environment; 2) providing the opportunity for students to engage in individualized 1:1 e-learning using mobile learning devices that each student will own and operate; and 3) establishing a public educational service platform. All students from kindergarten through secondary school will ultimately receive an individual mobile learning device to support "ubiquitous learning." The public educational service platform is intended to provide both: a) an interactive learning environment where students can access digital content to learn on their own either inside or outside of school; and b) an interactive system to manage educational administration, content, and other functionality.

While the project components are well specified, the government did not clearly articulate the project goals at the start of the e-schoolbag project. As a result, many stakeholders—including government officials—struggled to clearly explain a complete vision for the program. This lack of communication also led many citizens to question the feasibility and value of the e-schoolbag program.

The government has included research and evaluation in its initial e-schoolbag plans in order to ensure high-quality programming. The research consists of three phases:

- Research on the technology integration context (September 2011 to February 2012)
- Follow-up research on schools and students (March through August 2012)
- Evaluation of e-schoolbag pilot studies (September 2012 to February 2013)

The results from this research will inform a revised e-schoolbag plan for the government to approve. The government also intends to use the results from the pilot research to better publicize the program and communicate its goals and features.

Challenges

- Need for citizens who are prepared to be innovative and proactive in addressing social needs
- Need for education to meet the needs of the current economic transition, promoting service industries
- Need to reduce the heavy academic burden on students
- Need to help students develop knowledge and skills to live, work, and learn in the 21st century

Implementation

The government is currently piloting the e-schoolbag project in the Hongkou district, located in the downtown commercial areas of the city. Eleven primary and middle schools in the district are participating in the pilot study. These schools have received 2500 mobile learning devices, which students have begun to use. The participating schools have selected 1-2 subjects where they will implement 1:1 e-learning. By 2012, 1:1 e-learning is being used for approximately 30% of class hours and has been extended to after-class hours. These reforms are promoting more student-centered instruction, and helping students to gain more control of their own learning. For example, one school requires students to use their devices for inquiry learning; students then share findings and discuss important questions with the class. In addition to the school-level implementation, government and education leaders have created a refined plan for the digital curriculum and designed a framework for the educational service platform.

E-schoolbag Project

- Individual mobile learning devices for all students in kindergarten through secondary school
- Digital content, including e-textbooks, online courses, and high-quality instructional materials
- Public education service platform to access e-learning tools and resources

The biggest challenge so far is delays in the creation of the digital curriculum. As a result, teachers and students do not have access to all the tools, resources, and content that was intended to be available through the mobile learning devices. Students are therefore using printed textbooks and workbooks as well as the technology. One reason for the delay is that over the past decade, the Shanghai government focused more on creating resources for teaching (e.g., multimedia resources to use for instruction) rather than resources for student learning.

Another challenge is the lack of teacher professional development to prepare teachers to teach within the new e-learning environment. Some training does exist to help teachers learn not only how to use technology for teaching, but also how to use technology to improve student learning. Nonetheless, most teacher training programs still have not been adapted to emphasize technology integration. The lack of this training is limiting teachers' ability to effectively support student learning within an e-learning environment.

As part of the pilot study, researchers examined media representations and public opinion about the e-schoolbag program. The findings reveal that the public does not have a common understanding of the e-schoolbag program. Supporters of the program believe that e-schoolbag will reduce the weight of schoolbags and improve student health. Supporters also believe that e-schoolbag will provide students with personal learning plans that will support individualized learning. Many people have concerns about the implementation, however. For example, since the creation of the digital curriculum is lagging, people worry that students will have to carry both their devices and books. At the extreme, people worry that the severe lack of digital resources would make e-learning impossible. People also worry about security problems with the e-learning devices, and they worry about students using the devices as toys rather than for learning.

The pilot study also examined educators' opinions about the factors that are most important for improving e-learning. As with the public, the research found that teachers too did not have a consistent view on e-learning.

The pilot research, and especially an awareness of the challenges in implementing the e-schoolbag program, will be helpful to government officials and educators as they seek to revise program plans and improve broad-scale implementation of the program.

Re-Informing the Vision

As part of the educational reform, the government has also spearheaded research to investigate educational issues in Shanghai. The research team consisted of government officials, university researchers, company representatives, and other experts and practitioners familiar with e-learning in China. The research team plans to present its findings and suggest revisions for the e-schoolbag program activities and standards. The government will ultimately have the authority to approve these recommendations.

So far, research on the e-schoolbag program has yielded valuable insights for revising the government education policies and e-schoolbag project plans. First, the research found that the public does not have a clear understanding of the project, and that concerns about implementation are widespread. Educators also do not have a consistent understanding of the factors that are most important for improving e-learning. These two findings suggest that government and education leaders need to do more to articulate and communicate a clear description of the project goals and activities in order to build a stronger understanding for the program and its value for teachers and students. The research also found that teachers have not had the necessary training to enable them to effectively adapt their instructional practices for an e-learning environment. It will be important to fill this need in order for the project to be successful.

Impact

The e-schoolbag pilot schools have demonstrated the types of changes that are possible through the integration of ICT and innovative teaching approaches. The pilot research also highlights the important role of the teacher and of on-going professional development to support the teacher.

The use of laptops and online resources allowed the students engage in self-directed learning activities that require them to use critical thinking skills and develop collaboration skills. The most successful lessons analyzed in Phase 3 of the research show that students make greater progress in communication skills when they are participating in collaborative learning activities supported by technology, and when teachers facilitate their engagement in the learning activities. The research shows that students' critical thinking skills can be better developed when they engage in guided inquiry focused on understanding concepts and basic principles, while being supported by technology scaffolds as they study and seek solutions for problems.

However, changing the ways that teachers teach the basic curriculum is not a deep enough change if the goal is to create students who can become engaged life-long learners. The research also identified three strategies that the pilot schools are using to combine classroom activities and extra-curricular activities to innovatively transform student learning.

Project-based learning: The schools stress the value of project-based learning and encourage the students to use technology to inquire into real problems, in order to understand natural phenomena and to connect science back to the needs of society.

Scientific reasoning. The scientific methods and scientific thinking, which scientists use routinely, have been introduced to students to change traditional instructional methods that place too much emphasis on memory and imitation. Students have experienced the integral process of doing research—such as collecting, analyzing, sorting data, drawing conclusions, and releasing products or work—to gain deep understanding of the scientific approach and to cultivate practical problem-solving skills.

Online collaboration: Online communication and collaborative learning have opened up new channels and resources for students in learning and solving problems.

Strategies for Success

The early experience in Hongkou district suggests several lessons and strategies that should be considered by stakeholders in other settings who are considering 1:1 initiatives:

- In order to ensure strong program implementation, government and program leaders must communicate a clear description of program goals and activities to educators and the public.
- A robust technology infrastructure, including connectivity and hardware, is an important prerequisite for successful technology-based educational initiatives.
- Teachers need training on how to adapt their instruction for an e-learning environment—above and beyond training in technology skills.
- Professional development for teachers should be centered around the Technological Pedagogical Content Knowledge (TPACK) framework which helps teachers understand how technology relates to the pedagogy and can effectively support students exploration of the content.
- High-quality digital content must be readily available for teachers and students to access in order for an e-learning environment to become valuable for student learning.
- As modern Shanghai grows and transforms itself, schools need think about how to prepare for BYOD (Bring Your Own Device) environment where students will access learning resources on multiple types of devices over the cloud.

Key Areas of Education Transformation

1. LEADERSHIP

- Shanghai Municipal Government
- Shanghai Normal University
- East China Normal University

2. POLICY

- E-schoolbag project is a government initiative started in 2010
- The project has three key components:
  - Implementing the digital curriculum environment
  - Using technology to support self-directed learning for students
  - Establishing a public educational service platform

3. CURRICULUM AND ASSESSMENT

- The government is creating a digital curriculum intended to provide tools, resources, and content for individual learning.

4. PROFESSIONAL DEVELOPMENT

- Most teachers have received basic technology skills training.
- Teachers need further professional development around integrating technology into instruction and teaching in an e-learning environment.

5. INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)

- Comprehensive school Internet access achieved through the "All Schools Connected" program.
- Pilot schools in Hongkou district received 2500 individual learning devices for students.

6. SUSTAINABLE RESOURCING

- The Municipal government thinks as more resources move the to cloud, a BYOD (Bring Your Own Device) strategy for students will be more sustainable.

7. RESEARCH AND EVALUATION:

- The evidence shows reform happens through simultaneous changes in the learning paradigm and technology application.
- Transformation in schools is a process of creating a technologically integrated ecosystem—not just getting laptops, Internet access, or digital resources.

8. STUDENT SUCCESS

- Students develop self-directed learning abilities and higher order thinking skills.
- Students engage in learning from anywhere.

Citations

21 Based on a report prepared for Intel Corporation by EDC and SRI International, based on original research by Dr. Minghe Jiang and colleagues.

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