Costa Rica: Are Computers in School Cost-effective?

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Costa Rica's Computers in Secondary Education program aims to install computer laboratories in all secondary schools. It has a number of components that are critical for success, including a strong and continuing national commitment, good central management, emphasis on training, slow start-up on a pilot basis, good feedback mechanisms and focus on local participation and commitment. The Costa Rican experience seems to indicate that in the long run, the economic and social payoffs of using computers as a learning tool can be substantial.

The Context

The leaders of Costa Rica are determined to make their country a leader in technology. The decision by INTEL to build a $300 million microprocessor plant in Costa Rica, which will generate 3,500 jobs as well as billions of dollars in future export revenues, is one result of this strategy.

The Computers in Secondary Education program in Costa Rica is part of this broader strategy. The program seeks to (a) contribute to the development of logical thinking and creativity; (b) improve learning in specific disciplines; and (c) encourage more positive attitudes towards science and technology, greater self esteem and increased technology competency. The approach is strongly influenced by "constructivist" pedagogy, explained in a Costa Rican document as follows: "Learning is greater when students are involved in the construction of a significant product. This involves construction of things in the external world and simultaneous construction in the mind's interior." Under this approach, the computer is used to encourage student-initiated inquiry. Communities pay for maintenance by being charged for services provided outside school hours. A parallel program in primary education has been underway for some time, especially utilizing LOGO to develop logical thinking.

The Program

As of 1997, there were 26 computer laboratories in 20 secondary schools. The total hardware and software cost was $1.9 million dollars for an average of about $73,000 per laboratory. Initial training had been completed and there was ongoing training of teachers as part of the regular computer program. A loan agreement with the Central American Bank of Economic Integration (US$12.9 million, with US$3.4 million in counterpart funds for administration and training) provided funding to install computer laboratories in all secondary schools and in 50 percent of primary schools. Communities were being asked to pay for air conditioning.

As of 1997, a separate specially trained teacher in informatics was responsible for each laboratory. Students from participating classes worked in the laboratory twice a week. Computer classes were not mandatory and were provided only if the subject matter teacher was interested. Sketchpad was used in math, Superlink for multimedia presentations in social studies, Labpc for science, and Word and Paintbrush for Spanish. There was no specific computer curriculum, and computer activities were not included in the official subject matter curriculum. For this reason, ninth grade teachers were often reluctant to use the laboratory since it took away time that could be spent preparing for national examinations. Nonetheless many students showed a great deal of interest in computers. It was reported that students often worked long after-school hours preparing reports such as multimedia descriptions of community and environment issues.

The computer laboratory in operation in the Liceo del Sur, a secondary school enrolling 1,000 students and located in a poor district of San José, was typical of the current program. The laboratory had 24 computers (IBM 486s) with a server. Software included Word, Paintbrush, Excel, PowerPoint, Winlogos, Sketchpad, PCLab and Superlink. In a typical example, students were developing a dictionary of teenage Costa Rican words and phrases, using Word and Paintbrush. The teacher was hoping to combine the student-generated dictionaries into a single dictionary and then to compare it with similar dictionaries in other countries in Latin America. The students worked in pairs, were reasonably adept at manipulating Word, and lingered until the beginning of the next period to complete their work. Training was provided every Friday to interested teachers. The laboratory was also used in the afternoon by the technical stream of the upper secondary level and in the evening by the Open University for technical courses. The school had a small but operational library (2,000 books, mainly old). Unfortunately, the science laboratory had been closed and replaced by a workshop for mentally handicapped students.

Implementation Issues

Costa Rica has the basic infrastructure needed for computers in education program, including electricity in all schools as well as relatively well trained teachers. In addition, Costa Rica's computer program incorporates much of what is considered best practice in implementing an educational innovation--a strong and continuing national commitment, good central management, emphasis on training, slow start-up on a pilot basis, good feedback mechanisms, and focus on local participation and commitment.

One current and acknowledged problem is the lack of integration into the official subject matter curriculum. This question and related training and cost issues will eventually need to be addressed. While the encouragement of bottom-up experimentation was noteworthy, eventually standardization of approaches and contents will be needed. As in any innovation, as the program goes national some school directors, teachers, and communities may not be adequately committed to the program.

Cost

A very rough estimate of annual unit costs of the program at the time was $38 per student. This assumes $22 per student in annualized capital costs ($73,000 for a school of 1,000 with a computer life of four years and a 10 percent discount rate), $6 for the cost of a full time technology teacher (estimated salary of 6,000), and $10 for training, maintenance and electricity (perhaps $10,000 per year). Overall this comes to 13 percent of the estimated annual cost of $300 per student in academic secondary schools in Costa Rica. These costs are significantly lower than those in Chile and Jamaica but are nonetheless significant. One reason for the low costs is that Costa Rica's program provided only minimum software and a maximum of two hours per week of computer labs for each student.

Effectiveness

Under a contract with the government, the University of Montreal undertook a comprehensive evaluation of the impact of the assessment on mathematics learning, science learning, logical thinking, expository writing, and attitudes towards schooling and technology. The evaluation study found an impact on improved critical thinking and creativity and on attitudes towards schooling in the seventh grade, but very little impact in the ninth grade, apparently because students and teachers were so heavily focused on the upcoming national examination.

Cost-Effectiveness

What can we say about cost-effectiveness of the program? While costs are lower than similar programs in the region, it is not clear whether computers are the most cost-effective means of increasing learning at the secondary school level, compared to, say, providing additional library and laboratory facilities, training teachers, and so on.

From a longer-term perspective, the program could well be cost-effective. To put it simply, if the program succeeds in getting students interested and excited over computers, and more likely to enter technical and mathematical careers rather than to humanities, law, and social science, then, given the expected higher economic returns to technical fields, as well as Costa Rica's national commitment to information technology, the program could well be considered a success.

Data from the 1992 Household Survey provide an example of the potential economic payoff to the Computers in Secondary Education program. The average salary of engineers at that time was about US$6,800 per year, compared to $4,500 for graduates in philosophy, arts, and letters, for a difference of $2,300 per year. This means that the cost of providing computer instruction ($38 per student per year, or $114 over the three years of lower secondary school) could be recouped by society if no more than 1 percent of all secondary school students changed their profession from humanities to engineering (e.g., the gain to society would be $23 per year for the entire work life of a graduate).

In short, in spite of the issues and uncertainties about using computers for the learning process, the long-term economic and social payoff of the Costa Rican program could well be significant. To verify this positive impact, future studies of cost-effectiveness of secondary school computer programs should especially focus on the impact of computer programs on student occupational aspirations, as well as, through "tracer studies," on the actual occupations chosen by graduating students.