Evaluation Summary: Intel® Teach Program and Intel® Learn Program

White Paper

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Executive Summary

The Intel® Education Initiative is a portfolio of programs that is designed to improve teaching and learning, both within and outside of the formal education system, and to advance understanding of science and mathematics. This paper discusses evaluation findings for two flagship programs intended to promote changes in educational practices—the Intel® Teach Program for teachers and the Intel® Learn Program for children. The Intel® Teach Essentials Course trains teachers to integrate information and communications technology (ICT) across the curricula as a tool for learning, and to design and implement inquiry-driven, project-based learning activities. The Intel Learn Program gives children the opportunity to design, create, and solve problems in collaboration with their peers. It also provides them with a structure, tools, and adult guidance to gain new knowledge and to become proficient in basic skills.

The evaluation results suggest these programs hold the potential to transform learning environments and to enhance teacher capacity to use student-centered pedagogical practices and to use ICT in pedagogically appropriate ways. Both programs are well received by participants, and there are clear indications of changes in teachers' use of ICT and student-centered pedagogy. Follow-up studies could help address additional questions regarding the degree to which these programs can enhance teacher practice and improve student learning in comparison to other programmatic options available to ministries of education (MOEs). These studies could assist MOEs in making more informed decisions about which programs can best help them reach their larger policy goals to prepare their education systems to meet the challenges of the twenty-first century.

Overview of the Intel® Education Initiative

The Intel Education Initiative is Intel's sustained commitment to improve teaching and learning through the effective use of technology and to advance mathematics, science, and engineering education and research. The Initiative consists of a portfolio of programs that is designed to improve teaching and learning, both within and outside of the formal education system, and to advance understanding of science and mathematics (see Table 1). Through these programs, Intel partners with governmental entities to address various components of the education system: policies, professional development, pedagogy, curriculum, assessment, information and communications technology (ICT) use, school organization, and, at the higher education level, the development of technical curricula and research programs. The Initiative is intended to help educational systems move from an approach that emphasizes the acquisition of knowledge, to one that emphasizes conceptual understanding and the application of concepts to real-world situations. All of the programs are designed to improve the effective use of technology to enhance the quality of education, to promote the development of twenty-first century skills, and to encourage excellence in mathematics, science, and engineering.

Table 1. The Intel® Education Initiative Portfolio

Program	Focus	Description
Intel® Teach Program	Formal education: K–12	**Getting Started:** A 24- to 32-hour course for teachers with little technology experience that prepares them for the Essentials Course. **Essentials:** A 10-module, 40-hour course designed to provide teachers with technical and pedagogical skills useful for changing their teaching. **Skills for Success:** A 24-hour course for ICT instructors to teach ICT skills in conjunction with other twenty-first century skills as students use technology to solve problems that are relevant to the community. **Thinking with Technology:** A 24- to 40-hour course that focuses on enhancing students' higher-order thinking skills using a set of free online Thinking Tools. **Leadership Forum:** A 4-hour session for principals, headmasters, or district administrators offering background designed to support effective use of ICT in their schools.
Intel® Learn Program	Informal education: K–12	A 60-hour, hands-on, after-school curriculum built around two core modules. The Learn Program is designed to build on children's interest in their own communities while developing their skills through technology-driven projects.
Intel Computer Clubhouse Network	Informal education	An after-school community-based learning program in which underserved youth access technology and are given the support to pursue their own ideas.
Intel International Science & Engineering Fair (ISEF)	Formal education: secondary-level science, math, and technology	An international network of science fairs in which 1,500 students from more than 50 countries compete for USD 4 million in scholarships and prizes.
Intel® Higher Education Program	Formal education: tertiary-level science, math, technology, and engineering	A collaboration between Intel and more than 150 universities in 34 countries to prepare scientists and engineers for the global knowledge-based economy by expanding university curricula, engaging in focused research, and encouraging students' participation in research throughout their education.

In a report titled *Lifelong Learning in the Global Knowledge Economy,*[1] the World Bank states:

> Developing countries and countries with transition economies risk being further marginalized in a competitive global knowledge economy because their education and training systems are not equipping learners with the skills they need.
> To respond to the problem, policymakers need to make fundamental changes. (p. xvii)

Research from around the world shows that educational ICT can support change, positively affecting an array of educational outcomes such as improving school attendance, deepening conceptual understanding in core school subjects, and promoting wider involvement in community development.[2] Teacher quality plays a central role in this process; research demonstrates that the effective use of ICT is dependent on teachers' ability to select ICT tools and strategies that are appropriate for achieving specific instructional goals.[3] Yet, research also shows that, to achieve positive outcomes, programs that integrate ICT into educational practice must be designed in accordance with state-of-the-art understanding of how children learn.[4]

This paper focuses on two programs in the Intel Education portfolio of offerings—the Intel® Teach Program and the Intel® Learn Program. Both programs seek to promote research-based changes in educational practice. The programs represent Intel's most comprehensive efforts to improve the quality of K–12 education through the effective use of technology. In its Intel Teach offerings, Intel targets two aspects of teacher quality that are core to twenty-first century educational reform: (1) adoption of student-centered pedagogical practices; and (2) integration of pedagogically sound use of ICT into those practices. The Intel Learn Program focuses on student learning, specifically in the areas of technology, collaboration, and critical thinking skills. The program's curriculum also exemplifies the instructional design goals of Intel Teach courses, aligning the program's outcome objectives with many of the teacher outcomes targeted by the Intel Teach Program.

Since the inception of these programs, the Intel Education Initiative has partnered with the Center for Children and Technology at Education Development Center, Inc. (EDC) and the Center for Technology and Learning at SRI International (SRI) to conduct program evaluations. Intel's focus on program quality has meant that evaluation efforts have been distributed among three evaluation goals:

- Formative Evaluation: ongoing analysis designed to provide feedback for continuous program improvement.
- Process Evaluation: analysis of program delivery and fidelity, serving as a means to monitor the quality of implementation.
- Outcome Evaluation: analysis designed to determine the effectiveness of the intervention.

Consistent with standard practices in the field, EDC and SRI have used mixed-methods evaluation approaches to study the Intel Teach Program and the Intel Learn Program, often relying on indirect indicators to determine the degree to which the programs are meeting their goals. This paper provides a discussion of evaluation methods and findings to date, noting possible future directions based on increased program maturity and shifting research priorities.

Intel® Teach Program

Description and Objectives

Intel realizes that teaching for the twenty-first century is very different from traditional teaching. Improving teacher training and knowledge is a high priority for nations engaged in educational reform since the quality of instruction is central to improving academic achievement.[5] Teachers and students play different roles than in earlier eras. The teacher is no longer the sole font of information, and the student is not a passive recipient. Increasingly, students assume active roles in their education, continually striving to understand the world and to apply what they learn. To meet the demands of these evolving roles, teachers need to expand their skills and refine their pedagogical approaches and students need to be able to access resources. The key to changing what is taught and learned in the classroom is effective professional development that builds teachers' capacity and provides them with new resources to share with students.

The Intel Teach Program is designed to help bring schools into the twenty-first century by providing teachers and administrators with the skills and resources they need to effect change. Launched in 2000 as Intel® Teach to the Future, the program has trained more than 4 million teachers in over 40 countries. Its customizable set of course components ranges from basic ICT literacy skill training to training on tools that support the development of students' twenty-first century skills to the training of school administrators on effective ICT implementation. The program is composed of five components: Getting Started, the Essentials Course, Skills for Success, Thinking with Technology, and the Leadership Forum. All five Intel Teach professional development courses directly target improving teachers' knowledge about effective instructional strategies and the use of ICT.

The Intel Teach Essentials Course offers ministries of education (MOEs) a program intended to help meet the goal of creating a well-trained cadre of teachers who are able to integrate ICT into student-centered and inquiry-driven learning activities. The objective of the Essentials Course curriculum is to train teachers to integrate ICT across the curricula as a tool for learning, and to design and implement inquiry-driven, project-based learning activities. To prepare teachers to engage in this kind of instruction, the curriculum addresses crucial factors for creating student-centered learning environments, including the classroom management issues associated with using technology with students, conducting research on the Internet, assessing students' technology-rich work products, and managing intellectual property issues.

Divided into 10, four-hour modules, the Essentials Course curriculum guides teachers through a process of developing a complete unit plan. Organized around a single research question, the unit requires teachers to use technology to conduct research, compile and analyze information, and communicate with others. This structure allows teachers to expand their technical skills in the context of a curriculum development process. Teachers learn from other teachers how, when, and where they can incorporate these tools and resources into their work with students, with a special emphasis on how to support students' work on sustained projects and original research. In addition, teachers are instructed on how best to create assessment tools and align lessons with local and national standards.

The implementation model for the Essentials Course uses classroom teachers and other local educators as trainers to develop local capacity and to make the program more sustainable. The curriculum is delivered through a train-the-trainer model, with expert trainers training a cadre of Senior Trainers in each country, who then train Master Teachers from local districts or schools. The training uses commonly available productivity software, focusing primarily on how to use word processing and presentation software (e.g., Word*, PowerPoint*, Open Office*) to support students in creating presentations, web pages, brochures, and newsletters.

The Essentials Course includes many techniques that research suggests are necessary for professional development programs to have an impact on teacher behavior. These techniques include 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 repertoires of teaching approaches.[6] Research has also demonstrated that professional development programs which, like the Essentials Course, offer teachers time to explore new content and actively engage with the ideas presented to them, are more successful than programs that present prescriptive approaches to teaching.[7]

Bringing the Essentials Course to teachers in so many different countries has required worldwide, regional, and country-level program staff to maintain a constant balance between investing in localization of the program and a commitment to its core themes and goals. When the Essentials Course is introduced into a country, the Intel management team enlists local education experts to adapt the program to better conform to the requirements of that country's education system. However, certain core concepts are non-negotiable across countries. These include the program's focus on project-based learning and the use of a unit plan to structure the training activities. While many MOEs share similar goals for creating education systems that meet the perceived challenges of the twenty-first century, the program is also shaped by the current education system, traditional educational practices, level of economic development, and ICT infrastructure of each country. Nevertheless, the evaluation data suggest that the Essentials Course can be adapted to a wide range of contexts.[8]

Once the Essentials Course is introduced in each country, it intersects with local conditions in two ways. First, the messages that participants take away from the program are shaped by the extent to which the program connects with their prior experiences and knowledge.
The evaluation data demonstrate that teachers come to this training with widely varying levels of prior knowledge, that there are broad national and regional patterns of what teachers know and can do prior to the trainings, and that teacher experience in the training is strongly influenced by their prior knowledge.[9] The local program staff works to tailor the program to communicate clearly to the local teacher population. Second, the ability of participants to follow up on what they have learned can be both facilitated and impeded by school context issues such as infrastructure, leadership, and alignment of new strategies with existing curricula.[10]

Evaluation Methodology and Findings

The Intel Education Initiative has consistently supported independent, third party evaluation of its programs, and more than 20 evaluation and research groups are studying its programs worldwide. For the Essentials Course, Intel has required a core set of two surveys that all countries worldwide complete. The first, the End of Training Survey, is given to teacher participants on the last day of the training and asks them to report on their training experiences. The second, the Impact Survey, is administered to teachers at least six months after they have completed the training and asks them to report on whether and how they were able to use the ideas, techniques, and materials presented or developed in the training in their classroom instruction. The purpose of these surveys is to understand teachers' responses to the training and to assess the kind of impact teachers believe the training had on their teaching practice. This information provides feedback on the quality of the training and the implementation processes to program developers.

In addition to these core surveys, Intel encourages individual countries to conduct localized evaluations designed to address country-specific questions and concerns. These evaluations are central to the localization process. Evaluation data offers MOEs and program staff insight into how their teachers respond to the curriculum and identify the course elements and content that teachers believe is beneficial or challenging. These localized evaluations often involve case studies and other qualitative data collection techniques that delve more deeply into issues of interest. Some countries have conducted comparison studies between teachers who have participated in the program and colleagues who have not.[11] Local evaluators have conducted observations of the training and in the classrooms of teachers who have participated in the program; they have conducted interviews with policy-makers and educational administrators at the national, regional, and school levels, and they have reviewed teachers' work products to assess the quality of the instructional materials trained teachers develop.[12]

Since 2000, EDC has served as the United States evaluator for the Essentials Course, and it has coordinated the worldwide evaluation of the Essentials Course since March 2003. EDC's role is twofold. First, EDC designs and coordinates the implementation of the two global surveys. Second, EDC supports the national education managers and local evaluators in designing country-specific evaluations and administering the global surveys. This two-pronged approach to evaluation provides Intel Teach managers with information that is unique to the experience of each country as well as gross-level data about the program's implementation around the globe. Recent findings from the global surveys, and from the country-specific evaluations (including EDC's summative evaluation of the implementation of the Essentials Course in the United States) are described below.

Findings from the global surveys

The most recent analysis of global data, representing survey responses from 15,000 teachers in 20 countries, indicates the program has strong success rates across four indicators that EDC tracks.[13] First, 75% of respondents reported that they had used the unit plan they created during the workshop at least once with their students, if not more often. This suggests that most teachers leave the Essentials Course with usable lesson plans that let them experiment with ICT in the classroom. Second, 77% of survey respondents reported that they had engaged students in new ICT-based activities (in addition to their unit plans) since the training, suggesting that the Essentials Course helps teachers use technology with students beyond just that one unit plan. Third, 81.9% of respondents reported that they had used ICT more for their own lesson planning and preparation, suggesting that the course is introducing teachers to new professional resources. Fourth, 58.6% of respondents reported that they had increased their use of project-based approaches with their students. This finding might indicate that the Essentials course is encouraging teachers to experiment with new models of teaching. Teachers also reported positive student reactions to the ICT activities—91% of teachers said students were "motivated and involved in the lesson," and 81% of teachers stated that "student projects showed more in-depth understanding" than other, comparable work.

EDC also examined the global data by level of economic development, grouping countries according to the World Bank's 2006 categorization of national incomes based on gross national income (GNI) per capita. In reviewing the relationship between economic development and key indicators of program impact, the data suggest that there is no strict connection between the two. The program can be localized and adapted to support teachers in a variety of contexts to change their use of ICT.

A majority of teachers at all levels of national income seem to be following up on what they learned in the Essentials Course. The individual national evaluations also suggest that local and national contexts and the program needs and goals are increasingly aligned, and this alignment appears to support teacher success with the Essentials Course.

The evaluations also indicate, however, that two key contextual factors continue to be different for less economically developed countries than for wealthier ones. First, while the data suggest there is a core level of in-school access to computing resources across all levels of national income, there is still a trend for teachers in the lower income countries to have access to computers only in a computer lab rather than in their classrooms. In contrast, teachers in higher income countries are more likely to have access to computers in both a lab and their classrooms. The second point at which there was a linear relationship with national income was in teachers' familiarity with project-based teaching methods; teachers from countries with fewer economic resources were less likely to have had prior exposure to the teaching methods presented in the Essentials Course. This might be due to two inter-related factors: one, with fewer resources, these countries cannot afford to offer as many professional development experiences to their teachers, and two, the Intel Teach Program might be one of the first ICT professional development programs being offered to these governments.

Findings from the country-specific evaluations

EDC recently conducted a summative study of the effect of the Essentials Course in five United States school districts. Evaluators randomly selected the five districts from a list of 30 districts that have used the program for more than three years. To ensure a diverse sample, EDC conducted a large-scale survey study of all teachers in the five districts—more than one thousand teachers in total responded—and analyzed the responses of Essentials Course participants and non-participants.[14] The survey did not ask about the training or the specific instructional and technological practices that program participants encountered. Rather, it was designed to ask teachers general questions about their instructional practices, classroom uses of technology, access to technology, and experiences with technology professional development. (The title of the survey did not mention the Intel Essentials Course, but teachers were made aware that the study was funded by the Intel Foundation.)

Results from this survey suggest that there are significant differences between Essentials Course participants and non-participants, with a higher percentage of Essentials Course participants using technology to support their teaching than non-participants. The survey data from this sample of teachers in the United States indicate that more program participants than non-participants used technology—94.4% of participants reported using technology in their practice, while only 86.1% of non-participants did so. While the study found that teachers with good ICT access and extensive experience with project-based approaches were able to benefit from the program, the analysis suggests that the program is most effective for teachers with the weakest prior knowledge of project-based approaches and the poorest access to technology.

Research on effective ICT integration shows that the pedagogical beliefs that teachers hold impact their educational technology practices. Teachers who hold student-centered or "constructivist" pedagogical beliefs tend to value technology integration more than those whose beliefs about teaching are more teacher-centered.[15] However, the analysis of the results from this survey suggests that the Essentials Course had a greater influence on the behavior of teachers who exhibited characteristics (e.g., teacher-centered pedagogical beliefs, poor technology access) that research has found make teachers less likely to integrate technology into their practice. EDC used data from survey questions that examined teaching beliefs to cluster respondents into three groups: teachers with strong constructivist beliefs, those with moderate constructivist beliefs, and ones with weak constructivist beliefs. Evaluators then used these groupings to determine if there was a relationship between teachers' pedagogical beliefs and their responses about using technology in their classrooms. The analysis showed an interesting interaction between program participation, teachers' pedagogical beliefs, and what teachers do in their practice and with their students. Teachers with weak constructivist beliefs who were Essentials Course participants were more likely to be using ICT in their practice (93.6%) compared to the non-participants (82.2%).

EDC conducted a thematic analysis of in-depth qualitative data presented in the 2005–2006 evaluation reports of 16 countries (Argentina, Brazil, China, Columbia, Egypt, India, Israel, Japan, Jordan, Korea, Malaysia, Philippines, Russia, Thailand, United States, Vietnam) that implemented the Essentials Course. It also analyzed quantitative data submitted by 20 countries during 2005 and 2006. From these analyses, EDC identified the significant roles that national and regional policies on education and ICT infrastructure play in teachers' ability to follow up on their participation in the Essentials Course. Policy-related factors such as the professional expertise of local leadership, the coherence and depth of national curricula and standards for learning, standards for training local teaching staff, and the range and quality of instructional resources all shape teachers' opportunities to innovate and improve their teaching practices.[16] Below, findings are presented regarding two factors—curricular alignment and infrastructure—that were frequently identified in country evaluations and have particularly strong roots in local and national policy.

Curricular alignment

Findings from EDC's thematic analysis indicate that teachers in countries that have invested in reforming education policy to advance student-centered models of teaching and learning have consistently more positive and productive experiences in the Essentials Course. They are also better prepared to follow up on what they have learned when they return to their classrooms. Teachers who do not have a supportive policy context might still react enthusiastically to the content of the Essentials Course. Yet, many quickly encounter obstacles when they attempt to follow up on what they've learned, after they return to their classrooms. The following three, common challenges emerged from the thematic analysis of evaluation reports:

- Lack of time in the school schedule for sustained student project work
- Lack of opportunity to use teacher-developed curricular materials
- Required assessment measures that do not capture a wide range of students' skills

These challenges make it difficult or impossible for teachers to justify investing time or effort in pursuing classroom activities that cannot be sustained or do not serve their students' immediate needs appropriately.

Multiple country evaluations demonstrate that if MOEs wish to promote the use of ICT for project-based and student-centered learning, national curricula and assessments must reinforce and support this vision.[17] Many countries are at some stage of a process of curricular reform and/or reform of assessment practices, but few countries have moved far enough along in this process to have fully implemented new curricula that might align more closely with the models of teaching and learning emphasized in the Essentials Course.

Infrastructure

In order for teachers to follow up on their training and sustain student-driven, well-integrated uses of technology, ICT tools need to be easily accessible, reliable, and available in large enough numbers to support a variety of student activities. Providing and maintaining an adequate ICT infrastructure is a constant challenge, even for schools with considerable resources. The thematic analysis revealed that a significant minority of teachers participating in the Essentials Course does not have adequate access to technology, and a small group of participants no access to technology at all. Many participating countries have established policies to drive the deployment of ICT and Internet access in schools, but in many cases these policies have not yet been implemented at the local level.

Areas for Future Study

The evaluation of the Essentials Course program was designed to gain a comprehensive understanding of how the program functions in a wide range of environments in order to support program development and improvement, and to gain perspective on the fidelity of program implementation. The surveys of teachers' responses to the training and their use of ICT in their classrooms provides insight into teachers' experiences, while the local evaluations illustrate how the program works within each country's educational environment.

Current findings suggest that the program is well-received by teachers and that they find it useful for integrating ICT into their classrooms. The case studies and in-depth research also demonstrate which components of the program engage teachers and afford them the opportunity to experiment with new approaches and tools. Yet, an area for further research might be to conduct studies to look at comparable populations of teachers who have and have not participated in the program across a variety of national contexts or to conduct longitudinal random assignment studies. Such studies could explore whether the program changes teacher behavior in accordance with the program goals: encouraging teachers to use more project-based teaching strategies and improving their ability to use technology to support learning.

Intel® Learn Program

Program Description and Objectives

Designed for informal, community-based educational settings, the Intel Learn Program provides a project-oriented, hands-on approach to ICT learning for under-served children ages 8–16. Over the past few decades, evidence has accumulated to show that hands-on learning or "learning by doing" can produce significant outcomes.[18] In project-oriented, hands-on approaches, children are provided tools, strategies, and other social and material resources for identifying and creating their own solutions to problems, typically ones that have relevance to their lives. Research indicates that by working on activities and problems that matter to them, children can learn foundational skills useful across settings and situations.[19] Research also indicates that instruction grounded in hands-on experiences can be especially useful for segments of the population less successful at school.[20] This focus on the importance of active and extended learning experiences coincides with researchers' and practitioners' recognition that informal, everyday activities often provide children with a richness, complexity, and authenticity that both engages them and develops their capacity for critical thinking. Learning, as is increasingly acknowledged, is a "life-wide" process; that is, it occurs across all settings and situations. Accordingly, research scientists and funding agencies have progressively turned greater attention to the learning that happens outside of school, and, notably, have begun to investigate the ways in which experiences both in and out of school aggregate to produce learning outcomes.[21]

The Intel Learn Program targets three primary outcome goals:

- Technology literacy
- Critical thinking and problem solving
- Collaboration skills

Children in the Intel Learn Program follow a structured sequence of prescribed learning activities, in which they explore software applications, arrive at decisions about what they would like to do, and relate their learning to issues in their everyday lives. Intel Learn is intended to provide children with the opportunity to design, create, and solve problems in collaboration with their peers and with the structure, tools, and adult guidance to gain new knowledge, arrive at standard solutions, and become proficient in basic skills. Initially piloted in late 2003, the Intel Learn Program has been implemented with over 500,000 children in nine countries worldwide.

The Intel Learn curriculum is divided into two 30-hour units: Technology and Community, and Technology at Work. Technology and Community introduces learners to skills for word-processing, graphics, spreadsheets, multimedia, and Internet research. Children use technology to understand, design, and create products relevant to community life (e.g., fliers, calendars, news articles, multimedia presentations). Technology at Work provides learners with experience using computers as they might be used in a variety of jobs and careers (e.g., designing a survey that might be used by a public health worker, creating a business plan an entrepreneur might use). The units are typically divided into two- to three-hour face-to-face sessions, two to three times per week.

In addition to the curriculum, the program provides structured training for program staff—typically community-based educators or classroom teachers working in the after-school setting. The 40-hour training mirrors the hands-on, project-oriented approach of the children's program to a large extent. In the training, participants engage in the program's learning activities as children would and role-play facilitation of the course to provide constructive feedback to peers.

In each country, the program has been localized in an effort to suit the linguistic and cultural context. Using a model similar to the Intel Teach Program, experienced trainers from the global or regional level work with country-level trainers who, in turn, train the staff who work directly with children. In addition to building country-level training capacity, the model includes the cultivation of country-level pedagogical support teams, who further tailor the program during implementation and provide advice, additional training, and trouble-shooting as needed.

Governmental and non-governmental agencies oversee the training and pedagogical support teams in each country. These agencies provide the staff, the physical facilities, and the technical infrastructure needed to implement the program. The types and combination of Intel's partners at the national level vary widely from country to country, but in each case the support of local educational agencies is an essential element of the program model. Nonprofit foundations and consultants have also played key roles in the implementation of the Intel Learn Program.

As part of the evaluation, SRI conducted an analysis of the features of the Intel Learn Program's curriculum and implementation. The analysis revealed that Intel Learn is characterized by many elements considered important for providing twenty-first century learning opportunities for students:

- Thematic instruction. In thematic instruction, a set of activities or lessons focuses on a big idea or broad concept. A theme allows for the application of a wide variety of skills, and for the deepening, integration, and development of new knowledge. Both Intel Learn Program units, Technology and Community and Technology at Work, allow learners to develop a thematic and cohesive understanding of key aspects of social life and the use of appropriate artifacts (e.g., maps, spreadsheets, newsletters, planning documents).
- Problem identification and solution. "Textbook" problems typically require little to no analysis to achieve understanding of the nature of the problems, and support only the development of low-level skills for solving them. To develop the types of strategic thinking needed to solve real world problems, students need to understand the intrinsic properties of the problems themselves. In the Intel Learn Program, children are presented with complex problems and scaffolded in their efforts to analyze and address each problem.
- Relevance. Content that is relevant to the context of their lives leads students to deeper engagement and deeper thinking. Relevance is enhanced by instruction that helps students draw connections between what they are learning and how they can put the knowledge to use, especially in developing solutions to challenges facing them or their communities. Building on existing examples from students' local environments, the Intel Learn Program guides learners to design and create products that directly address issues of concern or meaning in their lives.
- Active exploration. Students are better prepared to acquire and remember new information, strategies, and skills once they have spent time exploring a challenge or problem for themselves; that is, without receiving explicit directions or answers at the outset of a lesson. Each Intel Learn Program session begins with a period

dedicated to active exploration, after which learners are encouraged to consult resources and one another to gain new skills or find answers to questions. Didactic instruction is kept to a minimum.

- Choice and autonomy. An environment that supports the development of twenty-first century skills provides students with a measure of choice in the activities they undertake; the strategies and tools they use; and the creative aspects of their plans, projects, or designs. Throughout the Intel Learn Program curriculum, children are given choices about the activities and projects they undertake, the tools they use, and the approaches, designs, and strategies they develop in creating their own, unique content.
- Cycles of creation. Students' ability to use technology effectively, to think critically, and to collaborate meaningfully with others is enhanced best by taking place in a cycle of generating and improving their work. In each cycle, students plan, execute, revise, reflect on, and share their insights about the product or solution they are developing. The Intel Learn Program leads children through a process of planning, doing, reviewing, and sharing their products for feedback that can lead to further reflection and revisions.
- Collaboration and communication. A key requirement of the twenty-first century workplace is the ability to communicate effectively with colleagues to set goals, identify and analyze problems, and deliver solutions. Collaboration is built into the Intel Learn Program, with children sharing course materials and computers in addition to working together to create technology products.
- Authentic feedback. In twenty-first century learning environments, students work on activities or projects that have no single, specific outcomes. Instead, with the help of others, students must assess their own work in relation to how well it serves the purposes for which it was intended. The Intel Learn Program provides a clear structure for feedback from staff and peers that helps learners improve their work and develop critical perspectives on it. The opportunities the program provides for learners to give useful feedback to other learners also develops their critical thinking and collaboration capacities.
- Teacher as facilitator. Rather than serving exclusively as an expert who provides information, the twenty-first century teacher facilitates students' research, development, application of skills, and creation of original work products. The teacher-as-facilitator helps students actively build on their strengths and incorporate their interests into their work. The Intel Learn Program staff training and pedagogical support thus emphasizes techniques for course facilitation that reduce or eliminate didacticism.
- Use of twenty-first century tools. Educational technology can support change, positively affecting an array of educational outcomes such as improving school attendance, deepening conceptual understanding in core school subjects, and promoting wider involvement in community development. Yet, to achieve positive outcomes, programs that integrate technology into educational practice must be designed in accordance with state-of-the-art understanding of how children learn. The use of technology in the Intel Learn Program is consistent with the goal of having children learn technology skills while creating useful content.

Evaluation Methodology and Findings

In partnership with local research organizations, SRI has conducted a mixed-methods evaluation of the implementation of the Intel Learn Program in each of the nine participating countries. The evaluation has included:

- Collection of program completion data
- Observations of trainings at the national, regional, and local levels
- Observations of program implementation with children
- Surveys of teaching staff at multiple points in their involvement
- Teaching staff logs and interviews
- Stakeholder interviews
- Collection and analysis of student work

Although focused on formative and process evaluation, the work of the worldwide evaluation team has used diverse data sources to monitor the outcomes of the Intel Learn Program. These sources include student completion rates, independent observation of student collaboration and engagement, staff and stakeholder report of program successes, and, most importantly, independent analysis of student work products.

To better measure student outcomes, in 2006 SRI developed two types of assessments of student learning: a rubric-based method for analyzing student work products and a multiple-choice assessment closely aligned with the Intel Learn curriculum. (The multiple choice assessments, which focus on the processes for creating the types of technology products featured, were developed for an in-school version of the program, Skills for Success, and have not yet been used in any of the implementing countries.) Evaluators have used the rubric to assess the quality of a sample of student work products in all participating countries. The original intention in developing the rubric was to track a sample of groups of students over time to attempt to detect changes in the quality of their work. This strategy did not prove practical. Nonetheless, evaluators in each country have piloted the rubric on a relatively large number of student work samples, analyzing 3,466 samples of learners' activities (work completed prior to the final project) and 1,077 examples of learners' final projects. The work was rated on five dimensions (originality, technical skills, required elements, communication to audience, collaboration) on a four-point scale (needing improvement, approaching expectations, meeting expectations, and exceeding expectations). In 2006, a majority of the 4,543 pieces of learner work submitted and analyzed (69%) met or exceeded expectations, and only 8% of work fell into the "needing improvement" category. A slightly smaller percentage (67%) of learners' final projects met or exceeded expectations. Eleven percent of project samples fell into the "needs improvement" category.

To assess learning outcomes in the program better, and to test whether evaluators were applying the rubric in a consistent and reliable way, a team of SRI coders[‡] conducted independent analyses of a random sample of 337 of the approximately 1,000 pieces of learner work produced in Chile during the program's first year there. Findings show that 63% of the samples that the coders scored represented work that fully met all the expectations for learner performance; this rate was comparable to the overall rate across all other countries. Moreover, many of the samples considerably exceeded expectations for these activities in regard to their originality, quality of communication, use of technology, and other assessment criteria. An additional 31% of the work samples that SRI scored closely approached expectations. Findings for learners' final projects, which consist of extended multimedia presentations developed by teams on topics of interest and import, showed that

‡ Interrater reliability exceeded 80%.

83% were at the highest levels of achievement. Further, because the "approaching expectations" category represents work that is only marginally below the standards of achievement targeted by the program, SRI's analysis of the Chilean sample provides evidence that almost all learners are achieving at high levels or are very close to doing so. These findings, viewed in light of the comparability of the Chilean data from other countries, indicate positive learning outcomes for students in the program throughout the world.

Overall, findings across evaluation methods reveal many positive outcomes. Most notably, the majority of children that enroll in the program remain in the program. Children freely "vote with their feet" when they decide whether they will participate in a program in an informal educational setting. In these settings, participation rates are noteworthy indicators of a program's potential. In 2006, Intel Learn's completion rates (i.e., attending a specified number of courses and completing activities) ranged between 85% and 99%, averaging 94% across the nine countries. Other key findings include:

- Teaching staff reported that the training prepared them well for facilitating the program (an average of 4.3 on a scale of 1 to 5 where 1 is not at all prepared and 5 is extremely well-prepared).
- The majority of teaching staff who are also classroom teachers (many are not) reported that they had used methods from the Intel Learn Program in their regular classrooms.
- Teaching staff reported that their students were prepared to undertake their final projects and had improved in their skills by the end of the course (an average of 4.0 on a scale of 1 to 5, where 1 is not at all prepared and 5 is extremely well-prepared).
- Staff reports, observations, and work sample analyses indicate that learners become more proficient with technology over the course of the program.
- Observations by independent evaluators indicate that student collaborations are effective, inclusive, respectful, and communicative.
- Staff report and observations indicate that students were highly engaged and motivated.

Overall, the positive indicators from the evaluation and characteristics of the Intel Learn program suggest that it represents an approach to ICT learning that is engaging for participants and is aligned with twenty-first century teaching and learning approaches.

Areas for Future Study

Perhaps unique among the Intel Education programs, Intel Learn is well-suited to experimental study of student outcomes through a randomized control trial. Since the program directly provides learning opportunities for students, these opportunities can be carefully monitored and controlled. Furthermore, the clear links between student work products and the opportunities to learn made available to students in the program make analyses of these work products compelling indicators of the quality and efficacy of the program.

Conclusion

A substantial amount of information about how the Intel Teach Program and the Intel Learn Program function across a diversity of national contexts can be drawn from the formative and process evaluations that have been conducted to date. In many countries, these programs have been functioning for over three years, and the consistency of the evaluation results suggest that the programs have reached a level of implementation maturity and fidelity which would allow Intel to undertake another level of evaluation and research around the programs.

Current data suggest that the Intel Teach Program and the Intel Learn Program hold the potential to enhance learning environments and to build teacher capacity to adopt student-centered pedagogical practices and to use ICT tools in pedagogically appropriate ways. SRI's evaluation of the Intel Learn Program and its characteristics indicates that the program represents an approach to ICT learning that is engaging for participants and is aligned with twenty-first century teaching and learning approaches. The findings on the Intel Teach Essentials Course from EDC and the local evaluators in each country suggest that the Intel Teach Program can encourage change in teacher practice. The findings also provide insight into the complex mechanisms through which the programs function in multiple environments.

Moving forward, we anticipate that national governments would derive value from experimental or additional quasi-experimental research on student outcomes and the alignment of program impact to MOE goals. Our current knowledge about the characteristics of the programs, the conditions under which they are implemented, and the nature of their impact can serve as the basis for the design of more rigorous efficacy studies of these two Intel offerings, serving the needs of MOEs to make informed decisions about which programs can best help meet the educational challenges of the twenty-first century.

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