Emerging changes in ICT-rich learning environments: The Intel® Teach Essentials Course and changing teacher practice in India, Turkey, and Chile

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Executive Summary

Understanding how technology fits into the complex realities of classrooms was a critical factor in creating real change in the industrialized nations,[1] yet little is known about how educational technology projects are impacting the classrooms of the developing world. This study looked at successful schools from the Intel® Teach Essentials Course in Chile, India and Turkey to explore how schools and teachers have been able to integrate ICT and the pedagogical approaches from the Essentials Course into their schools and how these changes are, in turn, changing what happens in the classroom. The Essentials Course, a professional development program that offers teachers the knowledge and skills to integrate information and communication technologies (ICT) as critical tools to encourage active student learning, is a core component of Intel's efforts to partner with national governments to promote educational improvement worldwide. With the collaboration of ministries of education around the globe, Intel has offered the course in more than 30 countries and, by 2008, more than 4 million teachers had taken the course.

The Education Development Center (EDC) decided that instrumental case studies of successful schools would be most informative at this early stage of emerging knowledge of the use of ICT in classrooms of developing countries. This allowed the research team to understand what teachers are actually able to do with their students in typical schools in each country, to talk with teachers about which aspects of the training were useful to their practice and why, and to learn more about the factors in each context that have helped these schools begin to integrate ICT tools into their educational programs. In collaboration with the Centro Costadigital at the Pontificia Universidad Católica de Valparaiso in Chile and GLOKAL Research Consulting in Eskisehir in Turkey, EDC conducted case studies of two successful schools in Chile and Turkey as well as in India to examine how they created change in *their* contexts. In each case *success* was defined by the local stakeholders - the Ministries, training agencies and Intel Education managers - to represent what they felt would be reasonable expectations for schools and teachers in their country.

This project addressed two research questions regarding the impact of the Essentials Course on classroom learning in a diversity of national contexts.

- **Supporting change at the school-level.** What are the factors that facilitate teachers' ability to follow up on the training with their students?

- **Changes in the learning environment.** Within each context, how are teachers able to follow up on the training with their students in their classrooms and in their schools?

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[1]Cuban, L. (1993). *How teachers taught: Constancy and change in American classrooms 1890–1990*. New York: Teachers College Press; Honey, M., McMillan Culp, K., & Carrigg, F. (2000). Perspectives on technology and educational research: Lessons from the past and present. *Journal of Educational Computing Research, 23*(1), 5–14; Somekh, B., Lewin, C., Mavers, D., Fisher, T., Harrison, C., Haw, K. et al. (2003). *ImpaCT2—Pupils' and teachers' perceptions of ICT in the home, school and community*. London: British Educational Communications and Technology Agency.

Although each country is unique and each school is at a different starting place, all are moving toward more student-centered, project-based, and ICT-rich classroom learning activities. Across the diversity of their situations, educators in each school connected the ideas and tools offered in the Essentials Course with their own needs.

In all three countries, we found that the educators we interviewed felt they had been able to implement both new ICT activities and new teaching approaches with their students after the course. Additionally, we consistently found that no single factor or program accounted for these schools' ability to move forward. Instead it was a combination of programs and policies coupled with the motivation and skills of the educators in each building that enabled the schools to innovate. The ICT activities and teaching approaches that teachers applied to their work with students varied, however, due to differences in each country's broader educational context.

The Intel Teach Essentials Course

Over the years, program evaluations have found that teachers across a variety of countries value their experience in the Essentials Course and report using ICT and/or making changes in their teaching practice following the program.[2] The Essentials course is constructed around known attributes of good professional development, such as focusing on issues that are directly relevant to teachers' everyday work, offering a well-defined concept of effective learning, and offering opportunities for teachers to develop knowledge and skills that broaden their repertoire of teaching approaches.[3] The Essentials curriculum guides teachers through a process of developing a complete unit plan using a project-based approach and ICT activities for their students. The implementation in the classroom of the unit plan that teachers designed during the course is a key feature of quality professional development since it allows teachers to experience and value the new teaching approaches.[4]

Methodology

EDC used an instrumental case study approach. In an instrumental case study, the analytical focus is on identifying underlying factors and patterns that can be generalized beyond the case study[5] to inform, in this instance, a broader discussion on technology

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[2] Light, D., McMillan Culp, K., Menon, R., & Shulman, S. (2006). *Preparing teachers for the 21st Century classroom: Current findings from evaluations of the Intel Teach to the Future Essentials Course*. New York: EDC/Center for Children and Technology; Light, D., Menon, R., & Shulman, S. (2007). *Training Teachers across a Diversity of Contexts: An Analysis of International Evaluation Data on the Intel® Teach Essentials Course, 2006*. New York: EDC/Center for Children and Technology.

[3] Garet, M., Porter, A. C., Desimone, L., Birman, B., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*(4), 915–945; Kennedy, M. (1999). Form and substance in mathematics and science professional development. *NISE Brief, 3*(2), 7; Loucks-Horsley, S., Stiles, K., & Hewson, P. (1996). Principles of effective professional development for mathematics and science education: A synthesis of standards. *NISE Brief, 1*(1), 7.

[4] Guskey, T. R. (2002). Professional development and teacher change. *Teachers & Teaching, 8*(3/4), 381–391.

[5] Stake, R. E. (1995). *The art of case study research*. Thousand Oaks: Sage Publications.

integration and education reform. The cases are selected to represent the desired outcome. For this study, the schools were selected because of the strides they have made in integrating ICT and innovative teaching practices into their classrooms.

For each case study, we conducted interviews, focus groups, and observations with relevant stakeholders. In every school, we interviewed school administrators, teachers, technology coordinators, students, and the MT or ST who supported the Essentials Course. Other stakeholders might include parents and local officials, but the stakeholders varied somewhat in each case depending upon who were the relevant stakeholders in each location. We also observed standard classrooms as well as the computer lab, if possible. Furthermore, we asked the school to identify some of their best or most innovative teachers because we wanted to see what the best teachers were able to do in each context.

Selecting case study countries and schools

India: Given the context of India's educational challenges, EDC sought to identify schools that were attempting to change both teaching practices and the use of ICT with students. To identify a sample of exemplary schools, the Learning Links Foundation and Intel put together a list of eight schools across India that best exemplified the goals of the Essentials Course in India and, given the context and possibilities in India, fit their own criteria for success. The list contained both government-funded and private schools. Some schools were English-medium, meaning they taught in English, and others taught in local language. The research team made the final selection. The schools selected were the Ashok Nagur campus of the Children's Academy in a middle-class neighborhood of Mumbai, and the Fatehpura Anupam Primary School in the Gujarati village of Fatehpura. The Children's Academy is an English-medium private school from pre-kindergarten (pre-K) to Grade 10, and Fatehpura is a Grade 1 to 8 Gujarati-medium public school.

Chile: The Ministry and the Pontificia Universidad Católica de Chile in Santiago, which oversees the program nationally, and the Intel Education Manager met with the local evaluation team to generate a list of schools that met their terms of success and were "typical" Chilean schools. The local evaluation team reviewed the list to make the final selections. The schools selected represented a government-subsidized private school in a lower middle-class neighborhood of Santiago Chile and a small municipal school in a rural town. The private school, Colegio El Sembrador, has students from pre-K through Grade 12, and the village school, Escuela Pedro Aguirre Cerda, goes from pre-K through Grade 8.

Turkey: The Intel Education Manager worked with the local evaluators and EDC to discuss selection criteria, considering issues of location, size, and level. The Education Manager consulted with the STs and provincial directorates of education to develop a list of potential sites, and the final selection was made by the Turkish evaluation team. Both schools are public schools serving students from kindergarten (K) to Grade 8. Burak Reis School, in an outlying neighborhood of the national capital Ankara, is in dense urban environment. The second school, Mustafa Kemal School YIBO, is a public school in the

small city of Çorum. This school serves neighborhood children and has a population of female boarding students who come in from the villages in the province.

Factors that facilitate change at the school level

To answer the first research question about the factors that support change, we focused on examining seven commonly cited factors to help understand the case studies: pedagogical objectives and goals; leadership; professional development and ongoing support; experimentation, adaptation, and critical reflection; time; infrastructure; and financing and sustainability.[6] The data from the six schools we visited provide insight into the mechanics of how these factors function in the context of developing country schools.

1. Pedagogical Objectives and Goals

The research on educational innovation suggests that it is important for schools to share a reformed vision of teaching and learning in order to create sustainable change at the school and classroom levels. In all six cases we found that the educators we interviewed talked about a vision of education that was student-centered, encouraged projects and student inquiry, and supported students doing research and bringing their perspectives into the classroom. Additionally, the visions of learning that these educators articulated were tailored to their particular schools. The schools were able to translate a broad, abstract vision, such as "student-centered learning," into a set of practical goals and objectives that were relevant to actual classroom practices and meaningful to teachers in their schools. And technology was seen as a learn tool that would support this vision.

2. Leadership

Leadership at various levels of the system is important if an innovative project is to take root and grow. Most of these schools function with two levels of leadership— first there is the national or provincial ministry of education that sets overall policy, curricula, and national assessment, and second, there is the building leadership that makes the day-to-

[6]See Ely, D. (1990). Conditions that facilitate the implementation of educational technology innovations. *Journal of Research on Computing in Education, 23*(2), 298–305; Fullan, M. (1991). *The new meaning of educational change*. New York: Teachers College Press; Hawkins, J., Panush, E. M., & Spielovogel, R. (1996). *National study tour of district technology integration summary report* (CCT Reports No. 14). New York: Center for Children and Technology; Kozma, R. (Ed.). (2003). *Technology, innovation and educational change—A global perspective. A report of the second information technology in education study: Module 2*. Eugene, OR: ISTE; Light, D., & Manso, M. (2006, April). *Educational technology integration in developing countries: Lessons from seven Latin America SchoolNets*. Presentation at the Annual Meeting of the American Educational Research Association, Seattle; McMillan Culp, K., Hawkins, J., & Honey, M. (1999). *Review paper on educational technology research and development*. New York: Center for Children and Technology; Pérez, P., Light, D., Vilela, A. & Manso,M. (2003). Learning from the pioneers: A study on the best practices of the network TELAR. *Interactive Educational Multimedia, 6,* 17–39.

day decisions. While issues of national leadership are important for technology projects,[7] our research here focused particularly on leadership within the schools. Connecting to the discussion in the previous section, the school's leadership is the key nexus in the process of reinterpreting a broad, abstract vision into a practical vision.

The findings from these six schools suggests three observations of the role of building-level leaders in supporting a process of ICT integration and pedagogical innovation. First, leadership does not come only from the principal. In most of the schools, there were other figures who were strong leaders or advocates for technology and the Essentials Course. And, in each of these schools, the Essentials MT was a key figure.

Second, in all of the schools, the leaders of the ICT push do not just set the vision and provide clear expectations for teachers, they provide support and guidance in teachers' classrooms. Most of the teachers had no prior experience with the activities they were being asked to do, and in all six of these schools, the principals, technology coordinators, and MTs were often in the classrooms with support, suggestions, and praise.

Third, there are also specific administrative and logistic challenges around using ICT that school administrators have to solve. All of these schools had resource limitations on time, infrastructure, staff, space, and funding, and the administrators had to find solutions to allow change and innovation to take place with the resources that were available. ICT infrastructure is a constant problem for schools in developing countries, and the decisions administrators have to make are often frustrating because they cannot give all students all the access that they would like to give them.

3. Professional Development and Ongoing Support

For much the same reasons that supportive leadership is important to helping teachers innovate, ongoing professional development also appears to be a critical factor. In the context of education reform, the tools and teaching strategies are new to many of the teachers in these schools. Therefore, both the quality of the professional development course and the presence of ongoing support for teachers in their classrooms are important. First, the case studies suggest that the Essentials Course offers teachers multiple points of entry into practices supporting ICT use and student-centered teaching. This allows teachers to begin changing their practice from whatever point their context and current practice requires.

The case studies also highlight two features of the teachers' professional learning occurring in these schools: The importance of using the Intel unit in the classroom as part of the program follow-up and the informal professional communities that exist in these schools.

[7] Kozma, R. (2005). National policies that connect ICT-based education reform to economic and social development. *Human Technology, 1*(2), 117–156; Hepp, P., Hinostroza, J. E., Laval, E., & Rehbein, L. (2004). *Technology in schools: Education, ICT and the knowledge society*. Washington, DC: World Bank.

Designing their own unit plan is a key strategy of the Essentials Course, and the case studies suggest how important it is. A common feature in all of these case studies was the teachers' use of the unit plans designed during the Essentials Course in their classrooms. The chance to implement an ICT-rich, student-centered activity allowed teachers to experiment and see for themselves how these new ideas, tools, and approaches could work in the classroom. This happened in each school.

Another important characteristic of these schools, which helped them leverage the Essentials Course as a part of the change process, is that each of these schools has established a culture of constant improvement and professional learning. Educators at all of the schools talked about teachers meeting in groups to plan and discuss new strategies and to share challenges and successes. For some schools, these were faculty-wide meetings for sharing and planning, and at other schools, it was part of special project teams or grade-level meetings.

4. Experimentation, Adaptation, and Critical Reflection

These six schools offer interesting insight on the research literature's perspective regarding the importance of experimentation for ICT integration and education reform. The case studies reveal the role a culture of experimentation plays in schoolwide change and its relationship to leadership, pedagogical goals, and professional development. Educators in all of these schools exhibited a willingness to experiment and take on the challenges of trying to do new things. In these schools, the culture of experimentation is promoted by the leadership and in line with each school's pedagogical goals. If professional development provides teachers access to information about new tools and practices, there needs to be a willingness to experiment with novel ideas and an openness to reflect on the successes and failures in order to create positive changes.

5. Time

Much like a physical resource, time is a scarce resource that schools need to carefully manage. Time needs to be viewed in two dimensions: (1) teachers' professional development and planning time and (2) students' time in the classroom or learning activity. Each school developed their own strategies depending on the particularities of the larger system. Some strategies were teacher specific, where an individual teacher might make their own arrangements to find extra time on the computers. But, most of the schools needed to develop a schoolwide approach.

6. ICT Infrastructure

In most developing countries, ICT Infrastructure is also commonly a limited resource in schools. With limited resources, it is often difficult for schools to provide sufficient access so that students can use ICT during their classes. The case studies suggest that no single strategy will work for all schools with resource limits. Instead each school developed unique strategies to provide meaningful learning activities using ICT tools, whether it was teachers using ICT-based teaching aids or student ICT use.

7. Financing and Sustainability

Costs and sustainability are ongoing challenges for all of these schools when attempting to bring in new, complex resources such as ICT. These schools attempt to do two things to manage sustainability of their ICT activities: first, they try to obtain resources from as many sources as possible, and second, they try to control the costs related to ICT activities.

All of the successful schools utilize multiple strategies to obtain funds or ICT resources. There are three basic sources of funding the schools rely on. First, all three countries now have government programs that provide an infrastructure to support these schools. But a second critical source is the community: These successful schools have developed good relations with the surrounding community, and the communities value the ICT initiatives of the school. The schools also received support from companies, such as Intel, which sometimes donate computers or other resources. Finally, some schools had their own small sources of revenue from school concessions, such as a school café, or from fees.

These schools also attempted to control other costs associated with ICT, such as ink, paper, and peripherals. Some schools limited the amount of printing students and teachers could do. And for class projects like printing a booklet or making posters, schools sometimes required that students purchase the paper. Not all schools had peripherals available, such as digital cameras or scanners, and some principals reported that this was a due to cost factors.

Changes to the classroom learning environment

The previous section discussed the common factors across all six schools that supported teachers and schools in making change, here we address the changes that are emerging in classrooms after the Essentials Course, given the diversity in local contexts. Turkey, India, and Chile represent three different regions of the world; each country has a different history, different education system, and different challenges, yet from our case studies of the six schools, we identified four common dimensions of change that are emerging to support more project-based and ICT-rich activities in the classroom: changes in teachers' knowledge, beliefs, and attitudes; changes in how students engage with content; changes in relationships among teachers, students, and parents; and changes in the use of ICT tools to promote students' learning.

1. Changes in Teachers' Knowledge, Beliefs, and Attitudes

Because all schools in the study were considered successful, we explored what teachers had changed in their own practices. In the interviews, we asked teachers to discuss what they had learned from the Essentials Course that was useful for their classroom practice. Three themes emerged across all six schools as the teachers spoke about what they found to be valuable for their teaching: (a) their beliefs about how students learn were shifting; (b) they had a deeper understanding of new teaching strategies; and (c) they had improved their knowledge of how to use ICT as a learning tool, as well as strengthening their ICT skills.

a. Teachers' beliefs shifted to a constructivist paradigm of teaching and learning. Teachers expressed a growing belief that students could learn through exploration and discovery. The Essentials Course and, more importantly, the experience of implementing a project-based or ICT-rich learning activity appeared to influence teachers' understanding of how children learn. The interviews suggested the teachers began to value learning as different from memorization and to see that students could learn by exploring content, conducting research, and applying knowledge to real problems.
In all six schools, teachers also expressed their belief that students learn more than just content with projects and Internet research. Many teachers recounted what they did "before" and "after Intel," and their descriptions consistently included how students "learn more deeply," "have more confidence," and "are more motivated" by the new ways of learning. They reported that students were developing skills and attitudes such as self-assurance, curiosity, collaboration and teamwork skills, presentation skills, and organizational skills.

b. Teachers deepened their understanding of student-centered practices. Teachers reported improving their skills with innovative teaching practices. Although some countries had more experience than others, across the board, nearly all the teachers we interviewed valued project-based approaches and reported doing projects with their students. Teachers had very clear ideas about how project-based approaches could support student learning by allowing students to explore content as they respond to a research question or problem posed by the teacher. They felt the project approaches made the content more relevant to students and required greater intellectual effort for students to find and synthesize information, which led to students learning and retaining more information.

While teachers from all three countries agreed that the Essentials Course supported their use of student-centered practices, each country's context and educational goals influenced which topics were of most interest to teachers. For example, while all the teachers spoke about using group work and collaborative learning, the teachers in Turkey were very excited about the collaboration strategies presented in the Essentials Course. Turkey's traditional approach to teaching is lecture-based and emphasizes individual student activities, and teachers reported that they did not have any previous experience with collaborative learning. Group work and collaboration are, however, part of the new Turkish curriculum and reform efforts, and teachers expressed appreciation for how the two programs supported each other.

In India, teachers found the "Essential Questions" strategy to be compelling. Essential Questions (e.g., Why do we need others?) are intriguing, open-ended questions that organize a project and are an effective way to encourage students to think deeply and to provide them with a meaningful context for learning.[8] The Indian curriculum is very demanding and the school day is crowded, so teachers felt that they could not easily integrate project work into every class. While they could not do projects during the class

[8] Wiggins, G. P., & McTighe, J. (1998). *Understanding by design*. Alexandria, Va.: Association for Supervision and Curriculum Development.

period, they were, however, exploring the use of questioning strategies to push students' critical thinking and to allow students to share their perspectives and formulate their own conceptual understandings of the content.

In Chile, where schools had previous experiences doing projects, teachers focused on the use of rubric assessments presented in the Essentials Course. The teachers were facing increasing challenges in assessing students' work as the school moved toward complex, technology-rich student products, such as presentations and websites. Through these products, students mastered more than just content, and teachers wanted to value all aspects of students' learning and rubrics are designed to capture the range of skills, attitudes, and content that students develop.

c. Teachers improved their ICT knowledge and skills. Teachers reported that they had developed the skills needed to initiate or increase the use of ICT with students. Regardless of they were new to ICT or experienced ICT users, all teachers we interviewed who took the Essentials Course reported they increased their knowledge of how to use ICT as an educational tool. The strategy of having teachers design a model unit of their own choice appears to allow teachers to work on skills and areas that are new and challenging for them.

2. Changes in How Students Engage with Content

The introduction of ICT into schools and the use of project-based approaches and Internet research have changed how students interact with the content in a number of ways. In the site visits, teachers and students spoke about three types of new learning activities that would, according to the literature, contribute to a constructivist learning environment: (a) learning through projects, (b) conducting Internet research, and (c) connecting school content to students' lives.[9]

a. Project-based work gave students a chance to collaborate, use multiple resources, and direct their own learning. In all the schools, student projects were fundamental to bringing student-centered instructional strategies into the classrooms. The Essentials-trained teachers we interviewed spoke of doing projects with their students. Despite variations among project designs, a few core features emerged. In almost every site, projects gave students chances to work collaboratively and challenged them to take on new roles and responsibilities; students worked in groups and often had to coordinate efforts to complete the projects. Also, all of the projects described included research and culminated in a final product that required students to synthesize and share what they learned.

b. Independent Internet research gave students autonomy and a chance to develop and share their own perspectives. Internet research was a constant theme in these schools. Teachers, students, and parents all spoke about having students do Internet research for

[9] Windschitl, M. (2002). Framing constructivism in practice as the negotiation of dilemmas: An analysis of the conceptual, pedagogical, cultural, and political challenges facing teachers. *Review of Educational Research, 72*(2), 131–175.

homework and as part of the projects. Teachers often asked students to bring in additional information on topics in the textbook, or to research additional topics or themes.

c. Connecting school content to students' lives made learning more meaningful to students. We found that many of the projects teachers designed connected students' school work to their home life and their community. In a very simple sense, the increased use of practices such as open-ended questions and group work allowed students to share the perspectives and knowledge they bring from home. Yet many of the project topics also engaged students in examining real-world issues or concerns that gave them an opportunity to connect "school learning" with the real world and allowed them to develop their own opinions and perspectives about the issues. For example, students did projects on clean water and public health or collected stories and images from the community to publish in a booklet for their families.

Our interviews with parents in the Indian and Turkish sites also supported the perception that students were becoming a source of new information for their families. Parents credited their children's increased use of Internet research with providing them with current information to which they would not otherwise have had access. Students are generally more excited by information they find themselves than the contents of a textbook, and parents reported that their children were rushing home, eager to share what they had discovered.

3. Changes in Relationships among Teachers, Students, and Parents

In keeping with the new activities and roles for students, the teachers and students in the schools we visited reported that they were transforming how they interacted. The changes in teaching practices in these schools are part of a broader change in relationships within the school and between the school and the community. The educators and students described changes in the ways they collaborated with each other that grew out of the new teaching practices (e.g., project-based approaches, open-ended questions), integrating ICT into the schools (e.g., Internet research or presentations), or both. We noticed that teachers, students, and parents reported changes in three sets of relationships: (a) among the students; (b) between students and teachers; and (c) between the school, the parents, and sometimes the community.

a. Projects and ICT activities fostered collaborative relationships among students. Many of the teachers and parents interviewed said that students were developing a range of social and interpersonal skills that they attributed to the projects and the new roles that students were taking on. As noted, students in every school were taking on new responsibilities as they worked on projects—leading teams; conducting research; writing reports; debating with peers; and making presentations to peers, teachers, and parents.

b. New teaching strategies allowed teachers to develop more collaborative and interactive relationships with their students. The teachers reported that, as their teaching practices changed, their relationships with their students also became more open and supportive. Teachers began to allow more intellectual discussions between themselves

and their students, and students were more willing to approach teachers and share concerns and opinions.

c. Innovating with projects and ICT strengthened the relationships between the school, parents, and the community. The parents we interviewed were excited by the introduction of community-focused projects and student research, and they expressed pride in what the schools were doing for their children with technology. Parents and the community frequently initiated efforts to bring additional ICT resources to the schools by donating equipment or paying for improved Internet connections.

However, the parents also remarked on the new teaching practices and what these changes meant for their children. All of the parents we interviewed commented on how the school was developing the whole child since the project work was supporting teamwork, independence, and self–confidence. Parents highlighted their children's growing confidence and independence to do research or make public presentations, and they also noted the caring relationships between students and teachers.

4. Changes in the Use of ICT Tools to Promote Students' Learning

A core aim of the Essentials Course and a central objective for the ministries in Chile, Turkey, and India is to encourage the use of ICT as a learning aid for students. Although the administrators and teachers we interviewed in all six schools told us they wished they could do more, to the extent permitted by resources, space, and time, students were using ICT for learning activities. PowerPoint presentations and Internet research were, by far, the most common ICT tools that students used.

All six schools promoted student use of ICT, but each adopted different strategies to realize its goals. In Turkey and India, with short school days and tight schedules, the teachers had to strategically make time—either by working outside of class or rationing access—for students to complete their ICT projects. The Chilean teachers had more flexibility to schedule lab time during school hours, although they also did afterschool activities. Perhaps the clearest change is that, in all six schools, teachers gave students Internet research activities for homework.

Conclusion

This paper presents the findings about the nature of the changes taking place in the classrooms in these six schools and the factors that enable the schools to make these changes. Since the governments point to these schools as positive examples, their experiences can help contribute to an understanding of the process of integrating ICT into the schools of developing countries.

While some educators we observed are more skilled than others, and some changes in practice are just emerging, all six schools are making changes beyond just the use of new tools. The teachers are developing new beliefs about teaching and improving their knowledge of new practices; their students are engaging with content in new ways; and the relationships between teachers and students are changing relationships. And, both

groups are using new ICT tools to support learning. That three of the four common dimensions of change are pedagogical shifts, and that they are changes in pedagogy that are supported by the ICT, illustrate the paradigm shifted required for effective ICT integration.[10] These findings illustrate the complex sets of changes that have to occur for ICT to be deeply and meaningfully used to support student learning. This would explain why technology integration is so difficult to achieve but also points the way forward.

Our findings suggest that necessary changes are much broader than just the introduction of a new tool or one new practice. Instead, change begins by deeply reshaping life in the classrooms—from educators' beliefs about learning to the relationships that make up the school community. In each context, the teachers found points of engagement between the model of ICT use and teaching in the Essentials Course and the possibilities and limits of their context. For Indian teachers, it was most feasible to integrate aspects of the teaching model (i.e., open-ended questions) into their classroom and the ICT into after-class time. In Turkey, schools brought ICT activities into scheduled lab time and group work into their class activities. And Chilean teachers used holistic assessment strategies and inquiry-based projects in class because their school day provides a block of time for projects.

But the responsibility for change cannot rest solely on the shoulders of the teachers—bringing about these changes is a long-term, incremental process. There are a broad range of factors from leadership to funding to effective professional development that help create and sustain the conditions for change. Effective reform requires sustained investment and support along multiple dimensions of the educational system, including physical and technical infrastructure, human resources, curricular frameworks, standards, and assessments. In the end, the success of teachers is dependent on the conditions in which they work. If those conditions foster innovation and change, then teachers will be able to use a program like the Essentials Course to change the classroom learning environments they offer their students.

[10] Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How People Learn: Brain, Mind, Experience, and School: The Expanded Edition*. Washington, DC: National Research Council/ National Academy Press; ; Hepp, Hinostroza, Laval, & Rehbein, 2004.

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Introduction

The Intel® seeks to be a partner to national governments in creating modern, high-quality educational systems worldwide. This report presents findings from Education Development Center, Inc.'s (EDC's), examination of the impact of the Intel® Teach Essentials Course on the learning environments in schools in three developing countries: Chile, India, and Turkey. The Essentials Course, a professional development program that offers teachers the knowledge and skills to integrate information and communication technologies (ICT) as critical tools to encourage active student learning, is a core component of Intel's efforts. With the collaboration of ministries of education around the globe, Intel has offered the course in more than 30 countries and, by 2008, more than 4 million teachers worldwide had taken the course.

Understanding how technology fits into the complex realities of classrooms was a critical factor in creating real change in the industrialized nations,[11] yet little is known about educational technology projects in the classrooms of the developing world. This study examines the question of how schools and teachers have been able to integrate ICT and what they might have learned from the Essentials Course into their schools and classrooms. To this end, EDC and our research partners (see page 2) in each country conducted site visits to two schools that are considered to be "good examples" of using the Essentials Course to create change in *their* contexts. In all three countries, we found that the educators we interviewed felt they had been able to implement both new ICT activities and new teaching approaches with their students after the course. Additionally, we consistently found that no single factor or program accounted for these schools' ability to move forward. Instead it was a combination of programs and policies coupled with the motivation and skills of the educators in each building that enabled the schools to innovate. The ICT activities and teaching approaches that teachers applied to their work with students varied, however, due to differences in each country's broader educational context.

This project addressed two research questions regarding the impact of the Essentials Course on learning environments in a diversity of national contexts.

- **Changes in the learning environment.** Within each context, how are teachers able to follow up on the training with their students in their classrooms and in their schools?

[11]Cuban, L. (1993). *How teachers taught: Constancy and change in American classrooms 1890–1990*. New York: Teachers College Press; Honey, M., McMillan Culp, K., & Carrigg, F. (2000). Perspectives on technology and educational research: Lessons from the past and present. *Journal of Educational Computing Research, 23*(1), 5–14; Somekh, B., Lewin, C., Mavers, D., Fisher, T., Harrison, C., Haw, K. et al. (2003). *ImpaCT2—Pupils' and teachers' perceptions of ICT in the home, school and community*. London: British Educational Communications and Technology Agency.

- **Supporting change at the school-level.** What are the factors that facilitate teachers' ability to follow up on the training with their students?

EDC decided that a case study approach of "successful schools" would be most informative at this early stage of emerging knowledge of the use of ICT in classrooms of developing countries. This allowed the research team to understand what teachers are actually able to do with their students in typical schools in each country, to talk with teachers about which aspects of the training were useful to their practice and why, and to learn more about the factors in each context that have helped these schools begin to integrate ICT tools into their educational programs.

The Intel Teach Essentials Course

The core of the Essentials Course curriculum focuses on preparing teachers to integrate ICT across the curricula as a tool for learning, and to design and implement inquiry-driven, project-based learning activities. The program uses a train-the-trainer model in which Senior Trainers (STs) train Master Teachers (MTs) based in local districts or schools who run the course with Participant Teachers (PTs). The standard version of the course is 10 modules over 40 hours, but some countries have expanded the duration of the course (i.e., 60 hours) or have added extra modules before or after the course in response to local needs. However, none of the countries have removed content from the course.

The Essentials course is constructed around known attributes of good professional development, such as focusing on issues that are directly relevant to teachers' everyday work, offering a well-defined concept of effective learning, and offering opportunities for teachers to develop knowledge and skills that broaden their repertoire of teaching approaches.[12] The Essentials curriculum guides teachers through a process of developing a complete unit plan using a project-based approach and ICT activities for their students. The implementation in the classroom of the unit plan that teachers designed during the course is a key feature of quality professional development since it allows teachers to experience and value the new teaching approaches.[13] The course presents the idea of using an essential, or guiding, question to guide students' inquiry and exploration of a given topic and asks teachers to build a unit plan using an essential question. The course guides teachers in using ICT for student research. As a final product students should create a technology product to share their findings. The Essentials Course uses commonly available software, focusing primarily on how to use word processing software and presentation software to support students in creating presentations, Web pages,

[12] Garet, M., Porter, A. C., Desimone, L., Birman, B., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*(4), 915–945; Kennedy, M. (1999). Form and substance in mathematics and science professional development. *NISE Brief, 3*(2), 7; Loucks-Horsley, S., Stiles, K., & Hewson, P. (1996). Principles of effective professional development for mathematics and science education: A synthesis of standards. *NISE Brief, 1*(1), 7.

[13] Guskey, T. R. (2002). Professional development and teacher change. *Teachers & Teaching, 8*(3/4), 381–391.

brochures, and newsletters. The course design allows teachers to expand their technical skills in the context of a curriculum development process. The Essentials' curriculum also discusses crucial factors for creating high-quality, student-centered learning environments, including the classroom management issues associated with using technology with students, conducting research on the Internet, and assessing students' technology-rich work products.

Methodology

EDC used qualitative data collection strategies to examine the experiences of successful schools, supplemented by available secondary literature to understand common practice in each country and set the context. EDC used an instrumental case study approach. In an instrumental case study, the analytical focus is on identifying underlying factors and patterns that can be generalized beyond the case study[14] to inform, in this instance, a broader discussion on technology integration and education reform. The cases are selected to represent the desired outcome. For this study, the schools were selected because of the strides they have made in integrating ICT and innovative teaching practices into their classrooms. We conducted case studies of two schools in each country, for a total of six schools across the three countries: Chile, India and Turkey. At each school, we interviewed the principal, the technology coordinator or the Intel Master Teacher (MT), technology-using teachers, students, and, whenever possible, representatives of the parents. Classroom observations of both typical classrooms and students engaged in the computer lab or ICT activities complemented the interviews.

Selecting case study countries and schools

We selected Turkey, India, and Chile for the study because each country represents a mature implementation of the Essentials Course, and the countries represent three different regions of the world. Additionally, each country has strong local evaluation teams that have already conducted local evaluations of the Essentials Course.[15] This last factor was important, as EDC sought to conduct all of the field research in collaboration with the local evaluation teams.

To identify a sample of exemplary schools, we used an intentional sampling strategy. We requested that the local training agency, the ministries, and the Intel Education Managers in each country compile a list of schools with teachers that had taken the Essentials Course at least two years ago and that fit their own criteria for success. We asked that they exclude schools with privileged access to resources, technology, or funds. *Success* was defined by the local stakeholders to represent what they felt would be reasonable

[14] Stake, R. E. (1995). *The art of case study research*. Thousand Oaks: Sage Publications.
[15] Aydin, C. H., Ataizi, M., & Çalişkan, H. (2007). The Intel® teach essentials course turkey evaluations: October 1, 2006–March 30, 2007 (pp. 17). Eskisehir, Turkey: GLOKAL; IMRB International. (2005). *Intel® Teach to the Future (India) Program Report: An understanding of the programme* Mumbai, India: Author; Teacher Foundation. (2005). A comparative study of ICT leadership in schools: A case study of 4 government-aided schools in Gujarat (pp. 143). Bangalore: Author; Educational Computer Institute. (2003). Final report Intel® teach to the future project evaluation. Temuco, Chile: University of La Frontera.

expectations for schools and teachers in their country. Based upon these lists, we asked the training agencies and the ministries to identify the schools they considered to be model schools—those they held up as examples for other schools. From the list of schools, the research team made a final selection of two schools in each country. During the field work, we collected data at each school over a two- to four-day visit. We conducted semi-structured interviews with school leaders and participating teachers, and convened focus groups with students and parents, when possible.

India: Given the context of India's educational challenges, EDC sought to identify schools that were attempting to change both teaching practices and the use of ICT with students. To identify a sample of exemplary schools, the Learning Links Foundation and Intel put together a list of eight schools across India that best exemplified the goals of the Essentials Course in India and, given the context and possibilities in India, fit their own criteria for success. The list contained both government-funded and private schools. Some schools were English-medium, meaning they taught in English, and others taught in local language. The research team made the final selection. The schools selected were the Ashok Nagur campus of the Children's Academy in a middle-class neighborhood of Mumbai, and the Fatehpura Anupam Primary School in the Gujarati village of Fatehpura. The Children's Academy is an English-medium private school from pre-kindergarten (pre-K) to Grade 10, and Fatehpura is a Grade 1 to 8 Gujarati-medium public school.

Chile: The Ministry and the Pontificia Universidad Católica de Chile in Santiago, which oversees the program nationally, and the Intel Education Manager met with the local evaluation team to generate a list of schools that met their terms of success and were "typical" Chilean schools. The local evaluation team reviewed the list to make the final selections. The schools selected represented a government-subsidized private school in a lower middle-class neighborhood of Santiago Chile and a small municipal school in a rural town. The private school, Colegio El Sembrador, has students from pre-K through Grade 12, and the village school, Escuela Pedro Aguirre Cerda, goes from pre-K through Grade 8.

Turkey: The Intel Education Manager worked with the local evaluators and EDC to discuss selection criteria, considering issues of location, size, and level. The Education Manager consulted with the STs and provincial directorates of education to develop a list of potential sites, and the final selection was made by the Turkish evaluation team. Both schools are public schools serving students from kindergarten (K) to Grade 8. Burak Reis School, in an outlying neighborhood of the national capital Ankara, is in dense urban environment. The second school, Mustafa Kemal School YIBO, is a public school in the small city of Çorum. This school serves neighborhood children and has a population of female boarding students who come in from the villages in the province.

The research team

To conduct the study, EDC took a collaborative approach and partnered with local research groups in Chile and Turkey. In Chile, EDC collaborated with researchers from the Centro Costadigital at the Pontificia Universidad Católica de Valparaiso. In Turkey,

EDC teamed with GLOKAL Research Consulting in Eskisehir, Turkey. Unfortunately, the arrangements for a local research partner in India fell through.

EDC developed the site visit protocols, and Centro Costadigital and GLOKAL Research reviewed and localized the protocols. Teams of local researchers and EDC staff conducted the site visits in the two countries. The Chilean visits were carried out entirely in Spanish, and the Turkish visits were conducted in Turkish and English, with the local research team providing translation. Due to the lack of a research partner in India, one visit was all in English, and EDC conducted the other case study in Gujarati and English, with the help of a graduate assistant from a local school of education who served as translator.

Data Collection

For each case study, we conducted interviews, focus groups, and observations with relevant stakeholders (see Tables 1–3). In every school, we interviewed school administrators, teachers, technology coordinators, students, and the MT or ST who supported the Essentials Course. Other stakeholders might include parents and local officials, but the stakeholders varied somewhat in each case depending upon who were the relevant stakeholders in each location. For example, in the village schools, we spoke with the local elected officials who played a more central role in school-level decisions in small communities. But in large urban areas, the elected officials played a less direct role in the life of the school.

We also observed classes in each school. We asked to observe standard classrooms as well as the computer lab, if possible. Furthermore, we asked the school to identify some of their best or most innovative teachers because we wanted to see what the best teachers were able to do in each context.

Table 1: Data Collected in the Indian Case Studies

INDIA				
Children's Academy	**Interviews**		**Focus Groups**	**Observations**
	Leadership	Principal (1) Trustee (1)	Parent (14) Student (37)	English-Grd 8 History-Grd 8 Math-Grd 6 Science-Grd 5
	Teachers	ICT (1) Subject area (4)	Teachers (12)	
Fatehpura Primary	**Interviews**		**Focus Groups**	**Observations**
	Leadership	Principal (1) Sarpanch (1) Anupam Coord. (1) State Coord. Intel (1)	Students (5) Parents (3)	Grd 1 Grd 2 Math-Grd 4 Science-Grd 4 Science-Grd 7 Student presentation
	Teachers	ICT (1) Classroom (2)		

Table 2: Data Collected in the Chilean Case Studies				
CHILE				
Colegio El Sembrador	**Interviews**		**Focus Groups**	**Observations**
	Leadership	Principal (1) Head of UTP (1)	Students (7)	ICT Lab-Grd 5 ICT Lab-Grd 7 Soc. Studies-Grd 6 History Grd 10
	Teachers	Classroom (2) Subject area (1)		
Escuela Pedro Aguirre Cerda	**Interviews**		**Focus Groups**	**Observations**
	Leadership	Municipal Director of Education (1) Municipal UTP (1) Principal (1)	Students (5)	Grd 1–2 ICT Lab-Grd 3–4 ICT Lab-Grd 5–6
	Teachers	Classroom (2)		

Table 3: Data Collected in the Turkish Case Studies				
TURKEY				
Burak Reis	**Interviews**		**Focus Groups**	**Observations**
	Leadership	Principal (1) Tech. Coord. (1)	Students (5) Parents (3)	Language-Grd 5 ICT Clsrm-Grd 5 Math-Grd 6
	Teachers	Classroom (5) Subject areas (3)		
Mustafa Kemal YIBO	**Interviews**		**Focus Groups**	**Observations**
	Leadership	Principal (1) Provincial Secretary of Education (1) Head of School-Family Union (1) Essentials ST (1) Tech. Coord. (1)	Parents (5) Students (19)	Grd 1 Tech&Design-Grd6 Soc. Studies-Grd 7 Math/ICT Lab-Grd8 Science-Grd 8
	Teachers	Classroom (4) Subject areas (3)		

Analytical Framework

A large body of research from various countries has identified a number of common factors shared by projects that successfully integrate ICT into educational programs. While the exact number of key factors may vary from one writer to the next, multiple studies have underscored the importance of a minimum core group of factors. Our analytical framework focused on examining seven of these most commonly cited factors to help understand the case studies: pedagogical objectives and goals; leadership; professional development and ongoing support; experimentation, adaptation, and critical reflection; time; infrastructure; and financing and sustainability.[16]

[16]See Ely, D. (1990). Conditions that facilitate the implementation of educational technology innovations. *Journal of Research on Computing in Education, 23*(2), 298–305; Fullan, M. (1991). *The new meaning of educational change*. New York: Teachers College Press; Hawkins, J., Panush, E. M., & Spielovogel, R. (1996). *National study tour of district technology integration summary report* (CCT Reports No. 14). New York: Center for Children and Technology; Kozma, R. (Ed.). (2003). *Technology, innovation and*

1. Pedagogical Objectives and Goals: Although specific objectives and goals vary, the research suggests that clear goals and objectives drive effective ICT integration. These must expand beyond the integration of technology to include a strong pedagogical vision of how to best support student learning. The majority of successful projects have clear and consistent messages concerning the role of ICT in their programs and in education. In all cases, technology is viewed as a tool for transforming education and fulfilling long-term educational goals In addition, in most cases, educators can express their goals in very clear and practical ways. For example, they talk about improving reading and writing, enhancing technological skills, creating opportunities for research, or involving their community in projects.

2. Leadership: Leadership at various levels of the system is important if an innovative project is to take root and grow. In our research, we focused particularly on leadership within the schools. If a project is to succeed, there must be a person who takes the initiative for directing it. Leadership requires a pedagogical vision that recognizes the essential elements of sound education and that understands the role that technology can play in advancing educational goals. The literature suggests that in many successful projects, technology is used as a means for improving the educational experience, but it is never the final objective.

3. Professional Development and Ongoing Support: Teacher training—in both technical and pedagogical terms—is consistently cited in the literature as one of the most important factors in effectively integrating ICT into classrooms. Training and ongoing support allow teachers to acquire new skills and introduce new practices and teaching strategies. In the best cases, professional developers provide training and support that give teachers hands-on experience with a project's specific activities. Moreover, a successful school will sometimes adopt training strategies based on experiences within the school and the community—tailoring professional development to fit the local context.

4. Experimentation, Adaptation, and Critical Reflection: Another strategy that appears in the literature on successful integration projects is to begin on a small scale and experiment. On a national level, this may mean doing a pilot project in a small number of schools. But there is also an important corollary at the school level in order to create real change in the classroom. The professional development literature underscores the importance of each teacher being able to experiment with new tools and approaches and reflect on that experience as they integrate these new tools and practices into their everyday activities.[17] Every small step provides an opportunity to examine and assess

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educational change—A global perspective. A report of the second information technology in education study: Module 2. Eugene, OR: ISTE; Light, D., & Manso, M. (2006, April). *Educational technology integration in developing countries: Lessons from seven Latin America SchoolNets*. Presentation at the Annual Meeting of the American Educational Research Association, Seattle; McMillan Culp, K., Hawkins, J., & Honey, M. (1999). *Review paper on educational technology research and development*. New York: Center for Children and Technology; Pérez, P., Light, D. et al. (2003). Learning from the pioneers: A study on the best practices of the network TELAR. *Interactive Educational Multimedia, 6,* 17–39.

[17] Guskey, T. R. (2002); Guskey, T. R., & Kwang Suk, Y. (2009). What works in professional development? *Phi Delta Kappan, 90*(7), 495–500.

progress—identifying the positive elements, revising the negative ones, and refining plans and activities based on findings from the experimentation.

5. Time: Much like a physical resource, time is a scarce resource that education systems must carefully manage. Teachers need time to learn and manage ICT activities—which often involves mastering new pedagogy and practices. Students need time to explore and experiment with the many applications of ICT. Thus, time needs to be viewed in two dimensions: (1) teachers' professional development and planning time and (2) students' classroom or learning activity time.

6. Infrastructure: The educational infrastructure—the systems and resources that support teaching and learning—is often a challenge for schools in developing countries. But within the complex challenge of providing resources for the schools, three elements—equipment, connectivity, and access—are especially critical to the successful integration of ICT into educational programs.

7. Financing and Sustainability: Schools must have adequate funding to acquire, maintain, update, and upgrade the infrastructure. In addition, ICT projects also have other costs for supplies, such as paper, toner, and ink.

India

The Context of Indian Education

In India, the government and education leaders are investing substantial resources and undertaking widespread reform efforts to confront the daunting and significant challenges they face. Since its independence in 1947, barely over 60 years ago, India has had to confront complex deficiencies in the education system left by British rule. At independence, the literacy rate was 18 percent overall and 9 percent for women, and the vast majority of children lived far from a school.[18] As the Indian government strives to expand access to education and enhance the quality of education, they must simultaneously address these inherited deficiencies.

India's education policies have primarily focused on fulfilling the promise enshrined in the Constitution of 1950 to provide free education to all children under the age of 14 years. Towards this goal, most of the country's rural areas now have schooling facilities within a radius of one kilometer and primary enrollment is at 90 percent.[19] However the government continues to address problems of access, quality, quantity, utility, and financial outlay over the years is substantial.

India has two parallel systems that govern education in the country: boards of education managed by each individual state and a board managed by the central government. Private schools decide which board to follow, but government-aided schools generally adhere to their state boards. Most decisions are made at the top most level of the board, and each board establishes curricula, textbooks, examinations, the basic structure of the school day, and policies guiding expectations for students and teachers. The state boards establish curricula in the state's languages, and a few states also establish English-medium curricula. In addition, a nationwide Central Board of Secondary Education (CBSE) offers a common curriculum in English for schools anywhere in the country. The national Department of Education has attempted to promote change towards a student-centered learning environment by putting in place policies that require minimum content, student competencies, and life skills.[20]

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[18]Govinda, R. (2002). Providing education for all in India. In R. Govinda (Ed.), *India education report* (pp. 1–11). New Delhi: Oxford University Press.

[19] UNESCO Institute for Statistics. (2006). Country-Regional Profiles: UNESCO; Mehta, A. C. (2004). Retrieved August 18, 2006, from http://www.educationforallinindia.com/.

[20]India's guiding educational policy is set out in the National Policy on Education (NPE) of 1986 and the Plan of Action (POA) of 1992. The NPE 1986 provides for a comprehensive policy framework for the development of education up to the end of the century, and POA 1992 assigns specific responsibilities for organizing, implementing, and financing education. National Policy on Education of 1986 (Retrieved August 18, 2006, from http://education.nic.in/NatPol.asp); University Grants Commission. (2005). *Plan of Action, 1992*. Retrieved August 18, 2006, from http://www.ugc.ac.in/index.html.

The Intel Teach Essentials Course in India

Within this context, the Intel Teach Essentials Course serves as a reform program that offers teachers professional development in using ICT to support student-centered, project-based learning activities. The Essentials Course in India follows the basic structure as the international program. In India, the nonprofit Learning Links Foundation (www.learninglinksindia.org) oversees the program throughout the country in the participating states. Once Intel and the state governments create an agreement to implement the program in a state, Intel and Learning Links Foundation adapt and translate the Essentials materials into the appropriate languages and train the STs to start the program. Learning Links appoints a program manager to oversee the program, coordinate trainings, and promote the program among schools in the state. The state program managers are often STs from the program to ensure they have deep practical knowledge of both the program and the challenges teachers encounter during integration.

One important extension of the Essentials Course in India is the establishment of the Facilitation Process to support Participant Teachers (PTs) in implementing the units that they create during the training. In India, the Facilitation Process is divided into seven implementation phases, where MTs and PTs receive support on a variety of topics, from helping MTs train PTs to making an implementation plan for PTs to sustaining implementation.

The Indian Case Studies

Case One: The Children's Academy, Mumbai, Maharashtra State

The Ashok Nagar branch is one of three schools that are part of the Children's Academy. The Children's Academy is a nonprofit educational trust serving a middle-class neighborhood in Mumbai (formerly known as Bombay), one of India's wealthiest cities. Although not a wealthy school, the school's students consistently win top honors in the various regional competitions for academic excellence. According to a current Trustee, the school was established by his father in 1970, a teacher and former school inspector, who was dissatisfied with the poor quality of teaching in public schools in India and set out to establish a school for middle-class children that used the most "modern" teaching strategies. In his day, this meant teaching aids such as pictures, globes, and manipulatives for students to do hands-on work. But now the school seeks to engage students in projects and more authentic activities.

The Ashok Nagar campus is in a new eight-story building with a parking area and a children's play space enclosed by a cement wall located in a crowded middle-class neighborhood. Within the entryway of the school, there is a large room with a simple stage used for assemblies and performances. There is one canteen for teachers and staff and another one for students, which provides inexpensive home-cooked food, candy, and snacks. The primary students have a playground on an upper-floor courtyard. The secondary students play in the parking lot in front of the school.

The school has about 2,000 students from pre-K to Grade 10, and the average class size is about 60 students. Each class of students takes all subjects together as one cohort; they are in the same classroom all day, and the different subject teachers come to them. The school day is five hours long, from 7:30 a.m. until 12:30 p.m., but the school is open to students all day. There are seven lesson periods in a day—each period lasts only 35 minutes—and students have five or six class periods, a period for lunch, and some students may have one free period. By the upper grades, the students have a very full schedule with 11 compulsory subjects. Students are required to study three languages (English, Marathi, and Hindi), social studies, math, science, environmental science, ICT, personality development, the arts, and health/physical education.

Although the Children's Academy currently belongs to the Maharashtra State Board of Education, they are in the process of changing to the Central Board of Secondary Education (CBSE).

ICT at Children's Academy

Every classroom in the Children's Academy has a large TV hanging to one side of the blackboard, and the TV is connected to a computer station on the teacher's desk. The TV is used to show videos and PowerPoint® slide presentations related to the content of lessons. There are two computer laboratories, each with 60 computers. Additionally, there is a computer in the library and three computers in the teacher's room. The school principal and the administration also have computers, and the school uses a management information system (MIS) for school data. The computer lab and the teacher's room are connected to the Internet, and the school has two broadband connections to guarantee consistent access to the Internet.

Students have two computer classes per week: For one period, the students learn computing and software; in the other period, the computer teachers help students do work assigned by the subject teachers. In addition to the ICT activities that students undertake in their computer course, they participate in a number of common ICT activities in their free time related to their content courses. The three most common uses for ICT that teachers and students spoke about were for students to do Internet research and to make multimedia presentations as part of projects and club activities, and for teachers to design presentations and use the visual materials provided by the government. Most of the activities are done on the computer and projected, and the school tries to keep printing to a minimum. For example, students doing a research report will handwrite the report but print off pictures and graphics to paste into the report. This may be partly for cost concerns, but also because of the view that students need to "do the hard work" of handwriting things.

The subject area teachers feel they have open access to the lab whenever they need it. One teacher commented that, unlike in other schools, they could access the lab whenever needed, and teachers were allowed to use the Internet freely. In other schools in India, teachers often need permission to use the computer lab, as well as permission to use the

Internet. The school also extended this trust and openness to students. A group of recent graduates we interviewed from the school said they had access to the computer lab at the school around the clock—24 hours a day, all day. This helped them work on collaborative projects with peers because they could just meet at the school.

Technology has also played a key role in expanding the nature and quality of teaching resources that teachers bring into the classroom, breaking down the traditional reliance on a single textbook. The teachers reported that ICT was a rich source of visual aids and examples to help them clarify complex topics to students and present material in multiple ways to support students' comprehension and engagement. Most teachers reported that PowerPoint was their favorite technology tool and, when asked to describe a favorite lesson, they always shared an example of multimedia to support a lesson. A physics teacher said he tries to use ICT resources to help students understand the more abstract concepts. According to him, he and the other teachers are always looking for new lesson ideas and new materials. The computer teachers also reported helping their peers research new teaching aids and approaches.

Intel Teach Essentials Course at the Children's Academy

The school leadership credits the Essentials Course with being a key moment in the evolution of their use of technology and of project-based learning with the students. The Children's Academy was one of the first schools in India to participate in the Essentials Course in 2000. Intel approached the Children's Academy to be part of the initial pilots through a business contact who knew of the school. The Trustees and the Head Mistress both described Intel approaching the school as a surprise. Back in 2000, at the time of the initial Intel training, the school offered computer courses but did not view technology as a tool for learning in the other content areas.

Intel asked the school to send teachers to be trained as MTs in the program. The current Head Mistress of the Ashok Nagar branch of the Children's Academy was a math teacher at the school, and the Trustees asked if she was interested in taking the Essentials training to become an MT. Although she had never taught with computers prior to the training, she was interested in the opportunity and signed up for the 21-day training. The Head Mistress won an award from Intel for her unit plan.

The Head Mistress was so excited after the training that she trained all the teachers at the school in the Essentials Course. Two key messages that she took from the training were that students could use technology to create their own products and the Intel training offered strategies to do group work and project-based activities. Other teachers said they learned that they should ask students open-ended questions from the Essentials Course.

The Children's Academy uses both formal and informal strategies to support teachers' professional growth in the use of ICT. First, all the teachers have gone through either the formal Intel Essentials Course or have been mentored in ICT use by a fellow teacher. After the initial training of the Head Mistress as an MT back in 2000, the school quickly trained every teacher in the building. Since then, they have continued to send new

teachers to be trained whenever possible. In fact, the school has just finished training in the new Essential Version 10 course.

The learning environment in the classrooms of the Children's Academy

During our visits at the Children's Academy, we were able to observe four classes: Grade 1 Science, Grade 6 Math, Grade 8 History, and Grade 8 English. We also interviewed 17 teachers and 31 students. All of the classrooms we visited had similar layouts and resources. Each room had rows of 2-pupil desks facing a chalkboard, with a teacher desk and computer and, as noted, a TV monitor hanging from the ceiling.

According to the Head Mistress, the school began to rethink the vision of teaching and learning after the Essentials course. After participating in the Essentials Course—where they encountered different approaches to teaching that support distinct educational visions—the leadership felt the school's mission needed more specificity. They also believed that the school needed to come to a decision about the "best practices" they wanted to pursue to realize its vision. The school's brochure states "Children's Academy aims at providing the infrastructure and atmosphere conductive to holistic development and joyful learning." As we spoke with school leaders, teachers, parents, and even students at the Children's Academy, we heard a consistent thread of the school's mission and vision of holistic and joyful learning expressed from multiple perspectives.

In our interviews with teachers, they spoke about the things they feel have changed in their teaching over the last few years and that make the Children's Academy different from common practice in Indian schools. We spoke with a group of current teachers who had been students at the Children's Academy, and who expressed a keen awareness of the changes. First, these teachers reflected on the changed relationships with their students. Students no longer "fear the teacher." Both teachers and parents mentioned the absence of fear as a positive feature of the school. Another aspect of the changed relationships, according to teachers, was that students freely ask questions and share their understanding of topics. As one student commented later, "I like that whenever I do a report I can include my own critical opinion—it is not just cut and paste. And I can learn many things outside of the textbook."

Almost all of the people we interviewed at the school emphasized how important it was for students to ask questions and to find answers on their own or even offer opinions that might differ from the teacher. And, they felt that ICT was critical to this change because it gave students independent access to information. The Head Mistress and her teachers expressed the strong desire for their students to feel confident and competent enough to speak up for themselves. The Head Mistress felt that the Essentials Course and the project-based approaches helped her find ways to promote this new student voice. Initially, when the students began asking questions that teachers could not answer, the teachers were uncomfortable and had to decide what to do. By using projects and Internet research, the teachers now see questions as shared research challenges, and they put the responsibility back on the students to do the research themselves and teach the rest of the class.

A second change mentioned was that teachers no longer just "stand and teach." Instead, the teachers worked with the students as facilitators on project work and engaged the students in more classroom discussions about the material. Parents also commented that, at the Children's Academy, students went "beyond the textbook" in doing independent research on topics on the Internet and extracurricular activities and noted that the school also encourages students' artistic and creative talents.

A third change, also connected to ICT and the Essentials Course, is that teachers bring in a variety of ICT-based visual aids and teaching resources. In other schools, "teachers go to class with just the textbook in hand," but at the Children's Academy, according to a geography teacher, "We talk about much more than just the textbook" by bringing in materials from the Internet. She explained how she made a PowerPoint presentation about how the early continents were formed with images from Internet.

In the four classes we observed, the teachers were attempting to use innovative approaches by asking students to review the textbook prior to class, by using open-ended questions or by asking for feelings or opinions about topics, making explicit connections between the content and children's lives, and using student role plays or skits to dramatize the content. The teachers also assigned challenging homework that asked the students to do research or connect the course content to the world today. Additionally, teachers reported using the TV monitors to show presentations or visual aids related to class topics. One teacher who was new to the Academy compared this school to her previous school saying the "teaching here is different from my previous school. There we used to focus on academics, but here we focus on activities and the children learn by doing the activities."

All of the classes observed centered on teacher lectures and teacher-led discussions, but the teachers attempted to make innovative changes on the edges. Most of the changes that teachers made were evident in how they related to their students during the lesson—encouraging students to ask questions, share opinions, and make connections to their lives. One teacher used the common Indian practice of having students read aloud to their peers,[21] but the reading was interspersed with questions to check for comprehension and to engage students in sharing their reactions to the story. The story was about a citizen's group protecting forests from destruction, and the teacher asked students why they thought plants and trees were important, or what they felt about trying to protect them. The following sections describe five approaches or teaching techniques that teachers were attempting to use to support a more engaging learning environment for their students.

Coming to class having already reviewed the day's material: In India, typically, there are published notes or study guides that students purchase at the bookstore. There are guides for every curriculum (CBSE or the state boards), and they offer notes on the key topics, with questions and answers. Normally, students have to purchase the guides themselves, but the Children's Academy provides the guides for free. Teachers here expect the students to have read the material before class so that they will be able to discuss the

[21]PROBE Team (1999, p. 71).

material. In the history lesson on the impact of the British Colonial system, we observed that students were able to discuss a variety of negative impacts and explain how they grew out of the colonial system without the teacher lecturing on the topic.

Questioning strategies: All of the teachers attempted to use open-ended questions to encourage students to think more deeply and to share their opinions and reasoning. Some teachers attributed the use of questioning to the curricula framing questions covered in the Essentials Course. Not all the teachers were adept at facilitating a rich conversation with students, but they were trying. The most successful teacher we observed was a math teacher who asked the students how they might solve a geometry problem, consistently using follow-up questions to push the student's thinking deeper. He also actively discussed multiple strategies to solve the same problem.

Making connections to student's lives: In the lessons we observed, the teachers sought to connect the material to students' lives. The science teacher introduced nutrition by asking students what they had for breakfast, and the math teacher had students analyze the angles of their window grates at home. In the history class, the teacher asked students to connect the British colonial system to the problems of India today.

Role play and skits: Three of the classes had students present a skit in which they acted out a key theme from the material. For example, in the history class, the students presented a skit about the colonial tax collector coming to collect money from farmers suffering from a drought.

Challenging homework: Perhaps the clearest strategy for providing student-centered learning opportunities was the type of homework assignments given by the Children's Academy teachers. ICT plays a role in this strategy by giving students access to information. In addition to the four observed teachers, we also asked four other teachers to give us three examples each of typical homework assignments. Seven of the teachers did not simply ask students to do exercises from the book as homework. Instead, they asked students to do research and investigate a topic relevant to the class. For instance, a math teacher assigned students to calculate average rainfall in different parts of the world using online databases. As noted, the history teacher asked students to research the condition of farmers today in contrast to their plight under British rule, and the English teacher asked students to research other environmental defense movements. The Internet is a key resource for allowing students to do this research. All of the teachers, parents, and students interviewed reported doing Internet research for almost every class. The challenge for the teachers was how to grade the homework because of the large volume of students. Teachers might review the assignment as a whole class or read one student's work out loud and then have student helpers check to be sure each student had completed the assignment.

The learning environment outside the classrooms of the Children's Academy

The school uses two important strategies for "non-class time" to offer students enriching learning opportunities: long-term collaborative projects and activities conducted within afterschool clubs and within "houses." In the projects and the clubs, the students do a lot

of activities relevant to their lives and linked to broader community issues—from good nutrition and HIV prevention to environmental protection and community improvement.

Projects: A central element of the Children's Academy experience is the requirement that all students must do two long-term projects a year. The projects are two to three months long, and students work in teams to complete them. A teacher oversees each project, but the students primarily lead the process, and most of the work is done outside of the formal lesson time. The projects typically involve Internet research, and students usually create a PowerPoint presentation about what they have learned. The Head Mistress and the teachers reported that the actual in-class time dedicated to project work was only two or three class periods per project. The projects are not part of the official curricula but an activity the school feels fundamental to the type of learning they want for their students.

The Head Mistress felt that the Essentials Course had been instrumental to developing their approach to projects for the students, not just the technology, but for the ideas around student research and working in project teams. According to the Head Mistress, while she was still a teacher, the school had started experimenting with group projects for the students. But they had no training and no experience with project-based learning, and their attempts were not working. Students used the projects as an excuse to hang out with their friends, and the school felt that the parents were doing the real work. But when the Head Mistress took the Essentials Course, she was immediately excited about the project-based examples in the course and teaching philosophy presented in the course materials. With this material, the school developed guidelines to improve the quality of the projects, encourage students to venture out of "their comfort zones," assign project teams, give students real roles and responsibilities, and choose challenging and meaningful topics.

Clubs and Student Houses: The Children's Academy has also created a rich set of extra-curricular programs through school clubs and with the student "houses." The school building is open to the students before and after classes, and a wide variety of activities are available. The school hosts a number of clubs (e.g., Science Club, Literature Club, Nature Club), and the Head Mistress encourages the students to propose ideas for new clubs. The clubs do community projects that often involve Internet research and making presentations to the community. Following a common British approach, students at the Children's Academy are divided into four Houses—Red, Green, Yellow, and Blue. Students are assigned to a House when they enter the school and stay in the House until they graduate so each house is made up of students at all grade levels. The Houses elect student leadership, and they engage in a yearlong contest to earn points in a series of competitions ranging from poetry and dance to science and community service. The school winners in many competitions go on to compete in district and citywide competitions with other schools. These competitions provide a key motivation for the students at the Children's Academy and offer opportunities for student-centered learning. The students are able to use the school facilities after class for club activities, House activities, and to prepare for their competitions.

Case Two: Fatehpura Anupam Primary School, Mehsana District, Gujarat State

Fatehpura Anupam is the only primary school in a tiny village about a 90-minute drive outside of the city of Ahmadabad. The village is considered too small to be on the map, having only 200 families. The buildings are very close together, the streets are narrow but clean, and the buildings are all well kept. During our site visit, we learned that the students organized a campaign to clean up the village as part of a project—"Clean Village"—that the teachers designed during the Essentials Course. The students also painted wall murals about the importance of cleanliness throughout the village.

Located in the heart of the village across from the very colorful temple, the school appears to be in excellent condition. It is a two-story building with classrooms on both floors. The walls are all brightly painted with educational pictures and scenes, and the school grounds have plants and trees as well as space for the children to play and an area where they eat lunch. The school has electricity, and all the classrooms have electric lights; there is running water as well a new lavatory building. The lavatory was also an end result of the cleanliness project that the school did as part of their Intel program. Many government-aided schools do not even have electricity or water, so this is a very well-maintained government school.[22]

Fatehpura Primary has 309 students in seven grades (1st to 7th standards), eight teachers, one teaching assistant, the Head Master, and one grandfather who volunteers as a teaching assistant. Each class has about 45 students. School is held five days a week. The school day formally starts at 11 a.m. and goes until 5:00 p.m., but the school also offers optional classes on ICT and English before school. Each lesson is approximately 35 minutes long.

The school and the community have a very close relationship and work together to improve the school. In an interview, the village Sarpanch (mayor) shared his views about the importance of the school to the village. He noted that education is important to prepare the students and expose them to knowledge and new ideas, but not all villages have good relationships with their schools. He advised that other villages need to learn to "respect the school." This village has "deep regard for the teachers." He told us that he had noticed how good the teachers were with the children, and that they were very close to the students. For example, he said that the computer teacher comes early and does many things for the children, and he knows that the teachers give money to the children in need. Every year, the school has a celebration, and the teachers give the students gifts. There are no problems with absent teachers, as in many other villages.[23] So every year the village organizes a celebration to honor the teachers with gifts. Although the village is not rich, with the help of the Sarpanch, the school gets a little bit of support from everyone, which makes a difference in keeping the school building nice.

[22]Chawla-Duggan (2007, p. 133).
[23]Kremer et al. (2005, p. 659).

The school is also part of a special project from the local teacher-training institute, the District Institute for Education and Training (DIET), Mehsana. The Anupam School Project, started in 2000,[24] seeks to improve the quality of education by improving society linkages and creating healthy and engaged learning environments with teacher professional development and special projects. Anupam means *Incomparable* in Gujurati, and an Anupam School must commit to reach five norms:

1. Effective classroom teaching
2. Develop community relations and support for school activities
3. Good test scores/improve test scores
4. Teach children values
5. Enroll all children in the village

An Anupam School strives to be a "school where children wish to come, where children love the atmosphere and enjoy the study." One of the indicators of the quality education of an Anupam School is the use of computer-aided education. Fatehpura is considered one of the project's most successful schools and has moved into a new phase to become a model school for e-learning. A project coordinator from DIET Mehsana works with the school and visits frequently. She is herself an MT and brought the Essentials Course to Fatehpura and closely supports the MT at the school.

Fatehpura follows the Gujarati State Board of Education curricula and uses the Gujarati versions of the official textbooks. The content areas covered increase as students move up in grades: from Grades 1–4 there are three subjects—Gujarati language, math, and environment (e.g., science). Grade 4 also has Hindi, and Grades 5–7 have eight subjects—Gujarati language, Hindi, Math, Science, Social Studies, Physical Education, Sanskrit, and English. The school also offers optional courses in the mornings before school in English for Grades 1–4 and ICT for Grades 5–7.

There is a classroom for each grade plus a science lab, a computer lab, and an assembly room. The Head Master's office also serves as a teacher's lounge. All of the classroom walls are painted with educational materials. For example, the second-grade classroom walls are covered with beautifully painted educational posters depicting things such as stories (*The Tortoise and the Hare*), the seasons, directions (N, S, E, W), different jobs and professions, etc. The Head Master says that these serve as their textbooks, although all the students do have textbooks of their own. In the first- and second-grade rooms, the bottom 1/3 of each wall is a chalkboard, which students can write on to figure out math problems, practice spelling, or draw pictures.

The assembly room is used for class presentations, community activities, and group activities with the children, such as yoga, plays, dance performances, and competitions. The teachers built a table at the front of the room that is equipped with four microphones and buzzers, like a quiz show, so that students can have competitions. The room also contains a computer set up on a desk with wheels that the teachers laughingly call the

[24]See http://www.dietmahesana.org/activities_otheract.html for a description of the project.

"mobile computer" because they can move it to wherever it is needed, and it is often used in the assembly room with a screen and projector for presentations.

Like the quiz show setup the teachers built, the teaching faculty at Fatepurah works hard to bring in extra educational resources beyond the standard textbooks that the government requires. The teachers made the decision to have the walls painted, collected the funds, and contracted with the painter. The teachers also proudly showed us a number of educational materials that they built themselves. For example, the teachers saw a wall map of India, where the capitals and important economic regions light up, for sale in a catalogue, but they built their own versions for India and the state of Gujarat for a fraction of the cost. They also built most of the displays and models in their science lab themselves, as well as numerous hands-on models or activities for the students.

ICT at Fatehpura Primary School

The school has a computer lab with 14 computers and a printer, plus the "mobile computer" and the LCD projector. The lab is connected to the Internet through a dial-up modem. There is also a computer in the Head Master's office. These are the only computing resources the school has. Fatehpura offers ICT as an optional course in the mornings before school to the students in Grades 5–7, but ICT is not required by the government standard curricula. The computer teacher is also the English and Hindi teacher for the upper grades, and teaches ICT as an extra responsibility. But the teachers try to integrate ICT resources into the content teaching. The technology is used as a way to provide students with new ways to see or experience the content.

The teachers have a variety of multimedia presentations in PowerPoint format that they show to the students. While the teachers have created some of the presentations themselves, many of the presentations are made available by the government or other organizations. We observed a geography lesson in the assembly room that included a government-created PowerPoint presentation about the water cycle. The design of the presentation mimicked a traditional teacher lecture. The presentation was projected on the screen, and the voice-over narration read the text of each slide to the students with the addition of movie clips or animations about the water cycle. However, at certain points the teacher did interrupt the presentation to expand on points he felt were important or unclear to the students. He would ask questions to check for comprehension and teach the topic if needed.

The teachers also use Web-based resources with the students. One teacher used a virtual field trip to Mumbai, and another teacher used Google Earth for a geography lesson on the Great Wall of China. The computer teacher/Hindi teacher also assigned the students to create presentations as part of their Hindi lessons—for example, they might create a set of slides using new vocabulary. The school also organizes afterschool projects that use technology (see below). The school has moved to keep track of attendance in Excel®, but the Head Master also showed us a chalkboard where they post monthly attendance because the government requires it.

Intel Teach Essentials Course at Fatehpura

The Anupam coordinator from the DIET brought the Intel course to the school because the Essentials Course aligns with the project's vision of teaching and learning. In her view, the course promotes ICT use, project-based learning activities for students, and a more open, questioning relationship between teachers and students. In addition, the Anupam coordinator spoke highly of the quality of the Essentials Course training itself. She is a trainer with the DIET for a number of government in-service teacher training programs, and one thing she likes about the Essentials Course is that it allows the teachers to experience a student-centered learning environment. She felt that "the learners get involved themselves, the process is important."

The computer teacher at Fatehpura Primary, who was trained as an MT in the Essentials Course by the Anupam coordinator, conducted the Essentials Course with her seven fellow teachers in 2006. Together, during the course, the faculty decided to design seven projects, all around a central theme. Their theme, School as the Center for the Development of the Village, is a central objective of the Anupam program. Each of the projects is focused on a community issue (e.g., pollution, addiction, water use), and the students research the issue and solutions and develop a proposal for the community on how to solve the issue.

Project topics from the *School as the Center for the Development of the Village* initiative
1. Use of Rainwater for Irrigation and Drinking
2. Clean Village
3. Addiction
4. Solar Energy
5. Bio-Gas Plant
6. Drip Irrigation
7. Recycling Waste Water

The teachers started developing the projects during the training, but continued refining and working on the project plans as part of the Facilitation Process that Intel provides in India. The school implemented the projects with students in 2007.

The learning environment in the classrooms at Fatehpura

Like the school in Mumbai, the educators at Fatehpura made use of in-class time and non-class time to create opportunities for learning. In relation to in-class time, we observed five lessons: first grade, second grade, seventh grade, and two observations of the fourth grade. We also observed a school assembly for the upper grades (fifth to seventh) and spoke with three teachers, the Head Master, and a group of students. In the first two grades, the students sat on rugs on the floor in rows from front to back. Most of the children had pencils, notebooks, and workbooks, and some had little chalkboards, and chalk. The older grades had benches that sat 3–4 students lined up in rows, front to back. As in Mumbai, the class periods were 35 minutes long, though, in Fatehpura the students have the same teacher for most subjects.

During the class time, the activities we observed were almost entirely whole-class activities orchestrated by the teachers, but they incorporated many teaching aids, demonstrations, and dancing and songs. Many of the classes we saw were fast-paced, and students sang counting songs, alphabet songs, the national anthem, and songs about Lord

Krishna. At times, the songs were the longest sustained student activity. Additionally, teachers asked individual or small groups of students to the front of the room to help the teacher or to lead the class in a song or a dance. Strategies that we observed the teachers using to engage their students and support learning were a use of teaching aids and visuals and showcasing student work and student effort.

Teaching Aids and Demonstrations: When asked about the changes in teaching over the years, one teacher commented that "Initially we just taught from the text, but this makes students active." Although all the students had textbooks, and in some lessons were using the textbooks, neither the teachers nor the students were reading the text in class. For example, in a lesson on Earth's orbit around the sun, instead of reading the textbook, the teacher used a flashlight and a globe in a darkened classroom to demonstrate the effect of Earth's orbit to a class of rapt seventh graders.

The teachers reported that ICT provided them with a vast new source of visual teaching aids. We did observe the use of a PowerPoint presentation. That presentation, designed by a government project, reflected a very traditional teaching approach, since the presentation essentially lectured the students while showing animated images of the water cycle. However, in Fatehpura the teacher interrupted the presentation to ask questions and engage the students whenever they grew bored with the presentation.

Showcasing and giving individual or small groups of students visible roles in the class: During all of the lessons, teachers attempted to give students an active role by asking a few students to complete an activity in front of the room. This entailed anything from asking a small girl to lead the class in a dance about Lord Krishna, to asking a student to count how many pencils were on the teacher's desk, to leading the class in song. Students also did presentations of their work or talents. When students did projects, they showed the presentations to their classmates. We also observed a school assembly where students performed songs and dances.

The learning environment outside the classrooms of Fatehpura

Fatehpura Primary School uses four different strategies for non-class time to offer additional learning activities to the students: optional classes, extracurricular activities, long-term projects, and Value Education projects of the Anupam Project.

Optional Classes: Since the school cannot fit all the subjects they wish to teach into the official school day and with the number of teachers, the school offers optional classes in the mornings before school. The computer/English teacher offers English to the lower grades on some days, and ICT to the upper grades. The village Sarpanch commented on how dedicated all the teachers are to the children, and this was a clear example for him. If not for the ICT class before school, none of the students would be able to learn basic computing.

Extracurricular Activities: In the Head Master's office, there is a big calendar of challenging or hands-on activities that students in different grades are expected to do throughout the year. The activities range from English or Hindi composition competitions

to science experiments using the science models the teachers built themselves. These are all activities that go beyond the textbook and student workbook. The teachers may use some class time for these activities, but students are also expected to do a lot of the work on their own.

Projects: These are the projects that the teachers designed in the Essentials Course. All of these projects are within the syllabus guidelines but are done outside the standard class time. They also had a substantial impact on the community. For example, as a result of the students' examination of drip irrigation and their proposal of how farmers can use this new strategy, all of the farmers in the village have converted to drip irrigation, and the Sarpanch reported that they now produce more crops with less water. The students also did research on clean water, and they developed a plan to install a water treatment process in the village. The village adopted the plan and now has a small water treatment machine next to the school where villagers can collect clean water. The idea that village schools can be a change agent is a central theme of the Anupam Project that the Essentials Course helped them achieve.

All of the projects followed a similar process. The project teams were all composed of multi-age groups of 12–16 students, so they were not grade specific. The project topics were all selected by the teachers, but the process started with a discussion of the issue, and the students developed a community needs survey linked to the issue. Students conducted research on the topic by visiting local officials and institutions relevant to the issue. Some took a trip to see a solution in action, such as visiting a farm with drip irrigation. Some used the Internet to research the problem or to investigate government programs that might be of assistance. Some of the projects had a data analysis component (e.g., analyzing survey results or looking at numbers about water use). For most projects, students also had to examine budget information to calculate costs for their proposed solution. Once students had researched the issues and identified a possible solution, they created a PowerPoint presentation to present their work to the village community to get action.

The students did a lot of the work before and after school, but they also used some school time. Each project was overseen by a different teacher, but the Head Master was very supportive of the projects. He played a key role as teacher facilitator during the data analysis process. The project teams met during the school day for this phase, and the Head Master took over while the other teachers were in class with the rest of the students.

Anupam Value Education projects

Four special projects to help children's moral and social development are the heart of the Anupam project:

- *Ram Dukan* is a little "store" made up of small shelves with necessary things like pencils, erasers, notebooks, etc. Children buy and pay for things on the honor system, leaving the money in a little box with no one watching. This project helps children develop a sense of honesty and trust. The child who keeps the stores accounts was very proud to tell us that so far nothing has gone missing.

- *Akshaypatra*: Children bring a small amount of rice to school, which is collected in a metal can painted with beautiful birds. Every week, a different class takes the rice out to feed the birds. This project promotes respect for nature and birds.
- *Aaj No Dipak* is a commitment of the school to have a birthday celebration every month for all the children born that month, to ensure that even the poorest children receive gifts and a celebration to mark their presence in the world.
- *Aaj Nu Gulab*: The school has a mirror, comb, and soap and water available for children to wash up and comb their hair each morning. The project promotes hygiene and cleanliness, and every day one child receives recognition as an "Aaj Nu Gulab" ("Clean Child").

Examining the Indian case studies

The following section uses the analytical framework of the seven key factors to examine these schools' progress as they have experimented with new teaching strategies, integrated ICT use with students, and conducted follow-up on the Essentials Course.

Pedagogical Objectives and Goals

A fundamental factor is the way ICT use and the themes of the Essentials Course align with and support the central goals of each school. Both schools had a guiding vision about the type of learning environment they wanted to create for their students. Educators in both schools spoke about making learning "joyful" and relevant to children's lives. They all wanted to "go beyond the textbook."

In Mumbai, the Head Mistress was a strong advocate for project-based learning and student voice, building off of the Children's Academy founding vision to "use best, innovative teaching practices." According to the Head Mistress, the school began to rethink the vision of teaching and learning after the Essentials Course. After participating in the Essentials Course, they felt the mission needed more specificity. There are different approaches to teaching that support distinct educational visions, and the school needed to come to a decision about the "best practices" to achieve its vision. The school's brochure states "Children's Academy aims at providing the infrastructure and atmosphere conductive to holistic development and joyful learning."

At the Fatehpura Primary School, the guiding vision came from the Anupam Project. The Head Master and the teachers were very collaborative, and the school had a long, close relationship with the village, but Anupam shaped the vision of teaching and learning the teachers sought to achieve. They strived to instill values and connect the learning to the students' lives and to the community, and they aligned the projects they created in the Essentials Course with that vision. The school was an environment where the children were happy and appeared to enjoy learning. In a conversation with a group of Grade 7 students, they expressed how sad they were to be going to the village's high school because high school was not the same, and the Fatehpura teachers were very nice.

Both schools also had a clear vision of the role of ICT in supporting this educational vision. They wanted the technology to be an integral part of students' learning processes, not a supplemental activity or just another content area. At both schools, the teachers reported that before participating in the Essentials Course, computers were only a subject area. But afterwards, teachers in both contexts found ways to integrate ICT into core content areas. ICT offered access to new rich teaching aids, to research, and to a way to make presentations. One key value of ICT for teachers at both schools was that ICT gave them access to a wide variety of visual and animated teaching aids to provide their students with a better understanding of the content. Both schools valued the Internet for research, but the context of the Mumbai school allowed them to give students more continuous access to the Internet for research.

Leadership

Each school exhibits a different leadership strategy to promote the change efforts underway. Mumbai has a slightly more traditional leadership process. The leadership of both the Trustees and the Head Mistress communicates a clear message to teachers, parents, and students about the pedagogical approaches they want to see in classrooms and the type of learning opportunities they want to offer students. At the school level, the Head Mistress is a clear advocate for technology integration and for active, student-centered learning. Many teachers referred to her as a role model and an inspiration of how ICT and project-based learning can work in the classroom. She strongly encourages teachers to do projects, to utilize technology, and to give students more autonomy in the classroom and over their learning. These changes in teaching approach have affected the supervision of teachers, and, as noted earlier, the Head Mistress said she understood that these new philosophies of teaching will change the classroom dynamics: "I like them to make a little bit of noise in the classroom, As a principal, now, when I hear noise I just stick my head in to see if it's group work or not."

The teacher faculty at Fatehpura is a close-knit group of educators that has been together for many years, and there is a more distributed leadership. The Head Master supports and motivates his teachers, but they take very active roles in developing activities and projects for the school. In relation to ICT, the computer teacher is fundamental in coordinating the projects and in supporting ICT use by the students and teachers. She was the MT for all the teachers, and she coordinated the Intel projects done by her fellow teachers. Additionally, the Anupam coordinator played a central role in encouraging and supporting the entire school to experiment with these new approaches and activities.

Professional Development and Ongoing Support

Professional development and continued professional growth are key components for each case study, and the schools used both formal and informal professional development strategies. All of the educators we interviewed spoke of changing their practice, or trying new things to fulfill this new vision of teaching and learning. The teachers talked about experimenting and trying new things with the support of their peers, but they also spoke about professional development experiences and the Essentials Course specifically. All teachers in both schools had taken the Essentials Course or had received mentoring in the approach from a peer. Both schools had an Essentials MT on site—the Head Mistress and the Fatehpura computer teacher—both of whom were leaders of the change process.

Additionally, Fatehpura benefited from the support of the Anupam coordinator (also Intel trained) and the Intel Facilitation Process, which provided support for the implementation.

The Children's Academy also uses a number of internal strategies to support the continuing professional growth of its teachers. For example, the school sends a team of teachers to a training and then has that team train their colleagues. Although the Essentials Course was free to teachers at all schools, the Children's Academy pays the training costs for its teachers who do other programs. According to the Trustee, most private schools in India generally require that teachers pay for their own professional development. Another strategy is a "new teacher" mentoring system, where an experienced teacher will mentor teachers new to the Children's Academy. The mentoring is to help new teachers adopt the teaching approaches as well as the technology used at the Children's Academy. This helps maintain the shared vision around teaching and learning that is evident at the school.

The Anupam project plays a central role in providing ongoing support to the teachers in Fatehpura. The coordinator comes frequently to provide guidance and support about project-based learning or other innovative teaching approaches, and she also offers formal training sessions to the teachers.

Experimentation, Adaptation, and Critical Reflection

The Children's Academy is an interesting example of a school using a well thought-out process of experimentation and critical reflection to adapt and adjust new resources and approaches to work in their context. The leadership of the Children's Academy followed a process when initially considering integrating ICT. Before 2000, the Trustees installed a computer lab and evaluated the use of the lab and its effect on student learning. They found that students liked using the lab but that the teachers did not use the lab often because it was hard to schedule and the types of activities they did were not of sufficient quality. ICT use was supplemental but not integral to students' learning. The Essentials Course presented strategies to integrate ICT into the subject areas. The trustees also decided to shift the distribution of ICT resources within the school and experimented with a TV and teacher computer in five classrooms. After six months, this experiment was so successful that the school decided to put computers and monitors in all classrooms.

Time

The biggest challenge facing the schools in India is the short length of each class period. A 35-minute period inhibits the type of project work a teacher can do with the students because there is not enough time to organize the students, introduce new materials or give instructions, and allow the students to do the work. Both schools followed similar strategies to overcome the shortage of time by making use of students' non-class time to engage them in projects and other hands-on learning activities. One way they achieved this was by keeping the buildings opened and the computer labs staffed. With more financial resources, the Children's Academy was able to give the students more hours of access, while Fatehpura opened the school early and had teachers who were willing to stay late when the students were doing project work.

Planning time is also critical for the teachers. The Children's Academy had weekly planning meetings where all the teachers could meet to review the syllabus and plan the next week's activities. Additionally, the school had a 15-day planning period with the teachers before the students started at the beginning of each year. The teaching faculty at Fatehpura formed a very collaborative group, and they often stayed late talking and planning for the school. Plus, the visits of the Anupam coordinator created other spaces for the teachers to get together and plan. The student savings bank, for example, emerged from a set of concerned conversations about the fact that many of the villagers did not understand the value of banking.

Infrastructure

The level of the infrastructure varies between the two schools, but both schools make the best use of the resources they have. The common usages at each school aligned with what the infrastructure can support. A valued use of ICT among all the teachers was to present information to the students. With only seven classes of students, the "mobile computer" and projector in the assembly room at Fatehpura Primary could adequately cover this need. The Children's Academy model of one classroom computer to present multimedia material to whole classes of students was sufficient for this purpose. However, the model would not support more robust in-class use.

The students' uses of ICT were principally for Internet research and PowerPoint presentations. The Children's Academy encouraged both individual and group work with ICT and, thus, needed more resources available. The students at Fatehpura generally worked mostly in groups because of the lower number of computers. The use of non-class time for ICT-based student learning activities required both schools to find ways to keep their buildings open.

Both schools are also improving their infrastructure. The Children's Academy is expanding the connectivity in the building, and Fatehpura is planning to purchase two more computers to be able to put computers in each classroom.

Financing and Sustainability

Costs and sustainability are ongoing challenges for most schools attempting to do new things. In both of these cases, the schools have moved cautiously in purchasing equipment, but they also have community support for these expenditures.

Fatehpura Primary school said it was the first school in the state to raise funds from the community to buy its own computer back in 2002. Eventually, the government also gave them a computer, but they have built up their infrastructure to 14 computers with parent and community support.

As a private school, the Children's Academy Trustees decided to keep the tuition fees constant, even though they were expanding the technology infrastructure. The school pursued a careful procurement and budgeting process, but it was important that the parents valued these expenditures over other possible expenses. The school purchased the

necessary resources for all classrooms in the building and amortized the infrastructure cost over five years. This allowed them to provide for all students while keeping tuition constant. The need to keep within a reasonable budget is one reason the school pilots new technology innovations before expending funds for the entire school. Another measure that limits costs is that there are very few peripherals used (digital cameras, scanners, etc.) and the students seldom print anything.

The Essentials Course in India

Though the schools represent different contexts—village/urban, private/government-aided—they both embody some of the changes that Indian schools are struggling to make. Looking across both schools, we see attempts to offer more student-centered learning activities, to create more open and inviting classroom environments for students, to connect learning to students' lives, and to use more ICT and ICT-based resources.

While these schools may not yet exemplify the best practices one might find in a fully reformed "21st-century school," they have made good progress from where many schools in India are today. The educational leaders engaged with shaping the learning environments in these schools—the Head Mistress, the Head Master, the Trustees, the village Sarpanch, the Anupam coordinator, the village MTs—all reported that the Essentials Course had been an important resource for promoting change and for giving the teachers a vision and an experience of a different learning style, basic ICT skills, and exposure to new teaching approaches.

Chile

The Context of Chilean Education

The hallmark of Chilean education is, perhaps, the methodical and deep reforms in the system since the restoration of democracy in 1990. The relevant features of the current system are the model of privatization that Chile inherited from the dictatorship; the curricular reforms of the 1990s; and the national educational technology program, Enlaces (Links).

Model of privatization

The privatization of education that occurred under the Pinochet dictatorship is a central characteristic of the Chilean system.[25] Chile currently has three types of schools:

1. **Municipal Schools (serving 44.98 percent of students in Chile[26])**: With funding from the national government—a flat amount per pupil per month—municipalities own and administer these schools. Pupils are from the poorest families, and the schools are located in rural areas where there is not a large enough "market" for private-subsidized schools.
2. **Subsidized Private Schools (serving 46.51 percent of students in Chile)**: These schools receive partial funding from the government but belong to for-profit or nonprofit private entities. The government limits the fees the schools can charge parents and provides a subsidy per student (students mostly come from working class and lower middle-class families) that is prorated to the amount charged to the parents. Funds are paid directly to the school, based on monthly attendance rolls. This strategy generally means that subsidized schools have more funds per pupil than municipal schools.
3. **Private Paid Schools (serving about 6.95 percent of students in Chile)**: These schools are completely funded by the parents, and there is no limit to the fees.

Although the democratic governments have left the basic privatized system intact, they have pursued policies to improve the resources and infrastructure of the poorest and lowest performing schools, whether municipal or subsidized.[27] However, the privatized system came under serious pressure in 2006 when Chilean students across the country staged a national strike. The *revolt of the penguins* (a colloquial reference to the traditional school uniform) lasted for months, and one of the protesters' demands was an end to for-profit education.[28] A new General Education Law is under discussion by the

[25]Valenzuela, J. M., Labarrera, P., & Rodríguez, P. (2008). Educación en Chile: Entre la continuidad y las rupturas. Principales hitos de las políticas educativas. *Revista Iberoamericana de Educación, 48*, 129–145 (p. 131).
[26]Enrolment numbers by category can be found in: Ministerio de Educación (2008). *Estadísticas de la Educación 2007*. Departemento de Estudios y Desarrollo. Santiago, Chile. Additionally, 1.6 percent of students are served by vocational high schools run by businesses.
[27]Valenzuela, Labarrera, & Rodríguez (2008, p. 139-140); Cox (2004, p. 18).
[28]Vogler, J. (2007). The rise of the penguins. *NACLA Report on the Americas, 40*(1), 51–52; Valenzuela et al. (2008, p. 143).

government. EDC and the Centro CostaDigital conducted site visits to a subsidized school and municipal school.

Curricular reforms

Since 1990, successive Chilean governments have undertaken a series of curricular reforms. These reforms constitute a systematic, coordinated approach to gradually transforming the administrative and policy context of the education system and modernizing the teaching and learning in Chilean schools.[29] The Ministry of Education (MINEDUC) has improved and extended the school infrastructure, transformed the curricula, instituted full-day schooling, developed a national examination, invested heavily in teacher professional development, and integrated ICT into schools. The Ministry established curricular frameworks in primary (1995) and secondary (1997) education, which, according to one of the architects of the reform, Cristián Cox, move away from "encyclopedic" knowledge towards "the development of skills for accessing knowledge as major guiding principle."[30]

The MINEDUC extended compulsory education to 12 years, and under the current government, preschool has been added. MINEDUC mandated that all schools—municipal and subsidized—expand the school day to eight hours, increase the amount of time students spend in core areas, and create space for students to engage in optional activities or project-based learning experiences.

Along with the introduction of a longer school day and more demanding curricular contents, the Ministry implemented new professional development programs. For example, the Ministry offered a free, voluntary 70-hour course on the new curricular framework during the summer holidays.[31] However, most experts agree that the continuing challenge facing Chile's education system is the impact of these reforms on actual practice in the classrooms.[32] There continues to be a gap between what is expected of teachers and how teachers are able to implement or enact changes in the classroom with their students.

Enlaces: ICT in Chilean education

In tandem with the government's other reforms, Chile also began laying the groundwork to integrate ICT into schools. The *Enlaces* program (Enlaces means Links in Spanish) started in 1992 as an experiment to integrate technology into just one poor rural school

[29]Ferrer, G. (2004). *Las reformas curriculares de Perú, Colombia, Chile y Argentina: ¿Quién responde por los resultados?* (p. 131). Lima: Grupo de Análisis para el Desarrollo (GRADE); Valenzuela et al. (2008, pp. 137–140).
[30]Dussel, I. (2006). *Curricular reform in Latin America: Assessment and future prospects*. Paper presented at the Segunda Reunión del Comité Intergubernamental del Proyecto Regional de Educación para América Latina y el Caribe (PRELAC) (see Table 1 and section 3b, no page numbers).
[31]Cox, C. (2004). *Innovation and reform to improve the quality of primary education: Chile. Paper commissioned for the EFA Global Monitoring Report 2005, The Quality Imperative* (p. 27). Geneva: UNESCO.
[32]Cox (2004, pp. 9-10); Dussel (2006); Valenzuela, Labarrera, & Rodríguez (2008, p. 137).

and was expanded to 55 schools in 1995 before the program was taken to scale.[33] By 2007, Enlaces had provided hardware, software, and connectivity to more than 10,300 of the 11,033 schools in Chile (94.3 percent).[34] Enlaces considers teachers to be the principal change agents in schools, so the program is focused on teacher professional development and has provided substantial professional development to 110,000 teachers in Chile.

However echoing the concerns of experts in Chile's educational reform efforts above, the leadership of Enlaces are not satisfied with the extent to which teachers are using ICT in the classroom with their students:[35]

> We had provided just a basic *seed* that allowed schools and teachers to recognize the potential benefits of ICT. Technology has already been incorporated into the school culture, but it has not really been incorporated into teachers' regular teaching practice. If ICT is to make a contribution to teaching and learning practices, we still have a long road to follow. The next steps of Enlaces are directed towards the effective curricular integration of ICT.[36]

The Intel Teach Essentials program in Chile

The Ministry piloted the Essentials Course with teachers in 2003 and decided to integrate the program as a professional development offering as part of Enlaces activities.[37] A network of universities throughout Chile—which the Ministry selects through an open-bidding process—offers the standard 40-hour course to teachers in their region. Within each university, academic centers that specialize in educational technology house the Essentials Course. The course is free to teachers in municipal and subsidized schools that are part of the Enlaces program.

Chilean Case Studies

Case One: Colegio El Sembrador, Comuna Puente Alto, Santiago

Colegio El Sembrador is a government-subsidized private school serving a mostly lower middle-class population in the neighborhood of Puente Alto on the outskirts of Santiago. The school was founded in 1988, during the dictatorship, and has now been in existence for 20 years. Colegio El Sembrador is actually composed of three separate complexes, housing different grades all within a few blocks of each other. The school serves a total

[33]Cancino, V. C., & Donoso Díaz, S. (2004). El programa de informática edcuativa de la reforma educativa chilena: Análisis crítico. *Revista Iberoamericana de Educación, 36*, 129–154.
[34]Ministerio de Educación (2008).
[35]Cancino & Donoso (2004, p. 137)
[36]Laval, E., & Hinostroza, J. E. (2002, July–September). Chilean Schools: The Enlaces Network (p. 18). *Techknowlogia,* 14–18.
[37]Educational Computer Institute. (2003). *Final report: INTEL® Teach to the Future project evaluation* (pp. 12). Temuco: University of La Frontera.

of 2,500 students from pre-K to Grade 12 (the last grade of high school in Chile). Our visit was to the middle and high school buildings. There are 60 teachers in the school and the average class size is 36. As was the case in India, each class of students remains together all day. In Grade 5 through Grade 12, teachers rotate through the classes according to the subject taught. From Grade 1 to Grade 4, each class has one teacher for all subjects. The students spend all day in the same classroom, except for subjects such as English and ICT, where they may go to a specialized room. El Sembrador has full-day schooling (only one shift of students), and the school day is more than nine hours long, going from 8:00 a.m. to 5:45 p.m.

The students at El Sembrador score above the national mean on the SIMCE exams. For Grade 4 and Grade 8, the school's SIMCE exam scores are in the top 10 percent of schools of a similar socioeconomic level; the scores are in the top 25 percent for high school (Grade 10). Most members of the school's leadership team have been at the school since the beginning. The leadership consists of the school's owner, the principals of each school level (pre-K, primary, and secondary) and the head of the Unidad Técnica Pedagógica (UTP—the Technical Pedagogical Unit). At El Sembrador, the head of the UTP, who works directly with all the teachers in supporting good classroom practices, is the driving force behind the integration of ICT into teaching. She is also a Master Teacher (MT) for the Essentials Course.

According to the head of the UTP and the principal of the elementary school, pedagogy at El Sembrador has changed over the years. The head of the UTP was a teacher when the school started. She noted that while the school used very teacher-centered, lecture-based approaches in the early days, the school was attracted by the reform in 1996. Both leaders thought that many schools in Chile just made superficial changes to comply with the reforms in name only. But, when they participated in the government training programs about the reforms, they liked much of what they heard, and they felt the new approaches were better for the students than the traditional approaches.

The central task of the UTP is to promote good practice in the school, and the head of the UTP has a clear vision of what she wants to see in the classroom. She stated that the school leadership expects teachers to use problem-based teaching approaches, to explain learning objectives to students, and to give students a voice in deciding how to attain those objectives. She expects teachers to be lifelong learners who reflect upon and improve their practice, design lessons that start from children's knowledge and skills, and create lessons that engage children in solving problems.

As she shared her thoughts concerning the characteristics of effective teachers, the head of the UTP made a very interesting distinction. She observed that she prefers teachers who may be weaker on content knowledge but who are able to create an engaging learning environment that motivates children to teachers who may know the content very well but are not able to inspire or engage the children in active learning. The teachers we interviewed echoed this sentiment and said that the head of the UTP was constantly finding professional development opportunities for the teachers at El Sembrador.

In keeping with the school's vision that good teachers are constantly improving their practice, the school has a strong internal professional support structure with the UTP. The Chilean Ministry of Education requires all schools to have a weekly teacher meeting for planning and training. El Sembrador takes advantage of this time for reflection and professional growth. Each year, the faculty selects a theme which they work on for the entire year. Last year, the faculty focused on lesson planning using an approach (*Planificación Modelo T*) that is similar to the "backwards design" approach in the Essentials Course.[38] The head of the UTP is assisted by three teachers who split their time between teaching and providing support to their peers. They offer internal training sessions, as well as encourage teachers to sign up for external professional development offerings, such as the Essentials Course or the new Intel Teach Essentials Online.

In addition to continuous professional development, El Sembrador has another key strategy that it uses to promote consistent classroom teaching practice—the school provides pre-made unit plans and assessment tools so that teachers do not need to develop everything themselves. One set of materials is a collection of unit plans that teachers at El Sembrador created in the Essentials Course and then refined as they piloted them in their classes. These units are aligned with the curriculum of El Sembrador, and teachers use them year after year. Another idea that El Sembrador took from the Essentials Course is creating a library of assessment rubrics for different ICT products or projects.

ICT at Colegio El Sembrador

El Sembrador's use of technology predates its participation in the Enlaces program in 1997. The school's founder saw technology reaching into every corner of society and felt that students should have access to computers, so the school purchased its own computers. As El Sembrador had computers, it joined a program called Enlaces Abiertos (Open Links), which offered training to the teachers. The school now has five ICT labs, some with as many as 20 computers. Teacher computers are available in the UTP office, and the school also has digital cameras for students to use as well as a couple of projectors. Some teachers also have their own laptops which they bring to school.

El Sembrador's vision of technology as an interdisciplinary tool reflects the messages of the Ministry and the Enlaces program. Technology is spread throughout the curriculum as a tool to support student learning. As noted, the head of the UTP was aware that many other schools in the Enlaces program never effectively integrated ICT into the classrooms, and she spoke about the challenges she faced. Teachers had many complaints or excuses—lack of time to use ICT, lack of resources, their own training or poor student skills—but the school worked hard to overcome these obstacles. Some of the strategies they used are evident in the case study: ample time in the labs, frequent professional development opportunities, close coordination between classroom teachers and lab teachers, schoolwide planning, and pre-made resources to name a few. And, the teachers have had training on specific ICT resources such as Excel or an online library of educational applets from Spain called *Zona Clic* (http://clic.xtec.net/es/index.htm).

[38]See Wiggins, G. P., & McTighe, J. (1998). *Understanding by design*. Alexandria, VA: Association for Supervision and Curriculum Development.

The layout of the ICT labs reflects a conscious decision of the school to promote collaborative group work. In each lab, the computers are arranged around the four walls with room for two or three chairs at each computer. Work tables where students can work "offline" are located at the center of the lab. Both schools in Chile used "ICT lab" (*sala de informatica*) instead of "computer lab" to underscore that they were not simply teaching computer skills.

All students at El Sembrador have two ICT lab sessions per week. The ICT teachers are all classroom teachers at the school who take on this extra role. For example, the same fifth-grade teacher runs the ICT lab for all five fifth-grade classes. She teaches ICT while her own students are in English or Music. The school uses classroom teachers who know the content to ensure that the ICT activities are coordinated with the classroom teachers and the classroom content. The school values ICT as a tool for more than simply learning to use computers. According to one of the computer teachers, "the object is not to teach them computers, children are always going to know more! The thing is to teach them other things—skills and behaviors—like researching."

This value was echoed by a focus group of 10th-grade students, who said that they used technology in almost every subject for research and to create publications, Web pages, and presentations. We also saw this in one of the lab sessions we observed. Students were doing projects around a novel they read in class (*Alfonso Caso: El Explorador de Monte Alban*). As part of the project, they were making brochures, presentations, and a Web page using their reading of the book to answer the question "Can we learn about human culture through literature?"

Students and teachers alike mentioned a variety of common uses of ICT. Teachers spoke of using the Internet to conduct reference research and to make PowerPoint presentations. Additionally, the teachers at El Sembrador challenged students to act as researchers and make their own interpretations of primary documents or raw data on the Web. In one instance, we observed a lab session where a teacher asked students to examine photographs of Chilean life in the early 19th century and reflect on how these images contrast with the official interpretation of Chile's history. During an interview, a fifth-grade teacher spoke about using a game program, Tangram, to engage students in exploring geometric patterns. The teachers also spoke about using subject-specific software for students to explore difficult concepts. Two teachers at El Sembrador had recently completed Intel Teach Online and were experimenting with blogs. We observed a class of seventh-grade students working on blogs about the Industrial Revolution in Chile.

El Sembrador also participates in a community technology program run by the Ministry called *Enlaces Comunidad* (Community Links). This program offers free ICT classes for parents of students, which have been very popular among the mothers. The school estimates that about 60 percent of families have a computer at home, and this program helps the parents learn how to use that resource as well.

El Sembrador's Learning Environment and Use of the Essentials Course

El Sembrador got involved in the Essentials Course in 2004 when the head of the UTP was asked to become an MT in the course. After her training, she trained 40 of the 60 teachers at the school between 2004 and 2005. She has also trained 20 teachers from other schools in the area. She and the other leaders we interviewed noted that El Sembrador worked hard to avoid the problem of many other Enlaces schools, in which ICT became a teacher planning tool but did not make it into the hands of students. Although the school was already integrating ICT into classrooms, she reported that the Essentials Course introduced the school to two new things—inquiry-driven learning with essential questions and the use of holistic rubrics for student assessments.

The teachers and leaders at El Sembrador said they value the essential questioning strategies, the ideas of student ICT products, and the rubric assessments of the Essentials Course, because these techniques require students to take responsibility for their learning. All three of these facets are combined at El Sembrador to make the learning process explicit and transparent to the students. Due to the length of the school day, and the fact that many class periods are two hours long, the teachers are able to incorporate these innovative approaches into the formal in-class time. In all of the classes we observed, there was very little teacher lecturing, and at many times, the students were engaged in debating, creating, or analyzing something. Below, we describe the inquiry-driven learning environment, discuss how the school has woven essential questions into the learning environment, briefly examine the use of project work, and outline the central role that Essentials Course rubrics play in assessment and student learning.

The Learning Environment in the Classrooms of El Sembrador

The educators at El Sembrador identified two approaches to teaching that met their goal of creating a constructivist learning environment for students and discussed the differences between them. One approach is "problem-based" learning, which is promoted through the Enlaces program. In this approach, they said, students are presented with a specific problem, which they are then asked to solve, and solving the problem requires the learners to put into practice the content knowledge they have been learning. The other approach is using Essential Questions (see discussion below)—which they got from the Essentials Course and define as challenging students with complex, open-ended questions that require students to develop a process to answer the question—to support student investigations and projects.

At El Sembrador, we observed four classes: a Grade 5 ICT lab session, a Grade 6 social studies lesson, a Grade 7 ICT lab session, and a Grade 10 history class in the ICT lab. The school's desire to create a student-centered learning environment in the classrooms is evident in the head of the UTP's expectation to see "students working on solving problems or researching and taking responsibility for their work" when she visits classrooms. The students' description of a good teacher suggests that they experience this new learning environment. When asked to describe a "good teacher" in the focus group, students said that a good teacher:

- Offers models and examples to explain the content or the task at hand

- Speaks in a language that students understand
- Interacts with students
- Encourages students to disagree with him or her when they have a well-reasoned argument

Their hallmarks of a good teacher suggest they are in classes where the students have an active role in exploring the material, developing their own understanding, and sharing that with the class.

The teachers we interviewed also reflected on the learning environment in the classrooms, which they saw as a substantial change from the early years at the school. One fifth-grade teacher said that before the reforms in 1996 she used a lot of rote strategies, such as dictation and writing out answers. Now students are more like researchers picking, choosing, and analyzing information. This has changed her role in the classroom: "My role has changed a lot. Before, everything I said was the law. Now the children dissect, debate many topics. There are many ways to see things that are valid." The school's approach to ICT use fits right into this pedagogical model; creating the projects is the active process through which students engage with the content.

Common strategies that we observed in the classroom, and that were supported by the Essentials Course, were the use of essential questions, projects, and rubric assessments.

Essential Questions: The teachers at El Sembrador felt that Essential Questions work well to guide long-term projects and give students a lot of autonomy, whereas problem-based approaches are more suitable for shorter, discrete learning activities that last for a single lesson. Teachers noted that project work helps students dig into the content, but Essential Questions enhance this work by helping students develop skills and abilities. A high school history teacher valued the Essential Questions "because, by following a question, the students acquire a lot of the content through research" making the information more meaningful or relevant. For example, a science teacher used the Essential Question, "how does human activity affect the ecosystem's equilibrium?" to spark and focus students' learning. And, in a Grade 6 social studies class that we observed, which was starting a new unit on the 20th century, the teacher used an Essential Question to introduce a four-week project that would shape their lessons. The Essential Question she posed to the students was "what are the decisive events in 20th-century Chile?" This question meant that as students learned about the 20th century, they would determine the key events and forces that shaped Chile.

Projects: The school does many projects, and in every class we observed students were working on projects. (As noted, the UTP has a bank of Intel projects created by teachers during their participation in the Essentials Course that is available for all of the teachers to use.) Our observation of the Grade 6 social studies class referred to above provides a glimpse into how teachers at El Sembrador utilize project work. At the start of the 90-minute period, the teacher presented the project "what were the decisive events in the 20th Century Chile?" She noted that the project would take four weeks, and then she engaged students in collaboratively establishing the parameters of the project: key

concepts to learn about, the procedures to research and investigate the concepts, the attitudes and values they expected to develop in the project, and how this new knowledge might apply to their lives. Some of the concepts the students offered were proletariat, capitalism, and mono-production. This entire process took 20 minutes, but then the teacher transitioned to a lesson on Chile's early 20th-century economic system. This was basic information students would need to select key events and factors in history, but they were also engaging in other activities related to Chile's import-dependent economy in the early 1900s.

In the ICT lab sessions we observed, students' project work occupied most of the time and the students were generally working in groups to complete the ICT product that was the end result of their work. In one lab session, the students were analyzing early photographs of Chile on the Internet to understand how life conditions varied between social classes or racial groups, and this work would become part of their final product. The congruence between the work we observed in the ICT lab and that of the Grade 6 social studies class described above illuminates an interesting facet of education at El Sembrador—it appears that while teachers at El Sembrador use different teaching approaches and types of lessons, the projects serve to connect the content.

Not only do the projects give students a meaningful process to engage with the content, teachers value the group work and technology piece that come with the projects because it encourages students' collaboration skills. One teacher said that she appreciated the Essentials Course because when she participated in the course she learned the techniques of giving students distinct roles and responsibilities within the group. Normally fifth- and sixth-grade students have trouble working together, but these strategies facilitate her students' teamwork.

Rubric Assessment: Assessment and evaluation is a fundamental issue at El Sembrador. The school leadership believes that ongoing, continuous assessment and monitoring is fundamental to creating and sustaining a student-centered learning process. Students need to know what is expected of them and to have a way to judge their own progress towards these objectives, and these objectives need to be more than a simple test score. Rubric assessments have developed into a key component of the learning process at El Sembrador, and leaders credited the Essentials Course for the school's use of rubrics. By using rubrics, the school is able to make students responsible for their learning and give students control over the process, and teachers and students alike mentioned that the rubrics are a valuable tool. Teachers share the rubrics with the students, some teachers design the rubrics with the students, and many teachers have students assess each other using a rubric.

In a focus group, 10th-grade students explained the assessment strategies to us. The students like the rubric assessments a lot because they "always know where they stand" and how their work is progressing. They were quite definite that they could judge the quality of their own work and knew when they needed help and when they were doing well. They reported that they generally know the grade they should get for each project. If there are discrepancies between their expectations and the final grade, the teacher

encourages them to review their evaluations and to share their concerns with the teacher. These students were proud of their ability to raise concerns with the teacher in a respectful way.

Case Two: Escuela Pedro Aguirre Cerda, Comuna Calle Larga, Fifth Region Chile

Escuela Pedro Aguirre is a small rural school in the township of Calle Larga at the foot of the Andes. One of six schools in the Calle Larga municipal school system, it serves mostly children from low-income families. The municipality plays a strong role in leading the school system. The national government provides a flat amount of money per student, but the township provides additional funding because the national funds are insufficient. Calle Larga has a smaller student/teacher ratio because most of the schools are rural. Therefore, Calle Larga employs more teachers than a typical Chilean school. There is a strong leadership team formed by the Municipal Director of Education and the Head of the Municipal UTP. The current Director of Education was the former principal of the Pedro Aguirre School. Together, this team sets forth a vision of teaching and learning that focuses on classroom interaction, research, effective and varied use of all educational resources, and process monitoring or continuous assessment. The Director of Education (the former principal of Pedro Aguirre) was very clear that ICT should be used to "deepen learning and not just be an add-on activity."

The township participates in a great variety of educational programs offered by the Ministry of Education: Enlaces; Bicentenary Project; School Management 2008; the Programa de Mejoramiento de la Calidad y la Equidad de la Educación/Rural (Program for Improvement and Quality of Education/Rural), also known as the "MECE-Rural" program (in which the township has participated since 1998); the Essentials Course; and the Healthy Schools project. The head of the UTP commented, "When you have nothing, you'll put your name in for anything." The programs have helped the schools acquire ICT resources and many training opportunities.

Both of the school system's leaders support the educational reforms promoted by the government since the 1990s, and they both know well the challenges of creating a real change in the classroom. Creating this change has been a focus of their efforts for many years. Although the Ministry offered a number of professional development programs explaining the reform vision, Calle Larga augments the Ministry's professional development with its own professional development and other strategies to support change. Across the system's 57 teachers, only a portion of teachers are comfortable with and using the new student-centered approaches. The Head of the UTP feels that she needs to constantly supervise and visit teachers to keep promoting these new practices. They consider Pedro Aguirre to be their best school in attempting to integrate ICT and student-centered learning.

Pedro Aguirre Cerda School is a complex of three, one-story buildings at a bend in a dirt road. The school is fenced in with two grassy fields for football and school events. Each building is a line of classrooms that open up onto the courtyards. The school has 97 students from pre-K to Grade 8. There are six classroom teachers, and an additional five

teachers visit the school to teach Music or English or to provide special education services. With only six teachers for eight grades, some teachers have combined classes—combining Grade 1 and Grade 2, for example. The average class size is 15 students.

The school follows the national curricula, and by Grade 8 students are covering eight content areas. As part of the Healthy Schools project, a small medical clinic at the school offers students medical attention on certain days. The school also provides lunch for the children. The students' scores on the Grade 4 and Grade 8 national exam are above the 70th percentile among similar students nationally.[39]

As noted, Pedro Aguirre is part of the special MECE-Rural national program for rural schools, and it has participated in the project since 1998. The MECE-Rural program provides resources and trainings. In addition, as part of this program, each month the Pedro Aguirre faculty hosts a full-day teacher meeting with colleagues from another rural school. During the meeting, they work together to improve their teaching and to do professional development.

ICT at Pedro Aguirre School

The Enlaces program gave the school its first three computers in 1997, and the school now has 15 computers in the ICT lab, four laptops, a digital camera, a TV, a printer, two LCD projectors, and a wireless network that extends about 300 meters around the school. The school has acquired its infrastructure through various strategies—from township funds to parent activities to different government programs. For example, the laptops and wireless networks are part the national School Management 2008 program.

All classes have two ICT lab sessions a week, but the teachers reported that it is easy to schedule extra lab time whenever they need to do so because the school is so small. Since the teachers have all completed the Essentials Course, they work with their own students in the ICT lab, and there is no separate ICT teacher. Additionally, the laptops and projectors allow teachers to integrate ICT in the classrooms, especially for students' presentations.

The initial teacher training in ICT was part of the Enlaces program. The experience of Pedro Aguirre School and Calle Larga Township with Enlaces is similar to El Sembrador. Those we interviewed told us that a strong push from the principal and the UTP was necessary to get teachers to use the technology with students. The Municipal Director of Education was quite proud of the accomplishment. She noted, "We put it into practice! Which is the hard part!" even though she estimated it's still less than half of Calle Larga teachers.

The former principal of Pedro Aguirre spoke more in-depth about the process of getting her school to use technology. She commented that while there was initial resistance from teachers after the Enlaces trainings, she and other teachers began experimenting with technology. As a principal, however, she saw that the technology was not being used in

[39]SIMCE results for every school in Chile are available at http://www.simce.cl/.

appropriate ways. The teachers had realized that "cut and paste" was really easy: "I started supervising and I saw what was going on! I saw teachers projecting their notes and the students writing down notes." This did not match her vision of ICT as a tool for learning. The educational leaders are clear that the objective is ICT use that deepens the learning process.

The Essentials Course at Pedro Aguirre School

As noted, in order to keep driving change in the classroom, the leadership at Pedro Aguirre and Calle Larga is constantly looking for professional development experiences for their teachers. In 2006, a colleague from another municipality invited the then principal at Pedro Aguirre to become an MT for the Essentials Course. The municipality liked the Essentials Course because the content of the course aligns with and supports the other changes they are trying to make. They feel the course complements Chile's curricula and national reform efforts and reinforces the vision of Enlaces for ICT use with students. The former principal feels that one of the strengths of the Essentials Course is that it does fit so well with Chile's reform agenda, and it does not introduce contradictory approaches or messages.

The teachers at Pedro Aguirre took the course in 2007, and a project about insects, Pequeños Habitantes (*Little Inhabitants*), grew out of the training. Participating in that project deepened teachers' understanding of the role ICT can play in the classroom. One teacher commented that her experience with Pequeños Habitantes made her want to use ICT to change how her students learn. For example, she noted that in the past she would have had students type out poems of Gabriela Mistral (Chilean Nobel prizewinning poet) in Word, but now she has students do a research project about Mistral that brings together video, book reviews, and their own interpretations of the poet's work.

The learning environment in the classrooms of Pedro Aguirre School

As a small school, the teachers and students form a close community with a long history together. This is evident in the life of the school. For example, the eighth graders that participated in our focus group have been together for eight years. The teachers reported that they share strategies and suggestions since they have all taught the same students. This sense of common concern is apparent, for example, in the current principal's discussion of the school's learning needs. The teachers were not happy with the students' scores on the last national exam (SIMCE) and had created a program where teachers would support each other's students by tutoring the low-performing students during their free time.

We observed three of the six grades at Pedro Aguirre: the first and second graders in their classroom and the third, fourth, fifth, and sixth graders in the ICT lab. All of these classes are multi-grade, and the teachers reported that this requires a lot of planning. One teacher commented that there is no official curriculum for multi-grade, and they have to create a combination on their own. In the classes we observed, students spent most of the class time working on their own or in groups. For example, in the Grade 1 and Grade 2 classes, the teacher was doing a mini-lesson with the first graders while the second graders were working independently drawing pictures of new vocabulary words.

In all contexts, the teachers kept whole class lecture to a minimum, only using this strategy to give instructions to the class, and students were generally active working with materials or the computers in the rest of the class. In the ICT lab sessions, the students were very fluent with the technology, and all the groups got started on their projects with a minimum of set-up time from the teachers. The teachers spent the class time circulating among the students asking questions, pushing them to reflect on their work, and providing technical assistance when needed. The common strategies we observed in relation to ICT were project-based lessons.

Projects: The teachers at Pedro Aguirre do a lot of schoolwide projects that involve all students from all grades. Each year, they try to do at least one special project. Sometimes, the projects focus on the content. In other cases, the projects serve to connect the school to the life of the community. Students' first project, for example, was to do histories of all the old houses in the village by collecting stories, names of the inhabitants, photographs, etc. As noted, in 2007, after taking the Essentials Course, the school did the multi-grade Pequeños Habitantes project. Each grade did an insect-themed project connected to the curriculum and shared the results with fellow students. Then, the seventh and eighth graders compiled all of these experiences into a blog.

With a perspective the resonates with the Essential Course, the former principal explained that she does not like the commonly used strategy of assigning students to do reference research to find information about a topic, as in "You will be researching about amphibians," because it does not qualitatively change the learning process. She said, "Typically, students get a thousand pages and they cut and paste information" into a presentation. The former principal wants there to be a "guiding question that orients the process" of students exploring the materials to develop their own answers to a complex question.

The students in the focus group were excited about the projects they had done and could explain the different projects they had done in the past, such as Pequeños Habitantes or when they made a movie. The students do two kinds of projects. One type of project at the school is just for a single course. For example, we observed the third and fourth graders in the ICT lab doing research and building presentations about the impact of different inventions for their "Technology and Society" class. The teachers also create schoolwide, multi-grade projects that, although they connect to the content, also have a clear intent for the children to all work together and to reach out to the community. The community project for this year was centered on collecting stories from grandparents. The students were interviewing their grandparents and then creating a book of the stories.

Examining the Chilean case studies

The following section uses the analytical framework of the seven key factors to examine how each of these schools has been able to realize the changes they sought to make by experimenting with new teaching strategies, integrating ICT use with students, and following up on the Essentials Course.

Pedagogical objectives and goals

In Chile, educators saw a close correlation with the Essentials Course and government education reforms. The educators we interviewed understood Chile's reform agenda, the promotion of student projects, and the use of ICT resources as an integral part of the learning process. All of the teachers we interviewed felt that the ICT use and projects were valuable learning experiences for their students; none of them expressed that they felt like they were using ICT merely to comply with government regulations. In their conversations, educators at both schools shared that they view the Essentials Course as aligned with these goals and as giving them the training and skills to enact the goals in the classroom. Additionally, El Sembrador was working hard to incorporate new assessment strategies into their classrooms, and they valued the rubric assessment materials in the Essentials Course.

Leadership

Educators in Chile appear to be sensitive to the fact that many teachers seldom follow up on professional development in their classrooms. The leadership at both schools was proud that they and their teachers had carried the new approaches and tools from the Essentials Course into the classroom to the extent that they have.

The leaders played central roles in motivating teachers to experiment with ICT and projects. Sometimes they used positive strategies, such as modeling, to promote change. For example, the former principal at Pedro Aguirre was also a teacher, and she would use ICT with her students. However, the leaders also reported that they had to exercise authority and push reluctant teachers to take risks and experiment.

The Chilean cases also highlight the importance of pedagogical leadership in promoting change. In both schools, the head of the pedagogical support units (the UTPs) were fundamental to the change process. They consistently connected the changes they were asking teachers to make back to student learning and provided guidance and support whenever teachers needed it.

The leaders also made key decisions about how to use available ICT resources in a manner that facilitated student ICT use. In both schools, for example, students had two ICT lab sessions a week and lab time was used to support the content areas. At both schools, content teachers worked with the students in the lab to ensure that lab activities reinforced the content areas.

Professional development and ongoing support

Both school communities value professional growth and seek out opportunities to learn about new teaching practices. The structure of Chile's school system and the UTP are an important component of this. In El Sembrador, the leaders' perception is that good teachers always learn and improve their practice, and the UTP constantly provides opportunities to support teachers' ongoing learning. At Pedro Aguirre, where they have monthly MECE-Rural meetings, the municipal UTP brings in professional development opportunities, and the municipality participates in many government programs, bringing in new practices and training.

Educators in both schools reflected on the importance of early professional development from the Ministry about the reform in the late 1990's. The leadership in both schools credited the reforms as a guiding ideal and said that those trainings helped them begin to rethink their practice.

In relation to the Essentials Course, MTs at both schools—the former principal at Pedro Aguirre and the head of the UTP at El Sembrador—provided ongoing support around the program. Both played active roles in their schools in supporting, encouraging, and pushing teachers to follow up and experiment with their unit plans in the classroom. El Sembrador uses a very interesting strategy of creating a bank of unit plans to facilitate implementing ICT and project-based approaches in the classroom.

Experimentation, adaptation, and critical reflection

Perhaps because there are so many changes being promoted by the Ministry in Chile, both schools expressed a willingness to experiment and take risks with new programs. For example, the municipal Education Director said that they will put the school's name on the list for just about any government program. And, El Sembrador was also active in joining in experimental projects and programs from the Ministry. This attitude connects back to the schools' support for the new vision of teaching and learning embodied by the reforms and a desire to offer their students a different environment.

Both of these schools used the Essentials Course and the unit plans designed during the course to create opportunities for the teachers to experiment with new teaching practices and the ICT in a supportive environment where teachers could take risks to experiment. In each school there were supportive leaders—the principal and the heads of the UTP—to help the teachers during their initial use of the Intel-designed unit plans.

Time

Because of full-day schooling, teachers in both schools felt they had enough available class time to use ICT in class. Students have two lab sessions per week, and teachers reported that it was easy to schedule additional time if needed. But, time in the lab is only one dimension of time that can be problematic for teachers; there are also issues around planning time. Here, too, both schools have developed strategies to create time for teacher planning and reflection or create pre-made teacher resources tailored to the school's needs to alleviate time demands. For example, as noted, Pedro Aguirre has a monthly day-long meeting for teachers to plan and reflect on their teaching as part of the MECE-Rural program. El Sembrador also has weekly planning time for teachers, as well as offering the UTP's bank of ICT-rich unit plans and rubric assessments.

Infrastructure

The schools have sufficient computers and labs to provide students with easy access to technology for learning activities. The larger school, El Sembrador, has five labs to facilitate scheduling students. The smaller Pedro Aguirre School can make do with one lab. Each school also has laptops available so that teachers can take ICT into the classrooms, offering them greater flexibility in when and how they can use ICT.

Financing and sustainability

The subsidized and municipal schools have different financing structures. In the Chilean system, both schools can apply for many government programs that provide infrastructure and training. Pedro Aguirre has built up its infrastructure mostly through these government programs, even though the municipality also provides additional funding to the school system. El Sembrador, as a subsidized school, has more resources available. Thus, although the school participates in many Ministry-sponsored professional development opportunities, the leaders have also decided to invest the school's own resources in buildings a strong ICT infrastructure.

The Essentials Course in Chile

The research in Chilean education reform reflects the complexity of the challenges in creating real change in classrooms. The Ministry has sought to create the conditions needed to support the new teaching paradigm—including new curricula, a longer school day, and professional development—but the final step of a meaningful change in the classroom is still difficult. In their oversight of the educational technology component of the reforms, the leadership of Enlaces sought more strategies to promote ICT use in classrooms. They selected the Essentials Course to help them move towards this goal because they perceived that it aligned with their vision and targeted classroom use.

The schools we visited in Chile reflect that challenge and reveal how schools and school leaders are actually overcoming those final hurdles to changing practice around ICT use. The educators we interviewed were sensitive to the fact that many teachers seldom follow up on professional development in their classrooms. The leadership at both schools was proud that they and their teachers had carried the new approaches and tools from the Essentials Course into the classroom to the extent that they have. The leaders played central roles in motivating teachers to experiment with ICT and projects. Sometimes they used positive strategies, such as modeling, to promote change. For example, the former principal at Pedro Aguirre was also a teacher, and she would use ICT with her students. However, the leaders also reported that they had to exercise authority and push reluctant teachers to take a risk.

The schools we visited saw a close correlation with the Essentials Course and government education reforms. The educators we interviewed understood Chile's reform agenda, the promotion of student projects, and the use of ICT resources as an integral part of the learning process. In their conversations, educators at both schools viewed the Essentials Course as aligned with these goals and as giving them the training and skills to enact the goals in the classroom. Additionally, El Sembrador was working hard to incorporate new assessment strategies into their classrooms, and they valued the rubric assessment materials in the Essentials Course.

These committed school leaders on the ground were able to leverage the Essentials Course in two ways. First, they are using the Essentials Course as a training opportunity focused on core objectives of Enlaces and the new curricula that serve to reinforce key messages of the reform. Second, the unit plans teachers create in the Essentials Course offer a way for school leaders to push teachers to experiment, at least once, with the new

approaches and tools. The unit plans become a vehicle for teacher experimentation that allows them to grow comfortable with and refine their understanding of the new tools and approaches.

Turkey

The Context of Turkish Education

In Turkey, the education system is highly centralized, with the National Ministry of Education (MNE) performing the majority of decision-making across the country. The Turkish education system was created after the founding of the Turkish republic in 1922. The MNE oversees education directorates in each of the 81 provinces that are responsible for implementing the national programs within their schools. Since the 1990s, Turkey has been undertaking systemwide reforms to modernize and expand its school system as well as to align its system with European Union norms.[40] These include a shift to expand compulsory education and efforts to decrease class size, introduction of a new curricular approach and materials, the use of ICT, and efforts to provide teachers with professional development. In alignment with its professional development strategy, the MNE piloted and then scaled the Essentials Course.

Compulsory education and efforts to decrease class size

In 1997, Turkey expanded compulsory education to eight years starting at age six.[41] Four years of secondary schooling follow the eight years of basic education. This change has increased the demand for both trained teachers and school buildings. Turkey has set the goal of ending the "two-shift" structure of schools in which the same building is used for two populations of students:[42] one in the morning (e.g., from 8:00 a.m. until 12:40 p.m.) and one in the afternoon (e.g., from 1:20 p.m. until 6 p.m.). This has required the government to undertake a large building program. In the meantime, many schools still use a two-shift structure because they cannot otherwise meet their communities' demand for education.

The schools in Turkey range dramatically from large urban schools to many one-teacher schools in rural, farming communities. Turkey also has public boarding schools that accommodate students from smaller villages that may not have a local school. Both of the schools we visited worked on a two-shift schedule, and one of the schools we visited was a public school with a population of boarding students.

The high demand for schools also means that Turkey has not yet hit its target to reduce class size to 30 students; nationally, the average primary school class size is 38.6 students.[43] In the schools we observed, classes ranged from 50 to 60 students. In a two-shift school, the school day is under five hours and is divided into six 40-minute class

[40]Baki, A., & Gokçek, T. (2005). Comparison of the development of elementary mathematics curriculum studies in Turkey and the U.S.A. *Educational Sciences: Theory & Practice, 5*(2), 579–588 (p. 582).
[41]Baki & Gokçek (2005, p. 581)
[42]This is a component of the "Contemporary Education 2000 Project" as cited in Education for All 2000 Assessment, Country Report Turkey. (1999). Retrieved February 3, 2009, from http://www.unesco.org/education/wef/countryreports/turkey/rapport_2.html
[43]Otaran, N., Sayn, A., Güven, F., Gürkaynak, I., & Satakul, S. (2003). *A gender review in education, Turkey 2003* (p. 21). Retrieved February 7, 2009, from www.unicef.org/turkey

periods. In Turkey, each class of students is together for the entire day, students remain in the same classroom for most of their lessons, and subject teachers rotate into the classroom. In lower primary, the teacher continues with the same students. For Grades 1 to 5, students are together with each other and the same teacher for all five years. In Grades 6 to 12, subjects are "departmentalized," and teachers with content specializations rotate through the classes. First- through third-grade students have seven content areas, which include religion and English on top of the core areas of language arts, social studies, art, music, and mathematics. There are 10 content areas in Grades 4 to 12 that include sciences, health/physical education, technology and design, and optional ICT courses.

New curricular approach and materials

The Turkish curriculum for primary and secondary were reformed in 2005.[44] The objectives of the new curriculum are to create graduates who are highly skilled, productive, ready for the information age, hold democratic values, and are lifelong learners.[45] The previous curriculum used teacher-centered methods, such as explanation and demonstration, to cover content that students were expected to memorize.[46] But, the new curricula, based on constructivist pedagogical principles and the theory of multiple intelligences, promote more student-centered techniques, such as individual and group work to encourage students to explore and develop skills. One innovation for Turkey is that the course materials that accompany the new curricular approach—*Textbook*, *Student Practice Book*, and *Teacher Guide*—are prepared as a set. These materials explicitly state the approaches, skills, activities, and assessments to use.[47] In our interviews, teachers said the new materials greatly reduced the need to plan lesson themselves.

ICT in Turkish education

The Turkish ministry has been promoting the use of ICT in schools since the 1990s, but early attempts were either small in scale[48] or considered not very effective.[49] However, the MNE was able to launch a large-scale effort in Phase 1 of the Basic Education Program, 1998–2003, that distributed thousands of computers to schools.[50] This initiative is providing the basic infrastructure to enable teachers and students to use ICT. As in almost all countries, classroom use of ICT still lags behind the policy expectations. Some of the challenges to the increased use identified in Turkey are lack of support from

[44]Gomleksiz, M. N. (2005). An evaluation of the effectiveness of new Turkish primary school curriculum in practice. *Educational Sciences: Theory & Practice, 5*(2), 371–384 (p. 372).
[45]Akinoglu, O. (2008). An analysis of 2004 Turkish social studies curriculum in the light of new millennium trends. *Social Behavior & Personality: An International Journal, 36*(6), 791–798 (p. 797); Baki & Gokçek (2005, p. 581); Gomleksiz (2005, 372); Otaran et al. (2003, p. 23).
[46]Baki & Gokçek (2005, p. 583)
[47]Baki & Gokçek (2005, p. 582); Yangin, B. (2005). Evaluation of primary education Turkish curriculum and the guidebook. *Educational Sciences: Theory & Practice, 5*(2), 509–516 (p. 511).
[48]Schware, R., & Jaramillo, A. (1998). Technology in education: The Turkish experiment. *Information Technology for Development, 8*(1), 29.
[49]Yasar, S. (1997). *Expanding the effective use of computers in middle and high schools in Turkey* (p. 2.). Eskisehir: Anadolu Üniversitesi Kütüphane ve Dökümantasyon Merkezi.
[50]Akbaba-Altun, S. (2006). Complexity of integrating computer technologies into education in Turkey. *Journal of Educational Technology and Society, 9*(1), 176–187 (p. 176).

principals, lack of teacher training, shortage of technology coordinators, and weak ICT curricula.[51]

Professional development for teachers

With all the changes occurring in the Turkish system, professional development has become an important dimension. Most researchers suggest that retraining in-service teachers is one of the central challenges in promoting changes in the classroom.[52] In relation to ICT, research suggests that many of the in-service trainings for content-area teachers are insufficient: Unqualified trainers deliver the courses; training content does not focus on issues relevant to classroom experience; and the trainings do not focus on engaging teachers in hands-on activities with the technology.[53] The Essentials Course is designed to address most of these issues. Additionally, although teachers are mandated to complete in-service training, there are no other incentives for teacher participation.[54] The only incentive reported to us by teachers is that in-service trainings strengthen a teacher's ability to request a transfer to another location or school.

The Intel Teach Essentials program in Turkey

The Essentials Course launched in Turkey in 2003, and by the spring of 2007, 77,290 public school teachers had already been trained in 81 provinces of the country.[55] Within the larger reform context of Turkey, the Essentials Course offers teachers professional development in using ICT to support student-centered, project-based learning activities. The Essentials Course in Turkey follows the basic structure as the international program, but has been extended to a 60-hour training. The STs and MTs are selected and hired by the MNE. The MTs are based at the provincial education directorates and in larger towns and provide training to teachers in schools in their area. Based on research that shows that teachers who implement the units they design during their participation in the Essentials Course are more likely to change their practice, the Essentials Course in Turkey has a Facilitation Process to follow up on the training. Each semester, each MT works with five schools that have recently completed the training to support five teachers in each school with implementing their unit plans. During the Facilitation Process, with guidance from the MTs, the teachers refine their units as they plan for implementation, then they take what they have learned from the initial implementation to adapt or change the unit.

[51] Akbaba-Altun (2006, pp. 181–184)
[52] Akbaba-Altun (2006, pp. 181–183); DeMirel, O. (2006). Education in Turkey: Modern and contemporary. In R. Zia (Ed.), *Globalization, modernization, and education in Muslim countries*. New York: Nova Science Publishers; Yangin (2006, p. 277–278).
[53] Akbaba-Altun (2006, p. 185)
[54] DeMirel (2006, p. 282)
[55] Aydin, C. H., M. Ataizi, et al. (2007). The Intel® Teach Essentials Course Turkey evaluations: October 1, 2006–March 30, 2007. Eskisehir, Turkey, GLOKAL**:** 17 (p. 1).

The Turkish Case Studies

Case One: Burak Reis School, Ankara, Turkey

Burak Reis is a K–Grade 8 public school in Sancan, an outlying neighborhood of the city of Ankara, Turkey's capital. The school serves the children of mostly middle to lower class families in a neighborhood that is constantly growing from the influx of migrants from rural Turkey. Students mainly live in the nearby area, but a significant amount of parents hire private buses to have their children brought into the school from distant areas within the Ankara province.

The Burak Reis campus is a walled complex in a suburban neighborhood. The building is three stories tall with a large open asphalt play space in the back. Each floor is similar in layout, with one long hallway with rooms on both sides. There are offices at the beginning of each floor with classrooms down the rest of the hallway. In the basement, there is also a showcase area used for student presentations and meetings.

Because the neighborhood has grown so fast, the school is confronting the challenge of overcrowding. Burak Reis serves 2,300 students and employs 60 educators, with an average student teacher ratio of 55:1. To serve such a large number of students, Burak Reis operates in two shifts as discussed above. Both shifts have students from each grade. Even with two shifts, the classrooms are often crowded because of the large class sizes. This has important implications for teacher workloads and the use of student-centered activities in the classroom. Whereas a classroom teacher (Grades 1 to 5) may oversee 50 students' learning process, a subject teacher in the upper grades may be responsible for over 300 students.

ICT at Burak Reis

The school has limited ICT resources given the size of the student population. The principal reported having more than 60 computers in the school that can be used for teaching. There is one computer laboratory within the school that contains 21 computers that students share. There is also a computer in the front of the lab for the instructor and an overhead projector for demonstrations. There are additionally 15 computers in the classroom, and some teachers use their personal computers. Also, the school received a donation of 350 Classmate PCs from Intel, which the school dedicates primarily to Grade 5 and to a lesser extent to Grade 4. There are six cohorts of fifth-grade students, and six cohorts of fourth-grade students, which is nearly 600 students.

Some of the classroom teachers reported that because the Turkish curricula introduces ICT in fifth grade, the fourth- and fifth-grade students are targeted for technology. All students share the school's computer lab, but the fourth- and fifth-grade students have priority in using the lab since the teachers feel they need the lab to follow up on their Classmate PC activities. The computers in the labs are connected to the Internet, with wireless access and one additional landline available in the Grade 4 and Grade 5 classroom area. The wireless system was installed with support from the parents of fourth- and fifth-grade students. Fourth- and fifth-grade students are the highest users of technology in Burak Reis. Other grades may also use the computer lab, but this can cause

scheduling conflicts. In interviews, as well as in the focus group, the upper grade students and teachers reported very little use of the lab. The students in particular expressed their frustration with this and said they missed the ICT work they had done in the lower grades.

The school has a full-time technology coordinator who oversees the lab and works with the students while they are in the lab. The technology coordinator is expected to coordinate activities with the classroom and subject teachers within the school, and he is currently working on projects with 13 teachers, mostly from Grade 4 and Grade 5. The technology coordinator at Burak Reis is a former classroom teacher (Grades 1–5) who requested the position of coordinator after taking the Essentials Course and experimenting with the ICT-supported, project-based learning with his fifth-grade students. Because of the large class size, he often works with half of a teacher's class in the lab while the teacher does an alternative activity with the other half, then they switch.

Teachers in Grade 4 and Grade 5 use the Classmate PCs for student projects and research—although some teachers reported challenges using the Classmate PCs. One fifth-grade teacher stated that without a computer class that explicitly teaches students how to use the Classmate PCs, students took a long time just to learn how to operate the computers and had endless questions. To avoid this problem, this teacher decided to only use PowerPoint because it was easy for students. She felt that using PowerPoint was an effective means of education in its own right.

A fourth-grade teacher stated that the Classmate PCs are a challenge because the students need to learn how to use them and logistics can take away from teaching time. She has not used her Classmates for months. She said dealing with the time to connect and learn how to use them is too time-consuming. Students need more free time to play with them, not class time. She felt that with 52 students, it's too difficult to engage them in computer work.

Yet, the teachers who did use technology perceived benefits for the students. A Grade 8 teacher reflected on how her practice had changed, "I used to just stand and lecture to the students. Now they are asking questions, presenting, and doing other thing. It's a very different environment. Some students respond better to this environment than others. Some students even guide others—using technology and in their assignments." Another teacher reported that although the Internet and computers may be difficult to use sometimes, students really enjoy them because they get to demonstrate their knowledge and ability.

Intel Teach Essentials Course at Burak Reis School

Teachers at Burak Reis reported that the ministry requires them to take the Essentials Course. Over the last three years, many teachers have taken the course, but others have still not begun the course. There are no MTs based at Burak Reis; instead MTs come to Burak Reis for the trainings.

The technology coordinator took the training and participated in the Facilitation Process created by Intel and the MNE in Turkey. He explained how he did his first ICT project as

an afterschool project. He believes that the philosophy of the Essentials Course is easily adapted for large classes, "but it's really good for afterschool projects." So he used his unit with the students after their regular shift. The principal was a key ally in getting parents to support this. In the beginning, families were hesitant to send students after hours, so he got a letter from the principal to parents. He divided his 50 students into two groups that came on different days. In the end, the parents and the students "loved" the project, which he believes had a big impact on his students. Even now, they come to visit his lab and continue to do ICT activities on their own, even though the teachers do not assign activities.

The teachers who took the course and have tried to incorporate technology and the pedagogy into their teaching have responded well. The ICT use that teachers most frequently spoke about and found most useful was PowerPoint. One fifth-grade teacher, who was using a variety of ICT tools, felt this was a problem: "Students of Intel teachers [PTs] are mainly just doing PowerPoint and think it's all about presentations. It's hard to use the pedagogical stuff, especially in some subjects like math."

Echoing this teacher's concern was a fifth-grade class we observed. Students were using Classmate PCs to research famous women in Turkish history in a way that deviated from the approaches in the Essentials Course. The assignment was to "find three facts about a famous Turkish woman" and create a presentation. Once the students got settled with the devices, students were cutting and pasting from search results directly into a PowerPoint presentation and then working on formatting.

Some teachers noted that they enjoy trying new technology in their classes and feel that it engages students and keeps them motivated. One fifth-grade teacher felt that her students will want to do more work with computers in Grade 6 since they enjoy the Classmates so much. She even said that "to them not using computers is like punishment. Some students are even doing extra PowerPoint [presentations]."

The Learning Environment in the Classrooms of Burak Reis

The school leadership credits the Essentials Course with inspiring many of the teachers to begin using technology with the students. The principal and teachers feel the new national curriculum encourages more student-centered learning, and that the Essentials Course is aligned to this vision. But our interviews and observations suggest that teachers are having a difficult time enacting this in the classroom.

During the visit to Burak Reis, we interviewed 8 teachers from multiple grades and 12 students from Grade 7 and Grade 8 and observed three classes: Grade 5 language arts, Grade 5 research period for social studies, and Grade 7 mathematics. All of the classrooms we visited had similar layouts. Each room had about six rows of pupil desks (each containing two or three students) aligned in three or four columns, facing a chalkboard, with a teacher desk in the front. If all the children were present, the classes were very crowded with 50 students. Some rooms had a computer for the teacher and a projector with a screen in the front. A few teachers, such as the observed fifth-grade teacher, even had a SMART Board.

The fourth- and fifth-grade teachers were most involved in trying to use technology since the school had made a decision to focus ICT resources on those grades. These teachers reported feeling more actively engaged with students. They noted that with the old curriculum, they would only have had time to stand and lecture. Now they can interact with students and let students lead the activities.

Most of the activities that teachers described or that we saw in the classrooms continued to be teacher-centered, with carefully scheduled moments for student-centered activities in some grades, like the research session we observed above. There were opportunities for students to share their observations through more open discussion. In interviews, teachers discussed the challenges they felt because of the large class size and the difficulty keeping the curricula on schedule and doing student activities. They felt that students were active learners when they were doing technology-based projects in the lab or in the classrooms.

Projects: Students in Grades 4 and 5 were using the Classmate PCs and the lab to do technology-based projects. Teachers reported that students in those grades were doing more group work as part of this engagement. The teachers were happy that students were taking responsibility and pride in their work and were working together to complete tasks. The students we interviewed—who had finished fifth grade and were now in higher grades—said they enjoyed the projects they did when they were in the fifth grade (these projects often consisted of creating presentations, as in the example of the famous Turkish woman activity described above). They said they liked the increased responsibility and the chance to work with their peers.

Questioning Strategies: In the classrooms, some teachers were attempting to integrate open-ended questioning as a way to give students more voice in the class and to move beyond memorization. A seventh-grade mathematics teacher attempted some questioning strategies, but the discussion was very guided, and the overall classroom reflected a teacher-centered environment. When not using Classmates, the observed fifth-grade classroom also followed a teacher-centered pattern. As a language arts lesson, we observed the fifth-grade students taking dictation as the teacher read a poem that they would have to memorize for the following day.

Case Two: Mustafa Kemal School YIBO, Çorum, Turkey

Mustafa Kemal is a K–8 public school in Çorum, a mainly rural province in the central northern region of Turkey. The school serves mostly students from middle to lower class families. The school is also a Regional Primary Education Boarding Schools (YIBO in Turkish). Most of the students live in the nearby area, but the school has 176 girls who board at the school. The boarding students live in villages without sufficient school space.

The Mustafa Kemal campus is contained within a suburban neighborhood. The building is three stories tall with a small parking lot in front and a large open grassy park beyond. There is an additional large play area behind the building. There are three computer labs

and a large presentation room. The boarding house for the students is located across the park in front of the building. This four-story building has a cafeteria and lounge areas, with the sleeping rooms on the upper floors.

Mustafa Kemal serves 1,410 students and employs 81 educators, with a student teacher ratio of from 24 to 30:1. Fifty-four percent of the student population is female. To serve the large number of students, Mustafa Kemal operates in two shifts, similar to Burak Reis. However, unlike Burak Reis, the first shift is for the upper grade students, and the second shift is for the elementary students.

The principal at Mustafa Kemal School has pioneered the use of an innovative leadership approach by establishing a leadership team for his school involving the principal and vice principal, the head of the parents' association (The School-Family Union), the technology coordinator, and representatives from the teachers for each grade and subject. The leadership team works together to decide how to resolve a number of issues at the school. For example, the team decides how to manage access to technology resources in an equitable manner. Team members felt they had a real voice on many issues. The communication between the leadership, teachers, parents, and students was quite good. The parents we spoke with, for example, valued the depth of caring and communication that existed between teachers and students. One father described the school by saying "all the teachers are idealistic here."

Another positive aspect of the parents' involvement is that they are very supportive of the new curriculum and the new pedagogical approaches with technology. For example, in the first-grade classroom we observed, parents owned the projector the teacher was using. The teacher—who uses his personal laptop for teaching—had created a website to communicate with parents. He informed us that parents get discounts on Internet connections if they have students. Students also reported that their parents were buying more computers so the parents could learn the technology, and the students could have access to them at home. The parents we interviewed felt that a home computer was important for their children's education. The parents also felt that their children had become more open, independent, and intellectually curious since the introduction of the technology projects. They said their children "feel special because they go to this school."

ICT at Mustafa Kemal School

Mustafa Kemal has had technology since 1999, when the school put in a computer lab. In that year, the school had extra funds, and the school leadership team decided to invest in technology. Where other boarding schools might purchase a bus, this school invested in a computer lab because they wanted the students to have access to technology. As the principal said, "Without information technology, there is no development." More recently, the school made a decision to invest its own resources to upgrade to a wireless Internet connection. The leadership team wants to build an infrastructure that will allow the students to take full advantage of new tools like Web 2.0 applications. The MNE just funds basic connectivity for all schools. The Mustafa Kemal school has used monies from the concession stands and the photocopiers to pay for high-speed Internet access.

The school now has three computer labs with 15 computers in each lab. At least five teachers also have computers in their classrooms. These computers are their personal computers or computers and projectors that parents of the students in the class purchased. As the teachers and students in Grades 1–5 are together for five years, parents sometime organize together to buy a laptop that they manage but lend to the teacher. There are also five administrative computers, including one in the teacher's lounge. Two of the labs have newer computers, and one lab has older, slightly outdated computers. Classes can use all three of the computer labs, but scheduling is not always easy due to the high volume of demand. As noted, there is Internet access in the computer labs, as well as a wireless connection that is available throughout the building.

The school has a full-time technology coordinator. He has held this position for one year and was a computer teacher at this school for two years prior to assuming his role as coordinator. His prime responsibilities, according to him, are to keep the labs functioning and ready for teachers to use, to work with the teachers while they are in the lab with their students, and to teach three ICT classes. He helps teachers with the software and IT parts of the lessons. For example, he helps students work with PowerPoint while the classroom teacher handles the content of the project. At Mustafa Kemal, the teachers come to the lab with all the students, and he stays to help. The IT coordinator estimates that 60 of 81 teachers use technology, but he wants all of them to try. Some of the things he reports helping with are students' research, Internet use, preparing presentations, Web site creation, looking for test prep sites, Excel, graphics, test-data analysis by teachers, and grading.

Technology use in classrooms is less common. Only teachers who had access to laptops and projectors reported using them to project notes, visual aids, or student presentations. However, the teachers we interviewed stated that they view technology use as an effective way to engage students and get them to take an active role in learning. They feel that when using technology, students can work in groups and take ownership of what they are learning and creating. One teacher even reported that technology forces him to keep up with new approaches to teaching, so it serves as a tool for his own professional development. The most common ICT uses appear to be Internet research and making PowerPoint presentations.

Some teachers at Mustafa Kemal expressed a concern with technology, noting that students often just use "cut and paste" and focus on the appearance of the materials rather than on content. We observed this trend in the student showcases that fourth- and eighth-grade students presented to us. Both groups of students had attractive slides, but most read directly off the presentations and used language that was too polished and complex to be children's words. The teachers, and even the students with whom we spoke, felt there was a problem with this approach, but they were struggling to find a solution. Some teachers said that they ask students to rewrite by hand information from the Internet, and others stated that they ask students to underline key phrases. The students were quite reflective on the issue. Students said that a few teachers ask them to "write in their own words." They said that while "cut and paste" is easier, they learn more and they enjoy learning more when they have to use their own words and ideas.

Intel Teach Essentials Course at Mustafa Kemal School

The Directorate of Education in Çorum has placed a special emphasis on technology integration and has strongly encouraged teachers to take the Essentials Course. In 2005, all teachers at the school received and completed the training together. And the school participated in the Facilitation Process as well. Since the school is in the provincial capital, Çorum, the trainers (STs and MTs) are close to the school and the school has good relations with the local ST, who provides a lot of support and encouragement.

In their interviews, the educators at Mustafa Kemal drew strong connections between the new curricula and the Essentials Course. One upper grades mathematics teacher, for example, stated that "the technology [in Essentials] worried him—especially how it could relate to math, but the new curriculum helped scaffold the process with the new pedagogical approaches." And, many teachers felt that the Essentials Course helped them better understand the student-centered and group work practices introduced in the new curricula.

The school has adopted a very systematic approach to promoting ICT and projects—one that attempts to ensure that all students and all teachers will get the opportunity to experiment with these techniques, despite the limited resources. From the Essentials Course, the school has developed a bank of ICT-supported, project-based unit plans spanning different grades, which they call "Intel projects." Each semester, as a faculty, the school decides which teachers and classes to schedule into the lab and chooses the project they will do. They use this process to ensure that as many teachers get to do projects as possible over the years, and that all students get a chance to do projects every other year, if not every year. The chosen teachers get extra time reserved for them in the labs during their project periods. Sixteen teachers are currently doing these Intel projects with the help of the IT coordinator. In the focus group with sixth and seventh graders, the students were happy doing "Intel projects because it's active and fun" and wished they could all do them every year.

An example of pedagogical change without technology came from a sixth- and seventh-grade social studies teacher. She said that she gives students a scene to act out with questions about the historical figures in the scene that they have to research. The students research and discuss the characters and their motivations before acting them out. An example she described was a scene where students took on the roles of leaders of the Ottoman Empire who were deciding whether or not to go to war. The activity engaged students in identifying and understanding the reasoning the leaders may have used.

The teachers also credited the Essentials Course with helping them begin to do teamwork and group work. The Essentials Course is designed to model student-centered practices in the training, and the teachers in Çorum said they really liked the way they learned by doing and working in groups during the Essentials Course. They connected that experience to the new curriculum. Teachers noted that they enjoy the teamwork and feel that students learn more and have more confidence when learning together. One teacher said students really get into "sharing ideas and thoughts with each other; they trust themselves. After the projects they like teamwork, themselves, and their friends."

Another thing this teacher liked about using teamwork is that "during projects, the students and teacher brainstorm ideas together, but the students develop the ideas, NOT the teachers."

A social studies teacher stated that, "Before Intel, students did not do teamwork. Intel helped by getting projects involved and giving kids a role and guidance to work together. In Turkey—kids want to learn from teachers, now they have to do research on their own and can learn more deeply. Otherwise students aren't motivated to learn. They work more if they have to learn and not just memorize. It is shifting towards teachers working less and just facilitating."

The learning environment in the classrooms of Mustafa Kemal School

During the visit to Mustafa Kemal, we interviewed 7 teachers and 19 students spanning Grade 4 to Grade 8. We were able to observe five classes: Grade 1, Grade 6 language arts, Grade 7 social studies, Grade 8 science, and Grade 8 mathematics (working in the computer lab). All of the classrooms we visited had similar layouts. Each room had about six or so rows of pupil desks (each containing two or three students), aligned in three or four columns, facing a chalkboard, and with a teacher's desk in the front. If all the children were present, there were about 25 students. Some rooms had a computer for the teacher and a projector with a screen in the front.

The teachers we interviewed spoke about the pedagogical shift that the new national curricula required and their attempts to make that change. The prior curriculum in Turkey called for most to all lecture-driven, teacher-based learning for student, and the principal suggested we interview one of his teachers who did not agree with the new ideas. This fifth-grade teacher believed "teachers should give information to the students first, then maybe other things can be done." He adapts the new curriculum to a lecture format for as much as possible. However, this is not the norm at Mustafa Kemal, and the majority of the teachers with whom we spoke said they were excited by the opportunities the new curriculum created for them to try new types of pedagogy.

Teachers in Mustafa Kemal also reported being more open and experimental with using technology and adopting a student-centered approach to teaching that features group work, makes use of open-ended questioning strategies, and involves students in project-based learning. Teachers reported that students were more engaged and actively learning with this method of teaching. The teachers' interviews and the observations indicate how the technology use and teaching strategies have shifted towards the goals of the MNE and incorporated strategies presented in the Essentials Course. The most salient teaching strategies were group work, questioning strategies, and projects.

Group Work: In all of the classes we observed, whether in the computer lab or the classroom, we saw how teachers integrated group activities into the session that allowed students to develop their own solutions or responses to information. In a sixth-grade technology and design class, students debated what constituted good design, and then they broke into groups. Each group had to take a simple drawing given by the teacher, develop a product from it, and explain the product's benefits and features. For example, one group created a flying car and explained the car's specification and abilities. In the

computer lab, we observed a math class in which students were working on a project to address the question "How would you teach the next lesson?" Students had to pick a topic coming up in the curriculum, do Internet research about it, and make a PowerPoint presentation or a brochure to help fellow students learn the new topic. The teacher also asked them to find real-world examples of this math concept. All the groups had defined roles (e.g., leader, presenter, writer). One student stated that "I won't listen to the teacher during a plain lecture because I don't have to, but now I have to learn to be able to teach to other students." He followed up by saying he loves using the technology and computer lab. Another student said that students "like working with friends and bouncing ideas off each other. We like picking our own topic and focus and learn better this way."

Questioning Strategies: We did not observe any sessions that were entirely teacher lecture, although teachers still coordinated and led most activities. The students were frequently engaged in class discussions of open-ended questions. For example, in one history class the students were learning about the massive immigration to Turkey of Bulgarians of Turkish decent in the 1950s and debating the question of what makes someone an immigrant or a returning expatriate. A fascinating example of combining ICT and questioning strategies to engage students was in a first-grade classroom with a teacher who was a strong proponent of technology. His students were using computer-projected images of village life to discuss the meaning of the picture and how it related to their lives. After each guiding question, students met and discussed in small groups then took turns reporting back and discussing their answers as a class. All the students were active in and engaged by this activity.

Projects: As explained above, this school has longer term projects, which they called "Intel projects" in most of the interviews. The teachers credited the experience in the Essentials Course with giving them valuable tips and ideas, not just on ICT, but on many of the teaching approaches that are in the new curriculum. The school uses a core group of project-based unit plans, which different teachers use during the year. Other teachers reported doing more projects by adding to the curriculum or adjusting the activities to include more research and deeper student learning. The new curriculum contains a "performance assignment" for each grade, for each semester. The curricular materials actually prescribe an activity, but many teachers at Mustafa Kemal extend activities by adding technology. An example was given by a first-grade teacher who was engaging students in a social studies activity about where they lived and what kind of environment they would like (gardens, community life, etc.). The activity required students to think, research, draw their dream neighborhood, and share and discuss their dream neighborhood with their peers. The teacher encouraged his students to use computers for the research and drawing and said he was doing at least 20 percent more student-centered teaching with technology since his participation in the Essentials Course.

Showcasing and student presentations: Another way that the teachers at Mustafa Kemal are giving their students new roles in the classroom is by having students present their work to each other. All of the Intel projects done by the students end in a product that they can present and discuss with their peers, typically a multimedia presentation or a model. Some of the classes we observed included student presentations, such as the

technology and design course, where each group presented their design to the class. For larger presentations, the school uses an auditorium with a screen and projector. We observed a series of student presentations on Ataturk and the 1923 Treaty of Lausanne, which ended World War I and recognized the new Turkish Republic.

Examining the Turkey case studies

The following section uses the analytical framework of the seven key factors to examine the progress made by these schools as they have experimented with new teaching strategies, integrated ICT use with students, and conducted follow-up on the Essentials Course.

Pedagogical Objectives and Goals

Professional development programs are likely to be most successful when there is a degree of correlation between the goals and objectives of the schools and the training materials. The educators we spoke with who were making the most changes saw an alignment with the new Turkish Curricula, which values student exploration and group work, and the Essentials Course. For example, the technology coordinator in Burak Reis stated he has seen that "students have moved from passive learning and memorization; now they are active, doing, typing, and researching" due to their engagement in ICT-supported research projects.

Mustafa Kemal is another example of a school community that has a clear guiding vision of the teaching and learning environment they want in their school that closely aligns with the Essentials Course. The teachers and leaders at that school were very clear that they valued the Essentials Course as a resource that helps them fulfill their pedagogical vision in the classroom.

Leadership

The experience of the two schools highlights the importance of instructional leadership in drawing connections between the schools' goals and vision and the new pedagogy and technology uses presented in the Essentials Course. These cases suggest that without effective leadership targeting ICT use, teachers will not be able to easily follow up on the training. However, both cases also suggest that leadership needs to come from more than just the principal. In both schools, the teachers who were able to integrate ICT and project-based approaches had assistance from an "instructional" leader who understood their classrooms and content and could provide personalized guidance, support, and encouragement specifically on pedagogy and ICT integration issues. At Burak Reis, the fourth- and fifth-grade teachers had a well-established professional relationship with the technology coordinate (a former fifth-grade teacher); at Mustafa Kemal, the school's shared approach to leadership made it easier to reach out to teachers throughout the building.

In Mustafa Kemal, the school spoke of a leadership team and made certain decisions as a school community. The leadership structure, at least on ICT issues, included the principal, vice principal, technology coordinator, and included representation of

classroom and content teachers. The principal, vice principal, and technology coordinator could clearly articulate a shared goal for the school for both pedagogy and technology.

This leadership structure formed a great sense of community and a shared vision across the school. This has enabled the school to deal with complex challenges such as sharing limited ICT resources. Among the leaders, the technology coordinator stated, "decisions are made as a whole team. We decide with the teachers which teachers and in which semester they will do projects. The decision is based on available resources and equity concerns of which teachers have not yet done a project."

The leadership and community also help promote collaboration among teachers since the grade-level decisions are made as a team. The teachers within each grade level share and plan together. They choose similar software and exchange lesson plan ideas and activities. The development of a professional learning community augmented the professional development provided by the Essentials Course. One teacher, for example, stated, "the most beautiful thing from Intel was the teamwork. With our team we learned to communicate very well and we came up with so many good ideas. If we had done this by ourselves it would not have been so successful."

Mustafa Kemal's strategies to involve parents are also crucial to supporting ICT use and pedagogical reform. Before the new curricula, families did not want students to use the Internet and technology, and they were resistant to "student research" since they thought it meant that the teacher was not giving students the information. But the school hosts family visits and meetings six times a year where they discuss each child's development and involvement in school activities. Over time, they have been able to educate parents about the value of these new strategies. Now, students learn how to search the Internet and do projects, and by working with the families the school has been able to garner the necessary support and motivation. As one parent reported, "Now the school has a good reputation and technology is part of that."

At Burak Reis, overcrowding creates a different context, and the school gives priority to a subset of grades. The efforts to champion ICT are led by the technology coordinator and he is able to best reach out and push the teachers in his prior networks. The classroom teachers, because of the structure of the first to fifth grades in Turkey, tend to share a stronger sense of community, and the fourth- and fifth-grade teachers at Burak Reis reported this. After the fifth grade, teachers are divided by departments and burdened with heavy teaching loads; the upper grade teachers at Burak Reis did not report significant collaboration with their peers. This may make it harder to support these teachers in integrating ICT as their school expands its efforts to spread ICT use.

Professional development and ongoing support

In Turkey, the educators with whom we spoke, echoing previous research findings, [56] had negative views of many of the professional development courses offered by the MNE, but the Essentials Course received positive reviews for two specific reasons: It modeled a student-centered classroom, and it offered ongoing support. Many other MNE programs

[56] Akbaba-Altun (2006, pp. 181–183); DeMirel, O. (2006, p. 277–278).

were seen as "boring; you just sit in the back and listen for hours." Teachers saw the Essentials Course as connected to the new curriculum and to what they were trying to do with new pedagogy and technology use. One teacher enjoyed the Essentials Course because "we acted like students, learning and working together, and created something. It was exciting." A teacher in Burak Reis stated that "the experience of the training as an active learner was exciting and made me think differently about my teaching." Another stated that "we laughed and learned in the training, we got to do things! I have had many PD programs, and most are boring and you just want to sleep."

This experience as a *student* was important in changing teachers' vision of teaching, learning, and ICT. For example, a fifth-grade teacher at Burak Reis stated that, "I have not had any pedagogical-focused training other than Intel course. Initially, I thought ICT was for teacher presentations, but during the course I learned that students can make things. I now have students do brochures, PowerPoint presentations; my kids even have a website."

The findings also suggest that the Essentials Course Facilitation Process established by the MNE and Intel was a key factor to each school's success. Both schools participated in the Facilitation Process. At Mustafa Kemal, the MTs worked with a number of teachers in the building, and the technology coordinator at Burak Reis said that participating in the Facilitation Process helped him see the power of technology for the students.

At Mustafa Kemal, the school follows up on any training with informal strategies that support professional learning. Mustafa Kemal has frequent meetings among the teachers to gather feedback and reflections about teacher needs. From those discussions, the school develops informal sessions or seminars to talk about a specific topic. They have three to four schoolwide teacher meetings a year to select topics, and in a given year, the school might offer 5 to 10 different small informal seminars. This might consist of simply reviewing and discussing the material from a previous in-service.

Another professional development issue that arose in Turkey was with the consistency of topics presented in the Essentials Course. In an interview with national STs, the STs reported that there was little ability to oversee all the MTs to ensure that they give the complete course as designed, and that many trainers were eliminating core aspects. For example, MTs often skipped Essentials Questions and curriculum framing questions—key components of a quality student research project. These reports echo the comments from many participants who said that they had not learned about Essential Questions in the training.

Experimentation, adaptation, and critical reflection

For most of the teachers we interviewed, implementing the unit plans they designed in the Essentials Course is an opportunity to experiment. Teachers are using new technologies, but they are also trying out new teaching strategies. For example, a teacher at Mustafa Kemal "is trying to change the 'I' to 'we' to build up a teamwork perspective in the way students approach learning." And Mustafa Kemal's technology coordinator said that with his new approaches "the students are active, noisy, and doing things," and he likes what this means for their learning.

It is important for schools to value experimentation and innovation, and the Essentials Course has promoted a new respect for experimentation. For example, a classroom teacher who is currently teaching first grade at Mustafa Kemal said he began trying a few things with technology and student-centered learning before the Essentials Course was offered across the school. At first his "efforts were booed. But then Intel gave me the framework to show everyone how [my methods] can be effective." He discussed how "teachers' initial resistance changed now they see how well it can work. They are even disappointed they have not gotten into it yet." He discussed how every year his cohort of teachers come together and share the experiences they have had with their new strategies, both pedagogy and technology. They use this to reflect upon and improve their teaching.

Infrastructure

Despite differences in the two schools' technology infrastructures and student populations, both schools perceived similar strategies and problems of implementation. Both schools had limited resources to support the new pedagogical strategies and technology use presented in the Essentials Course, and the actual change reflects what the infrastructure could support. Teachers often commented on the lack of time in the computer lab(s), and many could not or did not do Intel projects for this reason. The leadership in both schools was aware of this issue but could not fully solve it due to financial limitations. Each school chose different solutions. Burak Reis focuses mostly on facilitating the ability of fourth- and fifth-grade students to engage in ICT-rich projects. Mustafa Kemal, which has fewer students per teacher, attempts to balance all grades' use of the computer lab, although it may be limited, to encourage all teachers to truly shift their approach to teaching. As a school, Mustafa Kemal makes conscious decisions to rotate the classes that do Intel projects each semester. They also open their computer lab after hours and before school to students so they can work on projects.

There are also problems sharing the PCs within the labs, since the class sizes are so large, and there are only 15 PCs in each lab. Mustafa Kemal has installed a wireless connection to encourage teachers to buy laptops and thus have Internet connectivity in the classrooms. Teachers at Burak Reis send only half of the 50 students in a class to the lab to give each student more time with the computer. The presence of a strong technology coordinator is necessary for this process.

Time

Providing sufficient time for students to work with technology is an important challenge in using technology in Turkey. The teachers whose students used technology to do projects had to develop strategies to provide students with the time they needed. One teacher at Burak Reis experimented with different divisions between classroom and lab time. Her strategy was to do weeklong projects using the first three days for classroom lectures and the last two days in the lab for students to do their research and build a presentation. Another teacher did the projects as an afterschool activity. Also, the technology coordinator allowed students to use the computer lab when their shift was not in class. At Mustafa Kemal, many of the students did ICT research as homework. Teachers also reported that many students made arrangements to use the computers at the home of relatives or friends.

Planning time is another crucial factor for teachers to effectively implement the pedagogy and technology in the Essentials Course. Many teachers reported doing lesson planning on their own time in the evenings. But at Mustafa Kemal, the teachers get two weeks at the beginning and two weeks at the end of the school year to meet, plan, and train together. The school staff discusses ICT resources and projects as part of the schoolwide planning. They also pick one teacher to be a leader of the group.

Financing and Sustainability

Financing is always a challenge for schools attempting to implement new programs, especially those with a large component of technology. In both cases, the schools have limited capability to buy new technology, but they have used creative methods and worked with the community to raise money to support their new vision. The MNE supports technology use by providing a basic Internet connection and supporting the technology coordinator position. At Mustafa Kemal, the provincial directorate provided funds to upgrade the Internet. Families played a key role at Burak Reis by raising enough money to upgrade to a high-quality wireless system. Parents indicated that families were not asked directly by the school, but feel dedicated enough to their children's education to help when they can.

Mustafa Kemal uses their photocopying and concession stands to raise extra funds. Especially in earlier grades, when the teachers and students are together for five years, parents are motivated to combine resources to purchase computers or projectors for the class.

The Essentials Course in Turkey

MNE has incorporated the Essentials Course as one of many professional development programs offered nationally that are helping the ministry address long-term needs. Teachers felt there were two benefits to the Essentials Course: It modeled a student-centered classroom, and it offered ongoing support. Teachers enjoyed the Essentials Course because "they acted like students, learning and working together, and created something. It was exciting." Other research suggests that many training experiences are not engaging and ineffective.[57]

The Turkish cases suggest that the opportunity provided by the Essentials Course for teachers to be learners is important. This includes the Facilitation Process established by the MNE and Intel, as well as the course itself. Participating in the Facilitation Process allowed teachers at both schools to experiment and reflect on how to integrate the strategies and tools presented in the Essentials Course in their teaching. At Mustafa Kemal, the MTs worked with a number of teachers in the building, and the technology coordinator at Burak Reis said that participating in the Facilitation Process helped him to see the power of technology for the students.

[57]Akbaba-Altun (2006, pp. 181–183); DeMirel, O. (2006, p. 277–278).

This research suggests that the Essentials Course may help the MNE address some of the professional development challenges identified in the research; however, no single program is sufficient by itself. The case studies also suggest a number of school-level factors that enable teachers to implement the Essentials Course. Teachers' beliefs about their role as a teacher and how they need to help meet their students' needs are important. If teachers do not think that ICT activities or using projects will help their students, they will be less willing to use ICT. The educators who were making the most changes in their practice were excited about the new teaching approaches presented in the new Turkish Curricula, and they wanted to implement these new approaches, not just because it was required, but because they felt it was best for their students. Furthermore, nearly all of these teachers reported that ICT activities and the Essentials Course supported these new approaches. The teachers we spoke to who were not supportive of ICT use tended not to support a student-centered vision of teaching either. They expressed a vision of teaching that valued student memorization to "learn facts" and saw ICT as peripheral to the content or as distracting students from learning more important topics.

The experiences of the two schools also highlight the importance of instructional leadership at the school-level in drawing connections between the schools' goals and vision and the new pedagogy and technology uses presented in the Essentials Course. These cases suggest that without effective leadership, teachers will not be able to easily follow up on the training.

Conclusion

Understanding how technology fits into the complex realities of classrooms has been a critical factor in creating real change in schools in the industrialized nations,[58] yet little is known about educational technology projects in the classrooms of the developing world. This study seeks to redress this gap in our knowledge by examining how successful schools and teachers in India, Turkey, and Chile have been able to use their participation in the Essentials Course to promote ICT use and student-centered practices in the classroom. Using an instrumental case study approach, we explore more deeply the nature of the changes that schools in different contexts have made to integrate ICT and student-centered practices and how these changes have affected the classroom.

In all three countries, we found that the educators we interviewed felt they had been able to implement both new ICT activities and new teaching approaches with their students after the course. Additionally, we consistently found that no single factor or program accounted for these schools' ability to move forward. Instead it was a combination of programs and policies coupled with the motivation and skills of the educators in each building the enabled these schools to innovate. However, the ICT activities and teaching approaches that teachers applied to their work with students varied due to differences in each country's broader educational context.

The following sections address the two research questions about the impact of the Essentials Course on learning environments in a diversity of national contexts: (1) What are the factors that facilitate change at the school level? and (2) What are the changes to the classroom learning environment? –

Factors that facilitate change at the school level

Building from a large body of research on the factors that support ICT integration and educational reform, we focused on examining seven commonly cited factors to help understand the case studies: pedagogical objectives and goals; leadership; professional development and ongoing support; experimentation, adaptation, and critical reflection; time; infrastructure; and financing and sustainability.[59] The data from the six schools we visited provide insight into the mechanics of how these factors function in the context of developing country schools.
The following sections look across all six cases to outline the findings on the role of each factor in supporting change in the classroom.

[58] Somekh, Lewin, Mavers, Fisher, Harrison, Haw, et al. (2003); Honey, McMillan Culp, & Carrigg (2000); Cuban, (1993).
[59]See Ely (1990); Fullan, (1991); Hawkins, Panush, & Spielovogel (1996); Kozma (2003): ISTE; Light & Manso (2006); McMillan Culp, Hawkins, & Honey (1999); Pérez, Light, Vilela, & Manso (2003).

1. Pedagogical Objectives and Goals

The research on educational innovation suggests that it is important for schools to share a reformed vision of teaching and learning in order to create sustainable change at the school and classroom levels. Additionally, in respect to ICT integration, the research suggests that successful projects have clear and consistent messages concerning the role of ICT in supporting that vision and that teachers see how ICT supports their students' learning.

This is what we found in all six of these cases— the educators we interviewed talked about a vision of education that was student-centered, encouraged projects and student inquiry, and supported students doing research and bringing their perspectives into the classroom. Additionally, the visions of learning that these educators articulated were tailored to their particular schools. The schools were able to translate a broad, abstract vision, such as "student-centered learning," into a set of practical goals and objectives that were relevant to actual classroom practices and meaningful to teachers in their schools. And technology was seen as supporting this vision.

Both of the Indian schools, for example, spoke of wanting to make learning "joyful" and to "go beyond the textbook." But the Head Mistress in Mumbai spoke very clearly about the process of interpreting a goal like "joyful learning" into practical objectives. The Children's Academy founding vision was to "use best, innovative teaching practices," and after the Essentials Course, the school's leadership realized the mission needed more specificity. There are different approaches to teaching that support distinct educational visions, and the school needed to come to a decision about the "best practices" to achieve its vision. The school created two key objectives from the Essentials Course: (1) Students should do team projects to create their own products and (2) open-ended questions invite children to share their perspectives and be part of learning in a different way. Teachers are able to understand these objectives and put them into practice in the classrooms. The students participate more, do activities that go beyond the textbook, and they report enjoying the opportunities they get to share their opinions and ideas with the teachers.

The Chilean schools offered an interesting example about the need for schools to reinterpret, or take ownership of, an abstract or broad educational vision. The Chilean ministry has been promoting project-based, student centered learning since the 1990s but many experts feel that the changes still have not reached all classrooms.[60] Whereas many schools in Chile appear to have difficulty making changes in the classroom, these two schools reported a deeply felt commitment to this new vision, based on their students' needs and not the ministry's mandate, and had clear sets of practical objectives and expectations for teachers. Both schools spoke of how the ministry's vision resonated with their ideas of what would be good for students and of how hard they have worked over the years to put that vision into practice. For example, educators at El Sembrador were thinking deeply about how to put students more in charge of their learning process and make them responsible for their own learning. Consequently, they developed a set of practices to apply that vision to the classroom: Teachers were expected to use problem-

[60] Cox (2004, pp. 9-10); Dussel (2006); Valenzuela, Labarrera, & Rodríguez (2008, p. 137).

based teaching approaches, to explain learning objectives to students, and to give students a voice in deciding how to attain those objectives.

2. Leadership

Leadership at various levels of the system is important if an innovative project is to take root and grow. Most of these schools function with two levels of leadership— first there is the national or provincial ministry of education that sets overall policy, curricula, and national assessment, and second, there is the building leadership that makes the day-to-day decisions. While issues of national leadership are important for technology projects,[61] our research here focused particularly on leadership within the schools. Connecting to the discussion in the previous section, the school's leadership is the key nexus in the process of reinterpreting a broad, abstract vision into a practical vision.

The findings from these six schools suggests three observations of the role of building-level leaders in supporting a process of ICT integration and pedagogical innovation. First, leadership does not come only from the principal. In most of the schools, there were other figures who were strong leaders or advocates for technology and the Essentials Course. And, in each of these schools, the Essentials MT was a key figure. For example, the Chilean schools had pedagogical coordinators (e.g., the head of the UTP), who were central in encouraging teachers to use technology and new teaching strategies. The technology coordinators played this role in the Turkish cases. These instructional leaders were not only internal to the school. In two cases, the Essentials STs were important. For example, one of the schools in India was part of a program, Anupam, from a local teacher education institute, and the program coordinator, who was also the ST, was a strong support for the principal and teachers in integrating ICT and active learning strategies. And the ST in Çorum, Turkey, worked closely with the teachers as part of the Essentials follow-up programs

Second, in all of the schools, the leaders of the ICT push do not just set the vision and provide clear expectations for teachers, they provide support and guidance in teachers' classrooms. Most of the teachers had no prior experience with the activities they were being asked to do, and in all six of these schools, the principals, technology coordinators, and MTs were often in the classrooms with support, suggestions, and praise. For example, at Burak Reis, the technology coordinator was a close collaborator with the teachers, planning with each teacher what to do with their students in the computer lab. The principal in Fatehpura worked with the students at critical junctures in their projects. And, in the Chilean schools, the heads of the UTP were constantly visiting classrooms and planning with teachers.

Third, there are also specific administrative and logistic challenges around using ICT that school administrators have to solve. All of these schools had resource limitations on time, infrastructure, staff, space, and funding, and the administrators had to find solutions to allow change and innovation to take place with the resources that were available. ICT infrastructure is a constant problem for schools in developing countries, and the decisions

[61] Kozma, (2005); Hepp, Hinostroza, Laval, & Rehbein (2004).

administrators have to make are often frustrating because they cannot give all students all the access that they would like to give them. For example, Burak Reis has such a large student population compared to the resources of the computer lab, that the school felt compelled to make a decision to give priority access to a limited number of grades. Time, also, is a constant challenge in many schools. We have already commented on the strategy of the Indian schools to do the projects as an afterschool activity, and schools in both Turkey and India have made Internet research a core homework assignment.

3. Professional Development and Ongoing Support

For much the same reasons that supportive leadership is important to helping teachers innovate, ongoing professional development also appears to be a critical factor. In the context of education reform, the tools and teaching strategies are new to many of the teachers in these schools. Therefore, both the quality of the professional development course and the presence of ongoing support for teachers in their classrooms are important. First, the case studies suggest that the Essentials Course offers teachers multiple points of entry into practices supporting ICT use and student-centered teaching. This allows teachers to begin changing their practice from whatever point their context and current practice requires. Teachers in India, for example, were using the Essentials Course to support both project-based learning and the use of open-ended questioning strategies, while teachers in Chile were digging into the use of holistic rubric assessments.

The case studies also highlight two features of the teachers' professional learning occurring in these schools: The importance of using the Intel unit in the classroom as part of the program follow-up and the informal professional communities that exist in these schools.

Designing their own unit plan is a key strategy of the Essentials Course, and the case studies suggest how important it is. A common feature in all of these case studies was the teachers' use of the unit plans designed during the Essentials Course in their classrooms. The chance to implement an ICT-rich, student-centered activity allowed teachers to experiment and see for themselves how these new ideas, tools, and approaches could work in the classroom. This happened in each school. In Turkey and India, all four schools participated in the formal facilitation process with MTs and STs that is part of the Essentials Course in those countries. The classroom teachers credited the MTs and STs with being a great help and a constant source of encouragement. Chile did not have a formal process, but the UTP in each school supported the teachers in their experimentation with the Essentials-designed unit plans.

Another important characteristic of these schools, which helped them leverage the Essentials Course as a part of the change process, is that each of these schools has established a culture of constant improvement and professional learning. Educators at all of the schools talked about teachers meeting in groups to plan and discuss new strategies and to share challenges and successes. For some schools, these were faculty-wide meetings for sharing and planning, and at other schools, it was part of special project teams or grade-level meetings. For example, each year the faculties at both Mustafa Kemal (Turkey) and at El Sembrador (Chile) plan a common professional development

agenda for the year, and the school creates time for the teachers to meet and discuss new topics or bring in outside speakers to present. The Children's Academy frequently sends teachers to new programs, and they share new topics with their colleagues when they return to school. And the teachers at the village schools we visited in Chile and India, also had common meeting times to discuss their teaching and to plan together.

4. Experimentation, Adaptation, and Critical Reflection

These six schools offer interesting insight on the research literature's perspective regarding the importance of experimentation for ICT integration and education reform. The case studies reveal the role a culture of experimentation plays in schoolwide change and its relationship to leadership, pedagogical goals, and professional development. Educators in all of these schools exhibited a willingness to experiment and take the challenges of trying to do new things. If professional development provides teachers access to information about new tools and practices, there needs to be a willingness to experiment with novel ideas and an openness to reflect on the successes and failures in order to create positive changes.

In these schools, the culture of experimentation is promoted by the leadership and in line with each school's pedagogical goals. The leadership of the Children's Academy was very explicit about piloting new ideas and gathering critical feedback from teachers and students to decide how to proceed. For example, the Children's Academy trustees piloted a computer lab and evaluated its use, and in doing so, discovered that the students liked the lab but the teachers had more reservations. From there the school developed a strategy— including the Essentials Course— to promote deeper integration.

The leadership of some schools also established a culture that was willing to trying anything that might help their students. For example, the pedagogical coordinator from the UTP at the Pedro Aquirre School expressed their desire to search out and sign up for new programs, commenting, "When you have nothing, you'll put your name in for anything." The faculty at the school also knows that they will get help to try out new things, and there are no negative consequences for them if the experiment is not successful.

The experience of a teacher in Turkey highlights the importance of a culture of experimentation as well as the importance of the broader school community understanding and valuing innovative activities. A classroom teacher at Mustafa Kemal had tried a few technology and student-centered activities before the Essentials Course. According to him, his innovative "efforts were booed. But then Intel gave me the framework to show everyone how [my methods] can be effective." He reported that teachers' initial resistance changed once the Essentials Course helped change the broader school culture to value experimentation with ICT. Now his cohort of teachers come together and share the experiences they have had with their new strategies, both pedagogically and with technology. They use this to reflect upon and improve their teaching.

5. Time

Much like a physical resource, time is a scarce resource that schools need to carefully manage. Time needs to be viewed in two dimensions: (1) teachers' professional development and planning time and (2) students' time in the classroom or learning activity. Each school developed their own strategies depending on the particularities of the larger system. Some strategies were teacher specific, such as a teacher at Burak Reis who, after experimenting with different divisions between classroom and lab time, decided that weeklong projects worked best, using the first three days for classroom lectures and the last two days in the lab for students to do their research and build a presentation. But, most of the schools needed to develop a schoolwide approach. For example, to provide sufficient planning time, Mustafa Kemal used two weeks at the beginning and two weeks at the end of the school year to meet and plan and train together. Both schools in India, as mentioned previously, integrated project-based activities as afterschool opportunities for their students. The Chilean schools benefited from the government's expansion of the school day to at least eight hours, and teachers at both schools reported being able to do projects and to easily schedule extra computer time if needed.

6. ICT Infrastructure

In most developing countries, ICT Infrastructure is also commonly a limited resource in schools. With limited resources, it is often difficult for schools to provide sufficient access so that students can use ICT during their classes. The case studies suggest that no single strategy will work for all schools with resource limits. Instead each school developed unique strategies to provide meaningful learning activities using ICT tools, whether it was teachers using ICT-based teaching aids or student ICT use.

Although, both the Indian schools had computer labs, there were still too many students to give classes consistent and frequent ICT access during the school day. Thus, the schools in India distributed part of their ICT resources in such away to enable teachers to use ICT-based teaching aides during class time, and students worked on ICT projects afterschool. In Mumbai, the school had a computer connected to a large TV in each classroom, and the village school had a computer and projector that could be moved around the school. The Turkish schools sought to integrate student ICT use into the classroom. Although both schools in Turkey had similar problems with limited resources, each school developed its own solutions. One school concentrated ICT efforts on the middle grades classrooms, and the other school assigned certain classes to do ICT projects each semester and rotated the assignments throughout the year. Chile, in this regard, was atypical, since both schools reported sufficient infrastructure and class time to do ICT activities during class as the teachers needed.

7. Financing and Sustainability

Costs and sustainability are ongoing challenges for all of these schools when attempting to bring in new, complex resources such as ICT. These schools attempt to do two things to manage sustainability of their ICT activities: first, they try to obtain resources from as

many sources as possible, and second, they try to control the costs related to ICT activities.

All of the successful schools utilize multiple strategies to obtain funds or ICT resources. There are three basic sources of funding the schools rely on. First, all three countries now have government programs that provide an infrastructure to support these schools. The government programs provide the schools with a basic level of resources, but each of these schools has gone farther. A second critical source is the community: These successful schools have developed good relations with the surrounding community, and the communities value the ICT initiatives of the school. Fatehpura school, for example, was the first school in the state to raise funds from the community to buy its own computer back in 2002. The Turkish schools reported strong support from the parents associations, which provided both schools with broadband Internet access. And, the schools also received support from companies, such as Intel, which donated 300 Classmate PCs to Burak Reis. Finally, some schools had their own small sources of revenue. Some of the public schools have concessions, such as a school café or a photocopy shop. And while both the Children's Academy and El Sembrador were private schools, they were careful in their expenditures since both wanted to keep tuition low.

These schools also attempted to control other costs associated with ICT, such as ink, paper, and peripherals. Some schools limited the amount of printing students and teachers could do. And for class projects like printing a booklet or making posters, schools sometimes required that students purchase the paper. Not all schools had peripherals available, such as digital cameras or scanners, and some principals reported that this was a due to cost factors.

Changes to the classroom learning environment

The previous section discussed the common factors across all six schools that supported teachers and schools in making change, and in this section, we want to look across all six cases to at what changes were happening in the classrooms. The other research question that started this project asked what were the changes that teachers were beginning to enact in the classrooms after the Essentials Course, given the diversity in local contexts. Turkey, India, and Chile represent three different regions of the world; each country has a different history, different education system, and different challenges.

Although each country is unique, and each school is at a different starting place, all are moving toward more student-centered, project-based, and ICT-rich classroom learning activities. Across the diversity of their situations, educators in each school connected the ideas and tools offered in the Essentials Course with their own needs. From our case studies of the six schools, we identified four common dimensions of change that are emerging to support more project-based and ICT-rich activities in the classroom:

1. *Changes in teachers' knowledge, beliefs, and attitudes*
2. *Changes in how students engage with content*
3. *Changes in relationships among teachers, students, and parents*
4. *Changes in the use of ICT tools to promote students' learning*

1. Changes in Teachers' Knowledge, Beliefs, and Attitudes

Because all schools in the study were considered successful, we explored what teachers had changed in their own practices. In the interviews, we asked teachers to discuss what they had learned from the Essentials Course that was useful for their classroom practice. Three themes emerged across all six schools as the teachers spoke about what they found to be valuable for their teaching: (a) their beliefs about how students learn were shifting; (b) they had a deeper understanding of new teaching strategies; and (c) they had improved their knowledge of how to use ICT as a learning tool, as well as strengthening their ICT skills.

a. Teachers' beliefs shifted to a constructivist paradigm of teaching and learning. Teachers expressed a growing belief that students could learn through exploration and discovery. The Essentials Course and, more importantly, the experience of implementing a project-based or ICT-rich learning activity appeared to influence teachers' understanding of how children learn. The interviews suggested the teachers began to value learning as different from memorization and to see that students could learn by exploring content, conducting research, and applying knowledge to real problems. For example, a Chilean history teacher remarked upon the difference from the traditional approaches of having students memorize information: "By following a question, the students acquire a lot of content through research."

In all six schools, teachers also expressed their belief that students learn more than just content with projects and Internet research. Many teachers recounted what they did "before" and "after Intel," and their descriptions consistently included how students "learn more deeply," "have more confidence," and "are more motivated" by the new ways of learning. They reported that students were developing skills and attitudes such as self-assurance, curiosity, collaboration and teamwork skills, presentation skills, and organizational skills. In appreciating how effective group work had been, a teacher in Turkey reported that, "Before Intel, students did not do teamwork. […] In Turkey—kids want to learn from teachers, now they have to do research on their own and can learn more deeply. Otherwise students aren't motivated to learn." A second Turkish teacher commented that students "were sharing ideas and thoughts with each other" and learning to "trust themselves."

b. Teachers deepened their understanding of student-centered practices. Teachers reported improving their skills with innovative teaching practices. Although some countries had more experience than others, across the board, nearly all the teachers we interviewed valued project-based approaches and reported doing projects with their students. Teachers had very clear ideas about how project-based approaches could support student learning by allowing students to explore content as they respond to a research question or problem posed by the teacher. They felt the project approaches made the content more relevant to students and required greater intellectual effort for students to find and synthesize information, which led to students learning and retaining more information.

At schools in Turkey and India, principals and teachers credited the Essentials Course with helping them learn how to do projects for the first time. In Turkey, teachers told us the Course helped them better utilize the project ideas offered in their new national curricula. One school in India had been experimenting with projects prior to participation in the Essentials Course, but the teachers reported that this professional development experience gave them a solid template and a set of strategies for project-based approaches. In Chile, teachers told us that the Course helped them learn about inquiry-driven, project-based strategies in addition to the problem-based approach supported by their ministry.

While teachers from all three countries agreed that the Essentials Course supported their use of student-centered practices, each country's context and educational goals influenced which topics were of most interest to teachers. For example, while all the teachers spoke about using group work and collaborative learning, the teachers in Turkey were very excited about the collaboration strategies presented in the Essentials Course. Turkey's traditional approach to teaching is lecture-based and emphasizes individual student activities, and teachers reported that they did not have any previous experience with collaborative learning. Group work and collaboration are, however, part of the new Turkish curriculum and reform efforts, and teachers expressed appreciation for how the two programs supported each other. The curriculum contains many group activities, and the Essentials Course offers strategies to facilitate group work, as well as follow-up support to practice these strategies with coaching from their MT.

In India, teachers found the "Essential Questions" strategy to be compelling. Essential Questions (e.g., Why do we need others?) are intriguing, open-ended questions that organize a project and are an effective way to encourage students to think deeply and to provide them with a meaningful context for learning.[62] The Indian curriculum is very demanding and the school day is crowded, so teachers felt that they could not easily integrate project work into every class. While they could not do projects during the class period, they were, however, exploring the use of questioning strategies to push students' critical thinking and to allow students to share their perspectives and formulate their own conceptual understandings of the content. For example, one teacher asked her students what they thought the impacts of British Colonial policies were on the farmers, and a social studies teacher asked students what they valued about their community. Teachers felt that asking for student input was a significant change. As one teacher commented, they no longer just "stand and teach," but facilitate discussions and encourage children to share their knowledge. The teachers we visited felt the open-ended questions and ensuing dialogue between teachers and students might be the foundation of a new relationship between teachers and students.

El Sembrador in Chile, which already had a lot of experience with ICT and projects, focused on the use of rubric assessments presented in the Essentials Course. The principal noted that teachers were facing increasing challenges in assessing students' work as the school moved toward complex, technology-rich student products, such as presentations and websites. Through these products, students mastered more than just content, and

[62] Wiggins & McTighe (1998).

teachers wanted to value all aspects of students' learning. They considered the rubrics—designed to capture the range of skills, attitudes, and content that students develop—as a key way to address these challenges. The teachers were also using rubrics to put students more directly in control of their learning process; students know from the beginning which aspects of the content teachers will evaluate.

c. Teachers improved their ICT knowledge and skills. Teachers reported that they had developed the skills needed to initiate or increase the use of ICT with students. Most of the teachers in India and Turkey reported little ICT experience before Essentials, whereas most Chilean teachers had previous trainings and experience using ICT. Regardless of their experience with ICT, all teachers we interviewed who took the Essentials Course reported they increased their knowledge of how to use ICT as an educational tool. For teachers with no prior experience, the Course helped them acquire basic skills. However, all of the teachers commented on how the Course helped them see ICT as a pedagogical tool. The strategy of having teachers design a model unit of their own choice appears to allow teachers to work on skills and areas that are new and challenging for them.

2. Changes in How Students Engage with Content

The introduction of ICT into schools and the use of project-based approaches and Internet research have changed how students interact with the content in a number of ways. In the site visits, teachers and students spoke about three types of new learning activities that would, according to the literature, contribute to a constructivist learning environment: (a) learning through projects, (b) conducting Internet research, and (c) connecting school content to students' lives.[63]

a. Project-based work gave students a chance to collaborate, use multiple resources, and direct their own learning. In all the schools, student projects were fundamental to bringing student-centered instructional strategies into the classrooms. The Essentials-trained teachers we interviewed spoke of doing projects with their students. Despite variations among project designs, a few core features emerged. In almost every site, projects gave students chances to work collaboratively and challenged them to take on new roles and responsibilities; students worked in groups and often had to coordinate efforts to complete the projects. Also, all of the projects described included research and culminated in a final product that required students to synthesize and share what they learned. For example, in Fatehpura, the students did a project about water use and irrigation. They visited local experts, surveyed the community, collected data, and researched solutions. As a result of the students' examination of drip irrigation, and their proposal of how farmers could use this new strategy, the village converted to drip irrigation. Again, the teachers in India could not fit the project into the class time, so students did a lot of the work before and after school. The municipal school in Chile did a multi-grade project on insects, in which the younger grades collected bugs and wrote reports, and the older grades helped them create a website.

[63] Windschitl, M. (2002). Framing constructivism in practice as the negotiation of dilemmas: An analysis of the conceptual, pedagogical, cultural, and political challenges facing teachers. *Review of Educational Research, 72*(2), 131–175.

b. Independent Internet research gave students autonomy and a chance to develop and share their own perspectives. Internet research was a constant theme in these schools. Teachers, students, and parents all spoke about having students do Internet research for homework and as part of the projects. Teachers often asked students to bring in additional information on topics in the textbook (e.g., in a Turkish project, students researched systems of the human body), or to research additional topics or themes (e.g., after a lesson on farmers under the British Empire, a history teacher in India asked students to research the condition of Indian farmers today).

c. Connecting school content to students' lives made learning more meaningful to students. We found that many of the projects teachers designed connected students' school work to their home life and their community. In a very simple sense, the increased use of practices such as open-ended questions and group work allowed students to share the perspectives and knowledge they bring from home. For example, a teacher in India asked her students what they had eaten for breakfast and then used this as the start of a nutrition lesson, and a Turkish teacher had his first-grade students discuss how an animated story related to their own families and lives.

Yet many of the project topics also engaged students in examining real-world issues or concerns that gave them an opportunity to connect "school learning" with the real world and allowed them to develop their own opinions and perspectives about the issues. For example, the Indian village that did the irrigation project mentioned above also did projects on clean water and public health. Other projects were less ambitious, but still meaningful, such as the Chilean school where students collected stories and images from the community to publish in a booklet for their families.

Our interviews with parents in the Indian and Turkish sites also supported the perception that students were becoming a source of new information for their families. Parents credited their children's increased use of Internet research with providing them with current information to which they would not otherwise have had access. Students are generally more excited by information they find themselves than the contents of a textbook, and parents reported that their children were rushing home, eager to share what they had discovered.

3. Changes in Relationships among Teachers, Students, and Parents

In keeping with the new activities and roles for students, the teachers and students in the schools we visited reported that they were transforming how they interacted. The changes in teaching practices in these schools are part of a broader change in relationships within the school and between the school and the community. The educators and students described changes in the ways they collaborated with each other that grew out of the new teaching practices (e.g., project-based approaches, open-ended questions), integrating ICT into the schools (e.g., Internet research or presentations), or both. We noticed that teachers, students, and parents reported changes in three sets of relationships: (a) among the students; (b) between students and teachers; and (c) between the school, the parents, and sometimes the community.

a. Projects and ICT activities fostered collaborative relationships among students. Many of the teachers and parents interviewed said that students were developing a range of social and interpersonal skills that they attributed to the projects and the new roles that students were taking on. As noted, students in every school were taking on new responsibilities as they worked on projects—leading teams; conducting research; writing reports; debating with peers; and making presentations to peers, teachers, and parents. A Chilean fifth-grade teacher explained how her students were developing the skills and maturity to work as a team, even across grade levels, because of the collaborative techniques she learned in the Essentials Course. Some of the parents also commented on their children's maturity and responsibility. A Turkish father noticed a change in his daughter's attitudes since doing the "Intel projects." He observed that before teachers participated in the Essentials Course, his daughter did not share her things with anyone. After her teachers participated in the Course, his daughter began to share more with friends, and she enjoyed working in teams. The father also said that, as a result of her involvement in projects and team work, his daughter completed her school assignments independently at home and no longer asked him for help.

b. New teaching strategies allowed teachers to develop more collaborative and interactive relationships with their students. The teachers reported that, as their teaching practices changed, their relationships with their students also became more open and supportive. Teachers began to allow more intellectual discussions between themselves and their students, and students were more willing to approach teachers and share concerns and opinions. The teachers and parents in Mumbai were, perhaps, the most eloquent. One group of teachers commented that, as children, they had been afraid of their teachers, and they were happy that their students no longer "fear the teacher" but gladly ask questions and give opinions.

The students we interviewed echoed these sentiments. A group of high school students from the school in Santiago, Chile, explained that a good teacher is one who encourages students to disagree when they have a well-reasoned argument. A student from Mumbai shared a similar perspective: "I like that whenever I do a report I can include my own critical opinion—it is not just cut and paste. And I can learn many things outside of the textbook."

c. Innovating with projects and ICT strengthened the relationships between the school, parents, and the community. The parents we interviewed were excited by the introduction of community-focused projects and student research, and they expressed pride in what the schools were doing for their children with technology. A group of parents in India praised their school "because of the new technology, [the school] is innovative. They have very high performance, but it is not just academics-oriented." In the four public schools we visited, parents and the community had also initiated efforts to bring additional ICT resources to the schools by donating equipment or paying for improved Internet connections. However, the parents also remarked on the new teaching practices and what these changes meant for their children. All of the parents we interviewed commented on how the school was developing the whole child since the project work was supporting teamwork, independence, and self–confidence. Parents in India and

Turkey highlighted their children's growing confidence and independence to do research or make public presentations, and they also noted the caring relationships between students and teachers.

4. Changes in the Use of ICT Tools to Promote Students' Learning

A core aim of the Essentials Course and a central objective for the ministries in Chile, Turkey, and India is to encourage the use of ICT as a learning aid for students. Although the administrators and teachers we interviewed in all six schools told us they wished they could do more, to the extent permitted by resources, space, and time, students were using ICT for learning activities. PowerPoint presentations and Internet research were, by far, the most common ICT tools that students used.

All six schools promoted student use of ICT, but each adopted different strategies to realize its goals. In Turkey and India, with short school days and tight schedules, the teachers had to strategically make time—either by working outside of class or rationing access—for students to complete their ICT projects. For example, the teachers at the Anatolian school in Turkey told us that they meet as a team each semester to decide which classes will do long-term projects to ensure every student gets a chance each year. The Chilean teachers had more flexibility to schedule lab time during school hours, although they also did afterschool activities. Perhaps the clearest change is that, in all six schools, teachers gave students Internet research activities for homework. For instance, a math teacher in India assigned students to calculate average rainfall in different parts of the world using online databases, and a Chilean history teacher had students analyze online photos for life conditions in 1900s Chile.

Tying things together

This paper presents the findings from our fieldwork that describe the nature of the changes taking place in the classrooms in these six schools as they integrate ICT activities and the factors that enable the schools to make these changes. Since the governments point to these schools as positive examples, their experiences can help contribute to an understanding of the process of integrating ICT into the schools of developing countries. While some educators we observed are more skilled than others, and some changes in practice are just emerging, all six schools are making changes beyond just the use of new tools. The teachers are developing new beliefs about teaching and improving their knowledge of new practices; their students are engaging with content in new ways; and the relationships between teachers and students are changing relationships. And, both groups are using new ICT tools to support learning. That three of the four common dimensions of change are pedagogical shifts, and that they are changes in pedagogy that are supported by the ICT, illustrate the paradigm shifted required for effective ICT integration.[64] These findings illustrate the complex sets of changes that have to occur for ICT to be deeply and meaningfully used to support student learning.

[64] Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How People Learn: Brain, Mind, Experience, and School: The Expanded Edition*. Washington, DC: National Research Council/ National Academy Press; Hepp et al., 2004.

This would explain why technology integration is so difficult to achieve but also points the way forward.

Our findings suggest that necessary changes are much broader than just the introduction of a new tool or one new practice. Instead, change begins by deeply reshaping life in the classrooms—from educators' beliefs about learning to the relationships that make up the school community. In each context, the teachers found points of engagement between the model of ICT use and teaching in the Essentials Course and the possibilities and limits of their context. For Indian teachers, it was most feasible to integrate aspects of the teaching model (i.e., open-ended questions) into their classroom and the ICT into after-class time. In Turkey, schools brought ICT activities into scheduled lab time and group work into their class activities. And Chilean teachers used holistic assessment strategies and inquiry-based projects in class because their school day provides a block of time for projects.

But the responsibility for change cannot rest solely on the shoulders of the teachers—bringing about these changes is a long-term, incremental process. There are a broad range of factors from leadership to funding to effective professional development that help create and sustain the conditions for change. Effective reform requires sustained investment and support along multiple dimensions of the educational system, including physical and technical infrastructure, human resources, curricular frameworks, standards, and assessments. In the end, the success of teachers dependent on the conditions in which they work