SRI International

Center for Technology in Learning

Review of Evaluation Findings for the Intel Learn Program

Center for Technology in Learning
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I. Introduction

Across the globe, digital technologies are profoundly changing the way we live and work. The way we prepare children to participate in a rapidly changing world must change as well. The skills students need to succeed now are not the same as those they needed a century ago, when educational practices reflected the labor demands and social conditions of the industrial age. The key skills children need in the 21st-century are ones that prepare them to work in the new knowledge economy—skills such as technological literacy, critical thinking, and collaboration. Without opportunities to develop these skills, children are unlikely to adapt quickly and effectively to a world in which they will be expected to function as knowledge workers and, in many situations, as innovators. Environments that allow children to "learn by doing"—to try their hand at participating in the types of activities in which they will need to participate as adults—allow students to develop these critical 21st-century skills. The Intel Learn Program is designed to provide children with a learning environment that can foster the development of such skills and abilities.

In the program, children work through a curriculum that is structured to promote the development of a clear set of skills and abilities. Within the sequence of the curriculum's prescribed learning activities, children explore software applications, arrive at decisions about what they would like to do, and relate their learning to meaningful issues in their everyday lives. The Intel Learn Program is designed to provide children both the opportunity to freely design, create, and solve problems in collaboration with their peers and the structure, tools, and adult guidance to gain new knowledge, arrive at standard solutions, and become proficient in basic skills. In this way, the Intel Learn Program blends features of 21st-century education with features of traditional education, making it well suited to be implemented across a wide range of educational settings—formal or informal, directive or child centered—and making it possible for participating children to experience the foundations of 21st-century learning. The aim of this paper is to illustrate how the Intel Learn Program helps children develop 21st-century skills and to review evidence of the program's success.

II. The Importance of 21st-Century Skills

Around the world, studies show that improving educational outcomes has both economic and social benefits.[1] Evidence links higher educational attainment with increasing personal income and a country's per capita GDP growth, as well as improvements in health and other aspects of the quality of life. [2] Not all educational environments, however, produce the same kinds of results. Therefore, as the global economic landscape changes and jobs require new skills, a critical question becomes: What kind of education is best?

Although educational researchers and economists are still weighing the evidence regarding this question, there is agreement that for sustained and equitable economic growth, nations must adjust their strategies to provide the educational opportunities necessary to develop a new type of worker. The World Bank, in a report titled *Lifelong Learning in the Global Knowledge Economy*,[3] argues:

> 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)

The fundamental changes that are needed include enhancing the traditional school curriculum with new types of activities that provide children opportunities to learn more than just reading, writing, and arithmetic. By the time they leave school, students will need to know how to think critically, communicate effectively, work well in teams, learn continuously, and use digital technology.[4] Students will also need to develop a deeper conceptual understanding of school subjects (particularly science, math, and technology) and learn how to produce new intellectual and creative works.[5] In short, the traditional school approach, reflective of 19th-century conditions, must be supplemented, refined, and updated to provide students with the additional skills they will need in the 21st-century.

Information and communication technologies (ICTs) lie at the heart of 21st-century economic and social transformations. Even traditional occupations are affected by the exchange of information and ideas that ICTs allow. These technologies are transforming education as well, providing previously unimagined possibilities for accessing, sharing, and creating knowledge. A technology-enhanced educational environment can promote 21st-century learning in two important ways: first, by enabling children to learn to use ICTs and, second, by creating optimal opportunities for children to develop a fuller set of 21st-century skills. Research from around the world shows that educational ICTs can positively affect an array of educational outcomes, from improving school attendance to deepening conceptual understanding in core school subjects to promoting wider involvement in community developments.[6] But research also shows that to achieve positive outcomes, programs that integrate ICTs into educational practice must be designed carefully, in accordance with state-of-the-art understanding of how children learn.[7] Ideally, these programs should lay out a pathway that can take a novice user through a set of experiences that build a core set of 21st-century skills. The Intel Learn Program is designed in such a manner.

III. Developing 21st-Century Skills

Key 21st-Century Skills

When describing 21st-century learning, educational researchers generally identify three broad areas of core skills that children should develop: being able to use information and communication technologies effectively, being able to think critically and solve problems, and being able to work effectively and collaborate with others.[8] The Intel Learn Program specifically targets these outcomes in the ways described below.

Technology literacy. Technology literacy involves using technology to communicate; to collect, organize, and share information; to generate solutions to problems; and to design and develop original products. The development of these capacities makes it possible for students to leverage the power of technology to gain a deeper conceptual understanding of subject matter and to produce new intellectual and creative works based on this understanding. The Intel Learn Program provides novices with hands-on experiences for learning to use computers for a range of socially meaningful purposes, and provides more advanced users the opportunity to further develop their skills. Children participating in the program learn to find useful information on the Internet, solve mathematical problems, use productivity tools to organize and generate information, and create presentations and other media products that incorporate pictures, designs, charts, and written text that they have developed.

Critical thinking. Critical thinking involves engaging in clear and precise analysis in order to solve problems. Critical thinking, problem solving, and other forms of "higher-order thinking" represent a different level of learning than is typical in traditional schooling, where learning objectives usually center on memorization of facts (for example, historical dates), of rules (grammar or math), or of procedures (for doing or making something). Although memorization, rote application of rules and procedures, and other "lower-order" activities are an important part of learning, they are only part of a much fuller set of capabilities that educational environments can and should promote. The Intel Learn Program introduces learners to many processes that help them develop and demonstrate critical-thinking and problem-solving skills.

Collaboration. Collaboration means teamwork—working with one or more other people to set goals and complete tasks. Whereas traditional educational environments emphasize individual learning and achievement, 21st-century approaches to education take into consideration that human activity, including economic activity, is fundamentally collaborative. In the 21st-century workplace, colleagues collaborate to develop their knowledge, insights, and capabilities, putting them to use for the good of the group. In the Intel Learn Program, children share in the processes of learning, solving problems, and creating products they recognize as having value. The program prepares children to be able to work well with others in the future by requiring that they work together today.

Promoting Key Skills

The question of *how* to teach 21st-century skills is best answered by describing the features of learning environments in which children can develop these skills. Effective learning environments for promoting 21st-century skills often include the following core elements, all of which are features of Intel Learn:

- **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 the deepening, integration, and development of new knowledge.
- **Relevance.** Content that is relevant to the context of students' 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.
- **Active exploration.** Learners are better prepared to acquire and remember new information, strategies, or 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.
- **Choice and autonomy.** An environment that supports the development of 21st-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.
- **Cycles of creation.** Students' ability to use technology effectively, think critically, and collaborate meaningfully with others takes place best within a *cycle* of generating and improving their work—in which students plan, execute, revise, reflect on, and share their insights about the product or solution they are developing.
- **Authentic feedback.** In 21st-century learning environments, students work on activities or projects in which there are no single, specific answers. Instead, students must assess their own work in relation to how well it serves the purposes for which it was intended. Feedback from teachers and peers helps students improve their work and develop their own critical perspective on it. Learning to give useful feedback to others also develops a student's critical-thinking and collaboration capacity.
- **Teacher as facilitator.** Rather than serving exclusively as an expert who provides information, the 21st-century teacher facilitates students' own research, development and application of skills, and creation of original work products. The teacher-as-facilitator helps students actively build on their own strengths and incorporate their own interests into their work.

Overall, contemporary research in the learning sciences argues for the design of educational environments in which today's students can learn to use available tools, solve problems, and work well in teams to respond to issues in the broader world around them.[9] In the 21st-century classroom, children must consider needs and what to do about those needs. It is within a framework of authentic issues and concerns that children can best develop the full range of skills—from simpler, more automatic processes to higher-order analyses—that they need to function in the contemporary world.

IV. Results and Successes of the Intel Learn Program

Researchers from the Center for Technology in Learning at SRI International in Menlo Park, California, have collaborated with local research partners around the world to conduct a comprehensive 2-year evaluation of the Intel Learn Program. The Center for Technology in Learning conducts evaluations of many large-scale initiatives that integrate new computers, digital media, and 21st-century curricula into learning environments or use technology to support the development of learning environments.

The SRI-led evaluation of Intel Learn reveals that, implemented in a wide variety of cultural and social situations in eight countries, the program supports the growth of key 21st-century capabilities for participating children. The three main areas in which SRI researchers have documented the growth of these capabilities are those targeted by Intel Learn: technological literacy, critical thinking, and collaboration.

In our evaluation efforts, we have found that children who participate in Intel Learn make gains in the three primary program goal areas in all participating countries. In the course of the program, students in every country are able to use technology to create digital artifacts according to activity and project guidelines, and, in many cases, they are able to move beyond and exceed the expectations set forth in the guidelines. Learners also develop their planning, collaboration, and critical-thinking abilities. Across ages, genders, and regions, learners show high levels of engagement in program activities and motivation to attend. Sustained interest is demonstrated by the growing number of boys and girls from a diversity of backgrounds who participate in the program, as well as the program's high completion rates; of the children who start the program, on average, more than 90% of them successfully complete it. Because Intel Learn has been implemented mainly in informal (noncompulsory) educational settings, where children freely "vote with their feet" about whether or not to attend, it is especially important to the success of the program that it attract, motivate, and engage children even while they undertake serious learning activities.

Table 1. Learners in the Intel Learn Program

Country	Number of Learners
Brazil (2005)*	3,170
China (2003)	103,875
Egypt (2005)	4,834
India (2004)	12,942
Israel (2004)	54,212
Mexico (2004)	11,668
Russia (2005)	1,000
Turkey (2005)	990
Total	192,691

** Year the program launched in this country.*

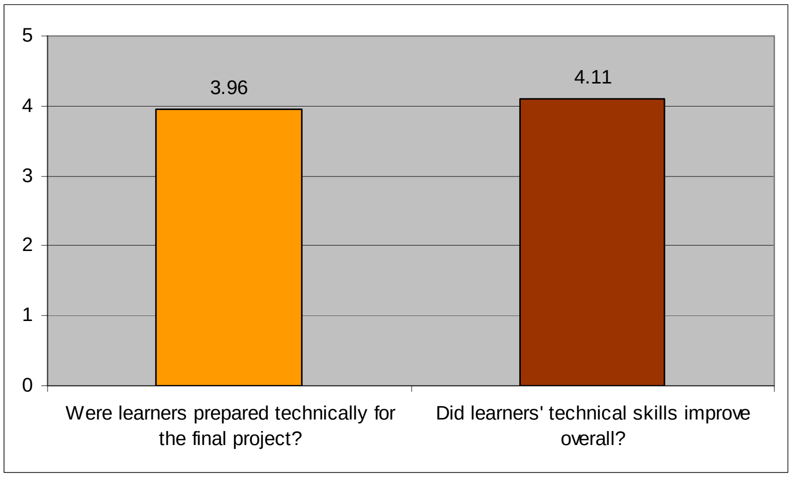
A significant test of whether children will be able to perform well in the 21st-century workplace is whether they can use similar skills in both school-based and informal learning environments. The following questions about the activities within these environments are important: Given the appropriate tools and requirements, are children able to use ICTs to create technically well-designed products? Are children's creations appropriate to the social use for which they were intended, reflecting critical thought about the match between design and use? Are children working well together in the learning setting, monitoring and adjusting their own behavior to contribute to the smooth functioning of their group? Because it is virtually impossible to answer these types of questions by using traditional, paper-and-pencil assessments of student learning, in conjunction with our worldwide evaluation partners, we have collected data from a sample of implementation sites, program instructors, and participating learners on relevant indicators of learning outcomes. We have relied on observations by local experts, surveys of instructors, written reflections from children and instructors, interviews with key personnel, and samples of student work to make judgments about the effectiveness of the program in promoting 21st-century skills.

Improvement in Technological Literacy

Since its inception in 2003, the Intel Learn Program has focused its efforts on children with little or no access to technology, often reaching young people who have never before touched a computer. By providing them with rich, hands-on experience in four technical areas—graphics, word processing, spreadsheets, and multimedia—the program offers children an engaging learning experience in which they develop a solid set of basic computer skills. With rare exceptions, our findings show that *all* participating children find the course engaging and useful and perform at least the basic level of competency.

Additionally, the large majority of children show marked improvement in their technical skills during the course of the program. Observations, interviews, surveys, and journals show that the technical supports built into the program—including strategies to encourage exploration and peer learning, as well as more traditional materials and instruction—work to promote the development of technological literacy for participants. Program instructors report that students are well prepared for the challenge of undertaking an extended final multimedia project by the time they have completed their initial work in the four technology areas (mean response of 3.94, on a scale of 1 to 5). Additionally, program instructors overwhelmingly report that learners in the program improve their technical skills, with mean results as high as 4.47 for participating countries. Figure 1 shows the mean responses from eight countries submitting data on learners' technical skills.

Figure 1. Staff assessment of improvement in learners' technical skills.

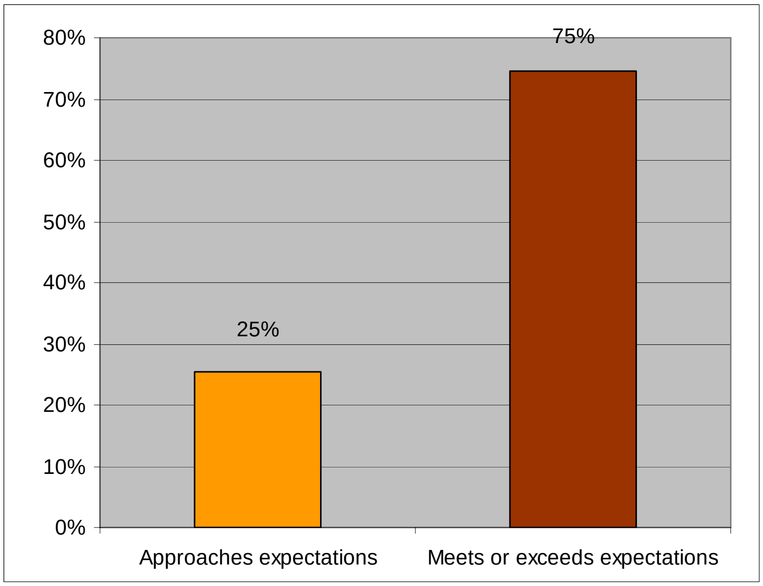


Note: Scale of 1 to 5, where 1 is not at all prepared and 5 is extremely well prepared.

To assess the thoroughness with which learners are acquiring basic technical skills in the context of program activities, SRI asked local evaluators to judge samples of student work products according to rubrics specific to each activity.* This approach allowed local evaluators to obtain both an index of the breadth of skills students were acquiring and a general indicator of how well children applied technical skills to create products suitable for their intended purposes. Each sample of learner work was rated as "approaches expectations," "meets expectations, or "exceeds expectations." Figure 2 shows that three-fourths of 2,628 pieces of learner work across seven countries either meet or exceed expectations.

* The rubrics were derived from checklists designed to help students ensure that their products reflected the technological skills targeted by the program, as well as the design features needed to make the products useful (for example, a statistical chart needs to have its axes and columns labeled, and a news article needs a title, content, and formatting).

Figure 2. Aggregated learner work analysis.



It should be noted that most of the student work samples assessed as “approaches expectations” were themselves indicative of significant technological skill and creativity beyond a rudimentary level.

Observations and case studies provide evidence of the positive effects of the program in the broader spheres of students’ lives. Local evaluators have documented that children in Israel who participate in Intel Learn have come to be viewed as “experts” on computers, improving their social and academic standing in their regular classrooms. In Egypt, children are teaching the technology skills they have learned through the program to parents and siblings.

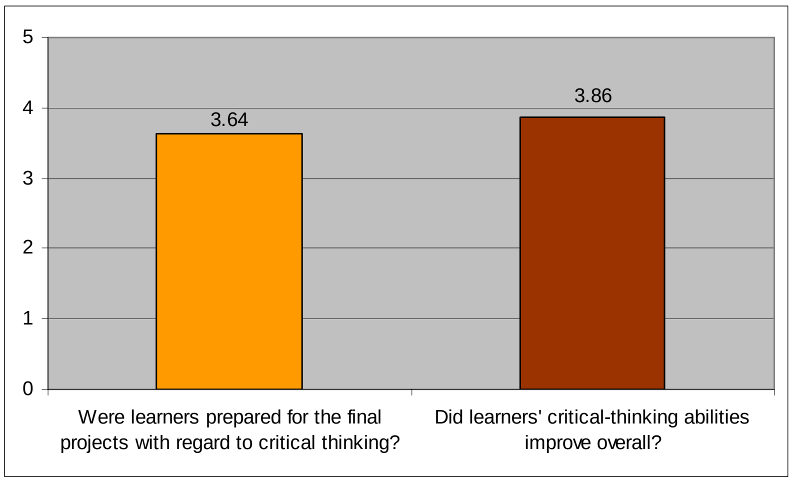
Critical Thinking

Across countries participating in Intel Learn, youth in the program are developing technology skills within the context of addressing issues relevant to their lives. Intel Learn evaluation results show that from Cairo to rural Mexico, young people are identifying significant problems within their communities and using the skills they have learned to create technological products designed to heighten awareness or develop solutions. Students’ final multimedia projects address real-world problems, such as pollution, overpopulation, the need for more green spaces and parks, the danger of natural disasters, and unemployment. As described by evaluators in Russia, students in the Intel Learn Program begin to “pay attention to what is happening” around them, reflecting on their circumstances, and asking whether there is anything they can do to make life better for themselves and their families.

In some notable cases, we see that students in the program are able to use the technology-based products they create to effect change within their communities. In India, students in one village identified two particular problems they faced: scarcity of drinking water and the lack of a playground for the children of the locality. For their final project, they created a multimedia presentation proposing solutions to the problems. The local district president, who attended the public presentation of the students' project, was profoundly impressed by the students' work and committed nearly $7,000 to implementing the students' proposed solutions. Within a short time, the community built both a new water tank and a children's playground, and also decided that all young people in the village would participate in Intel Learn.

Staff assessments show that a majority observed positive change in learners' critical-thinking and problem-solving abilities by the end of the course. Additionally, staff report that most learners developed sufficient critical-thinking skills to undertake their final projects. As shown in Figure 3, aggregated results across countries show that staff observed notable change in learners' abilities to engage in project work that required them to think critically about problems and how to address them.

Figure 3. Staff reports of improvement in learners' critical-thinking skills.



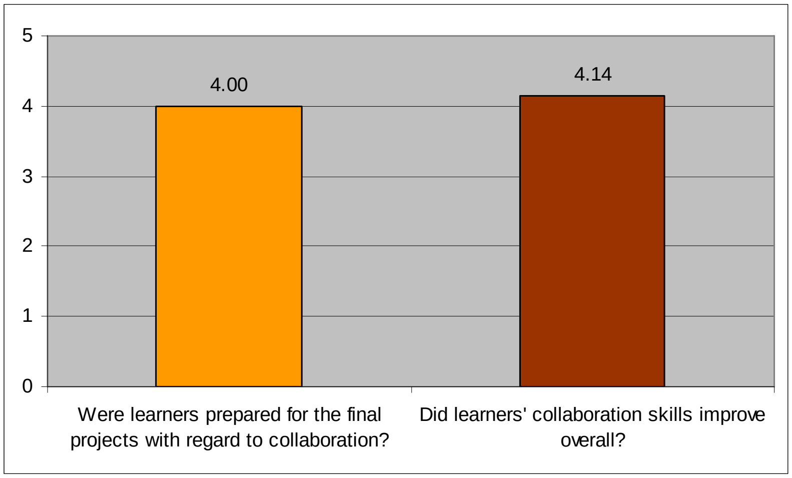
Note: Scale of 1 to 5, where 1 is not at all prepared and 5 is extremely well prepared.

Of the three program goals addressed by Intel Learn, the development of critical thinking proves the most challenging for staff to facilitate. Part of this difficulty seems to stem from localization and translation issues—staff may themselves take time to develop an understanding of what critical thinking is and how to foster it. In Brazil, for example, local evaluators noted that the terms used to translate "critical thinking" needed to be changed to help staff better comprehend the meaning of this important 21st-century skill. Nonetheless, by the end of the program, with the help of pedagogical support personnel and increased experience with the program itself, staff understanding of critical thinking improved, and staff report a concomitant improvement in students' critical-thinking abilities.

Collaboration

The Intel Learn Program is structured around student collaboration. Young people share computers and program materials, work together on activities and projects, and look to each other for ideas, suggestions, and assistance with problems. Although collaborating with other students in a classroom is a new experience for most program participants and often poses challenges, students typically overcome the differences that arise, finding meaningful ways to each make contributions to their shared efforts. Staff assessments indicate that students develop sufficient collaboration skills to effectively undertake their final projects (mean response of 3.98, on a scale of 1 to 5). Additionally, staff report that, overall, learners' collaboration skills improve over the course of the program (mean response of 4.03). Figure 4 shows the improvement in learners' collaboration skills as observed by program instructors.

Figure 4. Staff assessment of improvement in learners' collaboration skills.



Note: Scale of 1 to 5, where 1 is not at all prepared and 5 is extremely well prepared.

Observational studies show that students in all countries learn to work effectively as members of a group, relying on each other to gain new technical skills and solve technical problems, to develop their ideas for projects and activities, and to review and revise their work. Students in the program come to see their peers as key resources for learning.

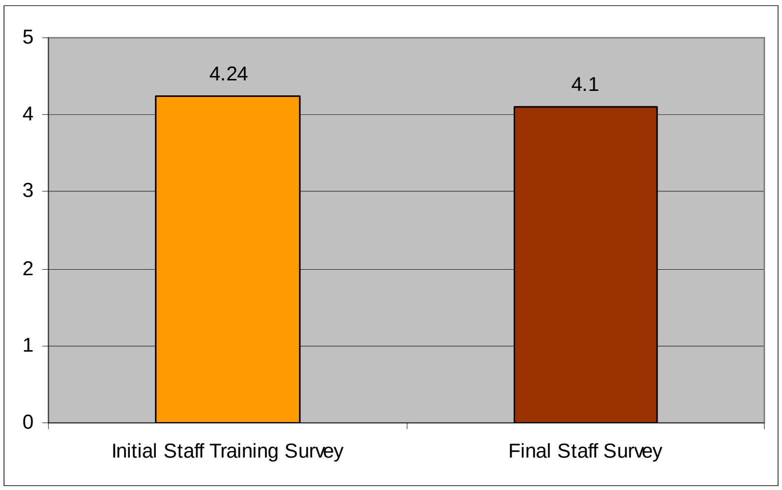
Collaborating on work can affect other aspects of students' relationships with their peers as well. Observations provide evidence of situations in which students have come up with their own solutions for organizing and managing the Intel Learn classroom. In one case, students who were annoyed with one overbearing child collectively developed a rule requiring this child, if found to be misbehaving, to give up his beloved wheeled computer chair and sit in a regular chair until his behavior improved. In one country, a parent even attributed improvements in her child's behavior to the collaborative structure of the program, reporting that he got along better with his siblings after participating in Intel Learn.

Teacher Learning

An important outcome for Intel Learn is the impact it has on teaching practice. Across countries, teachers trained to facilitate Intel Learn find that the program gives them a new and better way to approach teaching and learning. The methods used in the program help teachers support students' acquisition of 21st-century skills, particularly in the key program areas of technology literacy, critical thinking, and collaboration. Teachers generally find that the program lets them rethink their role to place less emphasis on dispensing information and more emphasis on promoting students' active exploration, problem solving, and creativity. One classroom teacher noted the new insights and capabilities she gained from the program, saying, “Even though I was teaching for the last 2 years, it is now that I understand how to facilitate [student learning].”

Data from staff surveys show the value and consistency of teachers’ experience in the program. At the end of training, teachers are asked how well they believe the training has prepared them to use new teaching methods to facilitate the course. Teachers are asked the same question again once they have completed their first full course with learners. At both points in time, teachers’ responses are equally high. Figure 5 shows the consistency in instructors’ views regarding the value of the staff training.

Figure 5. Comparison of initial and final staff assessment of training.



Note: Scale of 1 to 5, where 1 is not at all prepared and 5 is extremely well prepared.

Overall, evaluation data show that teachers participating in Intel Learn:

- Learn valuable new pedagogical approaches.
- Use these new pedagogical approaches with students in classrooms.
- Want to learn more and become more proficient with the new approaches.

Moreover, in many countries high-level stakeholders recognize the value of the program for providing instructors with a new conception of teaching and learning, and see the program as a potential model for pedagogical improvement.

V. Conclusion

Contemporary research in the learning sciences argues for creating educational environments in which today's students can learn to respond appropriately and successfully to the challenges around them. In 21st-century learning environments, student learning begins with questions, problems, challenges, and issues that matter to students. This context provides the framework in which all learning—from lower-level rote processes to higher-order analyses—takes place.

The Intel Learn Program, designed in accordance with the principles of 21st-century learning, can enhance traditional, teacher-centered instruction by providing a purposeful and meaningful context through which students can master their emerging skills. These skills must be experienced and practiced firsthand; 21st-century learning means active learning. A child collaborating with other children on designing a flyer for an event at their school, for example, experiencing both the successes and challenges of working with others to create an artifact by using digital technology, will have more resources to draw on when working to collaborate with others later in life than a child who did not have these experiences. The type of learning provided by Intel Learn can complement traditional learning, but traditional learning experiences, such as listening to lectures or taking notes from a text, cannot alone provide the basis for 21st-century skills. To prepare for participation in the 21st-century global economy, children need the innovative learning experiences that programs like Intel Learn can provide.

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