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AUTHOR Bosch, Andrea
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ABSTRACT

In 1986, an American computer company invited the government of Grenada to install and assess the viability of using computer assisted instruction (CAI) to improve school achievement. This case study reports on the results of this experiment. The Crochu Roman Catholic Primary School was chosen to receive the integrated learning system (ILS) that consisted of a file server, 32 student terminals, teacher guides, student workbooks, and the WICAT K-8 curriculum. This document begi. , with an overview of the project including information on the school, the ILS, cost and design considerations, and the people involved in the project. Next, early decisions which were vital to the success of the project are discussed. A description of the actual implementation of the ILS follows. Then, the evaluation design and results are examined. The overall impact of CAI on the learning of Crochu students was positive. Other benefits of the system reported were in the form of individual improvement; success in passing the Common Entrance Exam; and the impact of CAI on the community. Finally, the conclusions and implications of the study are presented. (Contains 16 references.) (JLB)

COMPUTER-ASSISTED INSTRUCTION IN GRENADA:

HIGH-TECH SUCCESS AND SUSTAINABILITY AGAINST THE ODDS

LearnTech Case Study Series No. 3

by Andrea Bosch

May 1994

The design on the cover is tie-dyed cloth from the Caribbean islands.

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For more information, contact:

Education Development Center
1250 24th Street, NW
Suite 300
Washington, D.C. 20037 USA
tel: (202) 466-0540
fax: (202) 223-4059

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As this case study suggests, without the continued dedication of those people in Grenada who have made this experiment with computer-assisted instruction possible, there would be little to report. I am indebted to them for providing me with such an interesting and colorful story.

I am also indebted to Steve Anzalone who spent valuable time reminiscing and recounting experiences in Crochu for me and who contributed the section on the evaluation design and its results.

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Overview

In 1986, in an effort to test and create demand for computer systems in the Caribbean, an American computer company, the Control Data Corporation (CDC), invited the Government of Grenada to install and assess the viability of using computer-assisted instruction to improve school achievement. The Ministry designated the Crochu Roman Catholic Primary School, a small rural school forty minutes from the capital city of St. Georges, as the proud recipient of an integrated learning system (ILS), consisting of a file server, thirty two student terminals, teacher guides, student workbooks, and the WICAT K-8 curriculum.

The WICAT minicomputer technology offered the possibility of enhanced course management, personalized and self-paced instruction, teacher education and support, and the opportunity to extend these educational options to adults after school hours. For a small Caribbean country like Grenada with an education budget stretched thin due to vast educational needs, the offer seemed timely.

The system was tested both for its ability to affect student achievement in a developing country and the technical and economic feasibility of using high tech computer-assisted instruction (CAI) in the Caribbean region. To gauge learning gains, the Institute of International Research (IIR) under the auspices of the A.I.D.-funded Learning Technologies Project (LTP) was invited to design and administer an evaluation of the project. The evaluation provided strong evidence that student achievement in math and language arts increased due to the use of the computer package over time. The link was further strengthened when the computer system went down for almost the entire third year and test scores dropped reflecting the instructional loss.

If the link between improved student achievement and CAI seemed clear, the financial means to expand the project or build new markets was not. The international education community, perhaps skeptical of long term educational returns on investments in CAI in the developing world, could not promise support. The Government of Grenada with its small budgets

and large commitments could not expand the project in any significant way either. The evidence for the sustainability of high tech CAI and educational benefits in developing countries was not strong enough.

After the pilot project ended, the ILS system still needed maintenance and replacement parts. Most local personnel and Ministry officials familiar with the original project had left the Ministry. External support from CDC for computer maintenance, salaries, training or support slowly dried up. One would think that without the attention of their international and regional guardians, the computer keys would no longer be tapped and the benefits to student achievement would remain short-lived or forgotten. Isn't that the way the story usually goes?

Yet eight years after the project's inception, the computer lab is still functional and regularly fills with eager students ready to log-in and learn math and language arts. The school principal states firmly that the computer learning system continues to increase the number of Crochu students who score high enough on the Common Entrance Exam to gain entry into secondary school — a goal not only widely sought but often elusive due to competition from students from the capital city.

And commitment to CAI remains strong. Parents state their willingness to pay small sums if needed to keep the machines operational. The local priest works hard to find extra funds to pay for replacement parts and international telephone calls when the local capacity to fix the specialized system is not sufficient. Finally, community, international and Ministry connections have come through at significant times to keep the system up and running.

While literature indicates that CAI can have a positive effect on promoting student achievement, the international education community suggests that such high-tech solutions to developing country education problems are not sustainable. Why then has computer-assisted instruction worked in Crochu for eight years despite the poor, rural and inclement environment and the projections and foresight of most international education researchers? Why does this unusual project, inspired not by development specialists but by a private business venture, approach sustainability by continuing to function at the local

level without external development funding or guidance, extensive support from the Ministry of Education or even current compatibility with most modern educational software?

The longevity and educational accomplishments of the WICAT integrated learning system in Crochu provide us with valuable insights into how at least one rural Caribbean school continues to produce learning gains over time with sophisticated computer-assisted-instruction. This case study is more than an analysis of high-tech sustainability against the odds, however; it is also a look into the personal and organizational inputs and shared investments — both monetary and human — that have made this learning technology work in Grenada.

Background

One Rural School

The Crochu school is located in St. Andrew's parish, about forty minutes drive from St. George's, the capital of Grenada. Crochu is a rural community with erratic electrical current, a humid

This case study is more than an analysis of high-tech sustainability against the odds. It is a look at shared investments.

rainforest environment, and scarce educational resources. Not unlike most rural towns in Grenada, the majority of its working population is engaged in agricultural work with few opportunities for alternative employment.

Community involvement and the Catholic church add a dimension of strong social interaction and cultural congruity among its inhabitants. Grenada has both public schools and parochial schools, although there may be only one choice in a rural area. In Crochu, the primary school is Catholic and the parish priest and manager of the school, Father Ed Conlon, provides support to the community and a link to his international Catholic order.

In a mini-ethnography written in 1987, Carla Freeman describes the educational environment as having many of the same constraints common in poor rural areas in other developing countries. While intentions are often good, classrooms are lacking in resources and trained teachers, and students are not given individualized or well-organized instruction.

> *"Despite their sincere efforts, untrained teachers understandably seemed to lack the self-confidence and sometimes the basic educational tools required to teach effectively.*
>
> *"The Crochu classrooms were sparse, and in most cases bleak — but neatly lined with rows of wooden chairs and tables. Students' pencils and copy books, purchased and brought from home, were often worn and tattered. In each classroom a blackboard stood prominently in the center — dividing the slow group on one side from the faster students on the other."*[1]

Restrictions make finding and retaining trained teachers difficult for rural area schools. According to Freeman, stipulations created by Grenadian national education policy prevent prospective teachers from entering teacher college without three years teaching experience and high marks on their O-level exams. In addition, in the Catholic schools the teachers must be of the Catholic denomination. Teachers often use the schools like Crochu R.C. to accrue their three years of experience before going to teachers college and/or securing higher paying teaching jobs elsewhere.

> *"Of the seventeen teachers employed at Crochu, only six were qualified (trained) and of those teachers making use of the computer lab, only one had received training beyond secondary school.*

> *"[Untrained] teachers did not appear to hold to any particular curriculum, beyond the use of specified texts. None could be observed to use lesson plans which might have revealed a curricular agenda...Much of the school day consisted of periods in which the students worked on the rote performance of some task, unattended by the teacher."*[2]

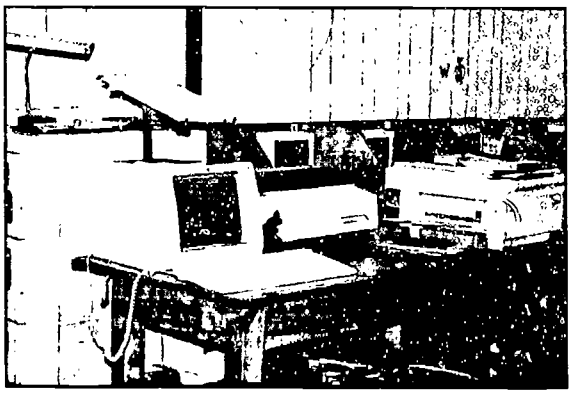
Imperfect as this teaching and learning environment is, because of its similarity to so many other schools worldwide it provides an excellent venue in which to study the success of CAI in developing countries.

The Integrated Learning System

To understand how the CAI system worked in Crochu R.C., it is important to understand the composition of the WICAT integrated learning system and how it differed from other CAI systems more commonly available today.

The ILS consists of:

- hardware;
- courseware for K-8;
- audio, visual and print components;
- teacher training;
- active and individualized pedagogy;
- instructional support; and
- tests to measure individual student achievement.



At the heart of the system was a powerful file server or "mini-computer."

The hardware. At the heart of the system is a powerful file server or "mini-computer." The server is linked to the thirty-two student terminals and the printer. Each student terminal consists of a keyboard, a monitor, and a set of headphones for listening to audio portions of the lessons. Unlike personal computers, the ILS file server serves as the hard disk and memory for the whole system.

The courseware. In contrast to some educational software with limited instructional objectives, the WICAT courseware covers the range of topics normally taught at K-8 grade levels in schools in the U.S. and Canada. The courseware is loaded on the large hard disk and backed up on tapes. While some teachers make use of a typing course included in the adult courseware on their own time, Crochu R.C. elected to follow only the language arts and mathematics portions of the curriculum for the students.

Audio, visual and print components. The system contains integrated graphics and audio to support each lesson. As educational inputs, the interactive computer, the visuals and the audio reinforce lessons learned through the more traditional print media and face-to-face teacher instruction. As the ILS curriculum was designed for students in the U.S. and Canada, the English contained in the courseware sounds substantially different from English typically spoken in the Caribbean. At times this has been a source of difficulty for many children.

Teacher training. Teacher training, while not a central component of the project, was provided so teachers could understand the basic functions of the ILS. In addition to running the lab, the lab

The visuals and the audio reinforced the traditional print media and teacher instruction.

manager also supports the teachers in the use of the curriculum manuals outside of the computer lab. Because the system also includes a program that tracks the progress of individual students and can generate tests of student performance, teachers monitor the students and compare their achievement across other subjects.

According to Elizabeth Phillips, the lab manager, the ILS package contained the potential for individual teacher enhancement.

> *"For teachers, [CAI] was an opportunity because the manuals that came with the hardware were absolutely great teaching guides. I encouraged them to look at the manuals for teacher training."*

Active and individualized pedagogy. The teaching style, as with most CAI systems, is self-paced and interactive. For less confident students or students who are slower or quicker at particular tasks, these teaching methods often bring out higher performance and time on task.

The curriculum itself generally follows a multiple-choice format with correct responses eliciting smiling faces. Wrong answers ask the student to try again. After a third failure, the teacher is needed to intervene, provide correction or further explanation, and to hit an override key to allow students to continue.

Instructional support system. The integrated system provides support for the learner on almost every level. The lab manager helps the student on an individualized level. The WICAT system also includes a help-key design which allows the students to receive assistance directly from the II S. While available, this function is thought to be poorly understood by the students and rarely used.

It is safe to say that the learning environment created by the CAI system was dramatically different from the rote style learning with which the Crochu students were accustomed. Learning gains in reading and writing were not achieved until after the second year, suggesting that time to adjust may have been necessary for the students.

Cost and design considerations

At the time the integrated learning system was installed in Crochu, there was considerable debate in educational circles on the merits and demerits of investing in integrated learning systems. First, they were expensive. The system installed at Crochu was never actually priced, but an estimate suggests that the whole ILS installed at that time would have cost at least $60,000. School districts normally pay CDC an additional annual fee for the use of the courseware, product support, and training, but the annual fee was waived for Crochu.

Second, in 1986 the "closed architecture" of integrated learning systems became an issue for many educators. Unlike open systems, closed learning systems could only run their own courseware. During the Crochu experience, educational software created for personal computers became more popular and sophisticated, and closed systems slowly became obsolete. Eventually WICAT got out of the business of making hardware altogether. (In 1992, WICAT was absorbed by the largest manufacturer of integrated learning systems, the Jostens Learning Corporation.) Today, integrated learning systems do not require investment in a particular, dedicated hardware system but rather run on networked personal computers. The WICAT courseware used at Crochu is no longer available.

While the ILS package used in Crochu may not be as flexible as open systems, it was advantageous for at least the following reasons:

1) The system was powerful and offered valuable instructional and management capabilities.

2) The comprehensive and well-structured nature of the courseware was easier to implement and probably more effective than stitching together an instructional program that drew upon a pool of existing software in math and language.

3) Many school-based programs using PCs as part of classroom activities floundered because of the teacher training requirements. In the developing world context

of Crochu, only the lab manager needed to master the intricacies of using the computer. The teachers *could* learn from the system, but it was not *required*.

The system was powerful and offered instructional and management capabilities.

The Players

Rather than an NGO or governmental body protecting the project — as one might find in many educational development projects — the central binding institution was the Crochu R.C. School itself. The project and school staff created a self-sustaining system to maintain and implement the project. Relying on outsiders only when needed, the management of the Crochu project remained close to the ground.

This informal network and people's attitudes and confidence towards the computer system, rather than the technology alone, determined the success and the sustainability of CAI in Crochu. In order to understand the project, it is central to understand the key institutions and individuals involved.

The Ministry. The Ministry of Education was not able to offer extensive long-term assistance, however, the Ministry did facilitate success in several specific ways. It paid for the extra electricity needed to keep the ILS running, provided duty-free import status for the equipment, and spare parts, and general support to the project from the beginning. It also paid the salaries of Mrs. Allard (the second project Lab Manager), and Paul Finley, the government-employed computer technician

who worked hard to keep the machines running both by referring to his training and by calling WICAT contacts in Utah.

In 1993, not everyone at the Ministry remembered that the computers existed and that reports had been generated on learning gains. This seems to have had an influence on the level of support to the computer center over time.

Control Data Corporation. The design of the project was largely due to the insight of Bob Brandberg at CDC. The expense of the equipment, training, salaries, evaluation and travel lay on the shoulders of CDC either directly or indirectly during the life of the project. After the project ended and the use of integrated learning systems began to fade internationally, CDC continued to provide occasional free consultation over the telephone and maintained a personal interest in the project.

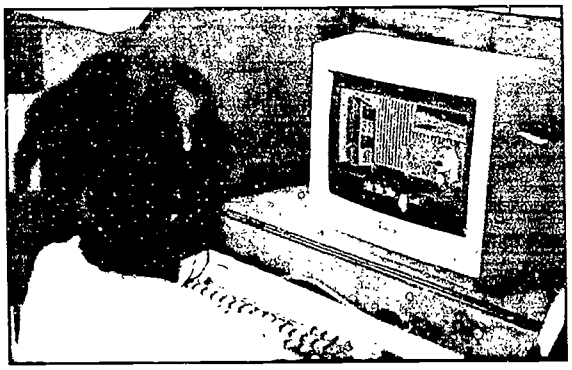
Agency for International Development and its Projects. The Institute for International Research through the A.I.D-funded LearnTech project and its precursor remained connected to the project through both its evaluatory role and through a personal interest in contributing to the CAI experiment. To add a qualitative understanding of Crochu to supplement the quantitative testing of the evaluation, IIR commissioned Carla Freeman to write the mini-ethnography on the educational setting in Crochu.

The Crochu School. The institution of the Crochu School was committed to the success of CAI in the school from the beginning. It may have been a scary endeavor for Crochu staff, teachers and parents to introduce high-tech equipment where their was no experience with these types of educational tools. If the positive combination of the Project Staff and the School Principal with the other institutions involved did not fully determine the success of CAI in Crochu, it at least contributed greatly to its sustainability.

Some say that the longevity of CAI beyond the project life in Crochu is due to the determination and efforts of the principal, Catherine Simeon. Elizabeth Phillips, the project's first Lab Manager, reported that,

> *"[Mrs. Simeon] was a big contributor to the success of the program. She doesn't accept failure under any circumstances and she maintained determination to keep the computers running always."*

Other evidence also suggests that Catherine Simeon's role as CAI advocate and organizer of support was significant to CAI's sustainability. With little knowledge of computers or international development and with the valuable support of the Project Director, Osmore Gall, Catherine Simeon recognized that multi-institutional support and community participation were essen-



It may have been a scary endeavor to introduce high-tech equipment.

tial. She brought in parents and Father Ed Conlon from the Catholic parish to facilitate connections to the community and an international constituency. More than once when the ILS went down her contacts came through for her and CAI was restored in the school.

The Catholic Church. The Catholic Church also played an unplanned but important institutional role in the sustainability of CAI in Crochu. Father Ed Conlon, the parish priest and School Manager, was dedicated to supporting education among children and adults in the community and called upon others in his Ohio dioceses to provide financial support for the ILS when needed. Twice during the time after the project ended, they came through and bought expensive replacement parts.

Beyond the general acceptance which the Catholic Church provided, Father Conlon supported the ILS financially in crisis circumstances. Small favors, such as when the computer technician was able to make international calls to the WICAT office from the priest's home, gave Crochu the ability to overcome typical high-tech breakdowns. Without this link, the project may not have been able to solve small problems and may have

been cut short under simple mechanical duress like other applications of high technology.

The Project Staff. The project staff included the Project Director, Osmore Gall; the Lab Managers, Elizabeth Phillips and Mrs. Allard; and the Computer Technician, Paul Finley. All continued to give their time to the Crochu school and the ILS whenever possible even after their contracts expired. Osmore Gall, for example, was called upon on many occasions to come to Crochu and work with the system. When he could, he did.

The person most intimately involved in the individualized learning process and day-to-day functioning of the ILS during the life of the project was Elizabeth Phillips. As the person most familiar with the total system, she understood the integration of the teachers manuals, the CAI lessons and styles and the daily achievements of the children. Better than perhaps anyone, she also understood the potential of the system if it were used to capacity.

> *"The simple access to the system was a great benefit to the students. The [content of] the software itself widened [the students'] horizons. It gave the children exposure to many new ideas and hope for the future."*

ELizabeth Phillips kept a logbook which detailed the mechanical functioning of the CAI system and the days that the system went down. She became versed in the basic mechanics of the ILS. system and was able to keep it operational most of the time on

Project staff, like Director Osmore Gall, continued to give their time to the Crochu school after their contracts expired.

her own. While she remembers this being frustrating at times, keeping records gave the project institutional memory and leveraged its ability to help itself.

The Groundwork: Important Early Decisions

Project set-up was not without its difficulties, but considering it was a project requiring that an educational system developed for one environment be introduced into an entirely different one, it was surprisingly easy. Differences in climate, power, physical space and the local capacity to maintain the equipment required that initial innovative measures be taken. The timeliness of early decisions cannot be overlooked in the analysis of institutionalization of CAI in Crochu.

Rationale for the Rural Setting. While some of the difficulties of project set-up might have been somewhat minimized in the more urban area of St. Georges, Computer Data Corporation and the Ministry of Education decided to locate the test facility in the remote and more typical school setting of Crochu for a variety of reasons. The principal of Crochu R.C. was felt to be a capable person and could be counted on to give the project the support that it needed. Physically, the school had a room large enough to serve as the computer lab and house the computer, terminals, and other related resources. And perhaps most importantly, (as mentioned above) the resemblance of Crochu to other Caribbean classrooms made the experiment transferable.

Priorities for the Evaluation. Due to limited resources, the nature and extent of the evaluation had to be prioritized. All parties agreed that the assessment should focus on what impact CAI would have on achievement. Strong effects would have to be demonstrated for continued or expanded use of CAI to be warranted.

A control group was used. The evaluation compared performance in language and reading of Crochu students receiving CAI with others who were not.

International Technical Assistance. The Ministry of Education and the CDC agreed to launch the Crochu Project during the 1985-86 school year. CDC agreed to provide technical assis-

tance during the first year to get operations up and running. This agreement was later extended for a second year.

Local Expertise and Capacity Building. To address the need and lack of local technical expertise in the ILS hardware and to prepare the system for sustainability, CDC made attempts to build local capacity and rely on local expertise. A government technician, Mr. Finley, was sent to the WICAT facility in Utah and trained in systems maintenance and repair. CDC also contracted with a local computer firm Computer Entrepreneurs Limited to guide implementation of the project. Its owner, Osmore Gall, became Project Director. Finally, CDC provided funds to hire the first full-time lab manager, Elizabeth Phillips, to act as liaison between the computers systems experts, the teachers and school personnel, and the students.

For the teachers and project staff, a WICAT employee visited Grenada to conduct a short training course. They learned to use the audio, visual and print components of the integrated learning system. Teachers were briefly exposed to the integrated curriculum, the worksheets that they and the students could use, and the types of reports that the computer could generate on the individual progress. The Lab Manager learned more specifically how to use the computers and how to monitor and support computer-related achievement and computer functioning.

In a decision crucial to sustainability, it was planned that the initial trained Lab Manager would later train a local teacher at

Because electrical current in Crochu was unstable and full of surges, a UPS was added.

the Crochu school to take over her responsibilities and maintain on-site capacity after the first year.

Obstacles and Solutions

An Auspicious but Difficult Beginning

Much needed to be accomplished before the students could begin using the computers: new power lines were extended into the computer lab, air conditioning was installed, the system was shipped to Grenada and set up, training was provided, decisions about starting points in the courseware for each standard were made, and schedules were drawn up to indicate what instruction (mathematics or language) would be provided for each standard and when. In Crochu, the new instructional support system was in place in a matter of months.

The project began on schedule. For varying hours per week, students in Standards 1 - 5 began to follow the WICAT curriculum in language arts and mathematics in place of the usual classroom instruction in these subjects. Unfortunately, a dip in the electrical current just two days after school began caused the hard disk to crash. The hard disk was replaced and an uninterruptible power supply (UPS) was installed. Elizabeth Phillips remembers the difficulties with the electrical current:

> *"In those days it was difficult to bring good current into Crochu, but we worked very hard to keep the computer system running and to make the most of times the system could function. Everyone did. The computer lessons diversified learning and gave the children immediate gratification for drill and practice. These were not teaching practices common in the rural areas."*

Students began using the computers again in November, 1985.

Visitors to Crochu during the first year noticed a lively spirit of commitment to the project by those involved with it. There was an awareness that something unique was taking place at Crochu. Osmore Gall provided project leadership beyond the requirements of his contract with Control Data. He made numerous journeys to Crochu, getting involved in troubleshooting and systems operation.

Elizabeth Phillips, the Lab Manager, delved into the tasks of learning about the courseware and becoming proficient in keeping the system running. Catherine Simeon, the principal, kept things organized and active at the school. The computer lab was kept immaculate — something that has continued to the present day.

The second difficulty arose from the unusual appetites of local ants. Students noticed that certain keys on their keyboards were becoming more and more difficult to use and often nonfunctional. Apparently, ants in the computer lab were consuming the glue that neld the keyboards together. As they ate their fill, the keyboards fell apart and some had to be replaced.

Due to time lost because of difficulties in operating the equipment, the system was operational only about 25% of the time up until January. During the months after that, the system was operating at about 75% of the time. In April, a backup generator was purchased to deal with the frequent losses of electrical power. Because of difficulties, each student on average received about 30 hours of instruction on the computer during the first year.

Enthusiasm at Crochu was still high. Control Data decided to extend technical support for the second year and found many fewer problems. At the end of the year, the financial support from Control Data ended and Elizabeth Phillips' contract expired, and she trained her replacement.

The 1988-89 school year saw an increase in the hours of usage to an average of 37. This increased to 50 hours the following year, when it was judged that the computer was up 98% of the time.

By 1989, the effects of CAI on achievement were demonstrated by the external evaluation and performance on the Common Entrance Examination (see pages 24-29). The system had been operational throughout the year and parents and the community began to feel the repercussions of the school's and students' excitement. In a letter written in 1989, Catherine Simeon wrote:

> *"I had a very successful meeting with the parents, and they have all started making contributions in monetary form. So far we have (EC) $ 250 to add to our bank account. There*

will also be fund raising projects, e.g. a fair, bingo, and a dance — all on dates to be announced shortly." (June 6, 1989)

At the end of the school year, the system went down again, and the Ministry of Education authorized the purchase of replacement parts. And still more mechanical difficulties hampered the project. The UPS went down and had to be replaced. This required an investment of $2,000, which was raised largely by Fr. Ed Conlon.

The second difficulty arose from the unusual appetites of local ants.

During the summer of 1989, the LearnTech project assisted Crochu in getting a courseware update from WICAT. WICAT made this available for the costs of reproducing disks and manuals.

During the 1990-91 school year, the hard disk crashed again, meaning that the system was in use for only half the year. The system was out for the whole next school year. Due to undying local commitment, funds were raised to replace the hard disk midway into the 1992 - 93 school year and Crochu returned to operation.

In 1993, in a series of interviews for this case study, Catherine Simeon suggested that despite the mechanical difficulties experienced in Crochu, the benefits of CAI were still being felt. Community members and staffpeople still supported the continuance of the system despite the frustration of its mechanical failures. The impinging obsolescence of the closed ILS had not yet affected the ability to keep achievement high in Crochu or ability to find replacement parts.

The Payoff in the Form of Results

Evaluation Design

All those taking part in the Crochu project had an important stake in the evaluation of the impact of the computer system on learning. For the Ministry of Education and the school, weak impact would clearly inform decisions about whether the effort and expense of the keeping the system going was worth it. For the manufacturer, credible evidence of impact would facilitate marketing of products elsewhere in the Caribbean and in other developing countries. For the A.I.D. sponsored Educational Technologies Studies and Applications Project and later the Learning Technologies for Basic Education project (LearnTech) conducting

"Despite the mechanical difficulties experienced in Crochu, the benefits of CAI are still being felt."

— Catherine Simeon

the external assessment, the Crochu project provided an opportunity to undertake a study that would be of interest to educators in many countries. The results from Crochu would provide an early benchmark of the effects of computer-assisted instruction on learning in primary schools in developing countries.

The evaluation study was designed by the Institute for International Research in conjunction with the Ministry of Education. In the control group comparison discussed earlier, the performance of Crochu students (enrolled in standards 1 - 5) was compared to that of students in one of the better primary schools in St. George's in order to see if the use of CAI might serve to reduce the usual gap in performance between urban and rural students.

The three control schools selected by the Ministry of Education

were chosen because they showed themselves to be similar to Crochu in terms of the: (a) past performance of students on the Common Entrance Examination (given at the completion of primary school for the purpose of determining entrance into secondary school), (b) proportion of the teaching staff that had been trained at the national teachers college and deemed to be fully qualified, (c) educational background, experience, and a subjective assessment of the leadership qualities of the school's principal, and (d) size of the school.

There were no standardized tests of student achievement in Grenada appropriate for measuring student achievement prior to the Common Entrance Examination which is given at the end of primary school. With insufficient time to develop new tests of student achievement for the first year, it was decided to administer the Canadian Achievement Test at the beginning and end of the 1986 - 87 school year. This test was easy to administer and tested basic elements of math and language arts. It was agreed that before the next school year achievement tests reflective of Grenada's curriculum would be developed with local educators.

Students took the Canadian Achievement test in September 1986 and again in May 1987. Analyses of test scores showed a high number of students performing at levels that could be obtained by chance, and it was judged that these results did not provide adequate information to draw conclusions about student achievement.

During 1987, Professor James Royer and colleagues at the Center for the Assessment of Language Skills, University of Massachusetts, were invited to join the external evaluation team. In a week-long workshop that was opened by the Minister of Education, a team of Grenadian educators worked with the external evaluators in developing two parallel versions of what was to be called the Grenada Achievement Test (Levels 1 - 5) for language and mathematics.[3]

The Grenada Achievement Tests were given to students in September 1987, May 1988, and May 1989. While the number of students taking the tests varied slightly from year to year, in 1987, 1278 students were tested, 290 of whom were Crochu students. The tests were administered by retired educators, who were trained in test administration procedures by the external evaluation team.

What the Tests Showed

The overall impact of CAI on the learning of Crochu students was positive.[4] The main findings of the evaluation were the following:

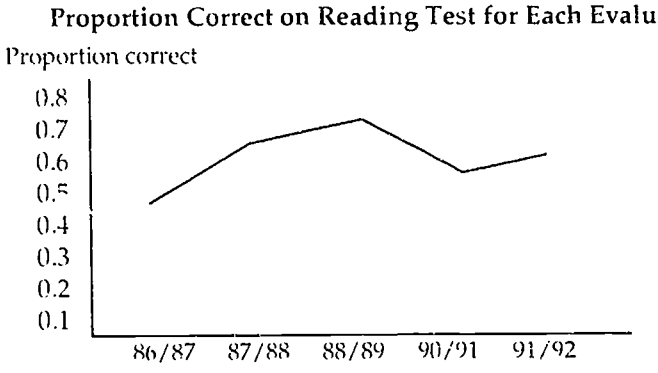
- The data indicate that by year three, one hour per week of CAI would place the average Crochu student at the 72 percentile level in reading and at the 82 percentile level in math as compared to a control group (these values assume a school year that is 36 weeks long)[5];
- In mathematics, the Crochu students outperformed control students throughout the evaluation period;
- In language, Crochu students did not perform as well as control students during the first two years but did so during and after the third year of testing;
- The impact on achievement was not affected by gender in either Crochu or in the control schools;
- Lower ability students benefited more (relative to control students) from CAI than did higher ability students; and
- The results of additional testing (discussed below) showed that increasing the level of use of CAI led to increasing performance levels in both language and mathematics.

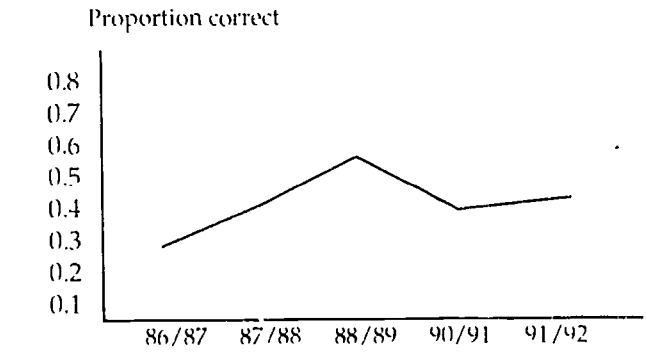
From 1986 to 1992, achievement in math and reading improved for Crochu students, as is shown in Figure 1. The hard disk failure during the 1989 - 90 school year provided additional information about the relation of achievement to CAI. It was only midway into the 1991 - 92 school year that Crochu was able to replace the hard disk and resume using the computer lab — about one and a half years later. Because students received no CAI during this period, the hard disk failure provided an opportunity to look at what happened to student achievement with the interruption and then the resumption of CAI. If, as the previous testing had suggested, CAI positively affected student

performance, then its removal should be followed by a decline in performance. Similarly, a reintroduction of CAI should result in an improvement in student performance.

The results of these tests were as expected. As shown in the graphs in Figure 1, there was a decline in student performance on the 1991 test after more than a year when the system was not in use at Crochu. There was also an upturn in student performance when the system became operational again the following year. Figure 1 also suggests that the amount of time students were exposed to CAI was also positively related to achievement.

Relationship Between CAI Exposure and Reading and Math Performance
Figure 1





Effect sizes (calculated by subtracting the mean of the control group from the mean of the CAI group and dividing by the standard deviation of the control group) provide an index of where a Crochu student receiving CAI would have been in the control group. (see table 2) Thus an effect size of .42 means that the average Crochu student would perform above average at the 66 percentile rank if the student had been in the control group. The bigger the effect size, the greater the relative performance of the students using CAI.

Table 2

Effect Sizes for CAI Groups as a Function of Time of Test, Standard and Test Content

	LANGUAGE			MATHEMATICS		
Standard	9/87	5/88	5/89	9/87	5/88	5/89
1	-.706	-.155	.260	-.705	.049	.380
2	.145	.407	.330	.811	.791	.420
3	-.378	012	.430	.082	1.080	.610
4	-.032	-.617	.120	.215	-.413	.220
5	- 218	-.096	.870	1.060*	.301	1.750
totals	-.237	-.090	.402	.419	.362	.676
percentile	40.5%*	46.4%	65.5%	66.3%	64.1%	75.2%

*This value indicates the percentile rank that the average CAI student would attain if s/he were in the control group.

source: *Royer and Carlo*

With a large number of students, as there was in this study, even small differences in performance may be statistically significant.

Redefining the "Slow" Student: The Story of Michael

Positive results were also felt on an individual level and the stories of some children introduced to CAI are worthy of repeating. One dramatic case which circulated throughout Grenada had to do with a boy named Michael Bishop. Michael was born with some obvious physical impairments, including speech problems. Together with his poor written work, this suggested to his teachers that he was unable to learn and would always be a hopelessly slow student. After some time working with the computer, however, it became apparent that Michael was indeed learning. In fact, when working with a keyboard rather than paper and pencil, his performance in reading and math was quite good. A closer look at Michael's written work revealed that underneath his very poor writing skills were often hard-to-decipher correct answers. In typing responses to the CAI language arts and math lessons, Michael was able to reveal his comprehension and abilities in a way that had been masked by his shyness and writing difficulties. His continued high performance exceeded all expectations when he passed the difficult Common Entrance Exam which determines which children can go on to secondary school.

Elizabeth Phillips described Michael's experience as educational to Crochu in general. By *"bubbling to the top in performance in the lab"* Michael changed others' perceptions of him and his possibilities for academic success irrevocably, but the teachers also benefited. According to Mrs. Phillips, they learned patience from the experience and that the labels of slow and fast learners were not always accurate or beneficial in the long run.

Success on Other Levels: The Common Entrance Exam

While the evaluation results were compelling in and of

themselves, people in Crochu related success in CAI to tangible personal achievement, such as the breakthrough of special students like Michael and the greater numbers of students passing the Common Entrance Exam and attending secondary school.

> *"1990 was the most successful year,"* stated Catherine Simeon. *"Fifty-three out of 60 students passed the entrance exam. Two of the students were in the top 20.*
>
> *"When the computers were down, the students placed lower on the entrance exams.*
>
> *"The computers helped. And the teachers at the secondary schools say the children from here continue to do well."*

Father Ed Conlon measured success in familial terms. He stated, *"most importantly, the computers help the students bring pride to their families when they do well in school."* The intimacy of his perspective is also mirrored in others in the community.

Catherine Simeon, for example, is a staunch supporter of CAI not only because of her status as School Principal, but also because her daughter, Mondelle, was also one of those students who passed the Common Entrance Exam and currently is enrolled in the only secondary school in the parish. According to Mrs. Simeon, Mondelle received one of the highest scores. She attributes her success largely to the support of CAI and goes to great lengths to make sure CAI is extended to other Crochu students.

"The computers help the students bring pride to their families when they do well in school."

—Fr. Conlon

"The computer gives the children something different other than blackboard and chalk. It reinforces what the teacher does and gives [the students] hands-on practice."

Young adults came to the computer lab and the small Crochu library to reinforce their basic education skills.

She also commented that after Crochu's experience with Michael, the teachers often turned to assessments generated by the computer to better understand their students' abilities and weaknesses. While many teachers often were fearful of using the machines themselves, others used the computers after hours and were convinced from hands-on experience that CAI was making the difference in the children's exam scores.

CAI in the Community

In the original project design, the computer lessons were to be extended to the community level and be available for adult education at night. While nothing was initiated in the first years, once the project was underway and children brought home stories to their parents, they began to be used more broadly. With the assistance of Father Conlon, the computer lab began to be integrated into an adult education program at night.

Thirty-two adults started a program of learning typing, math and language with computer reinforcement. Young adults also came

to the computer lab and the small Crochu library to reinforce their basic education skills. Still in the process of getting off the ground in 1993, Fr. Conlon reported that the adult students were starting to drop out. With tight job markets outside of the agricultural sector, he suggested that adults may not be motivated to upgrade their basic education skills without other incentives. According to Fr. Conlon, however, they were more attracted to the night school program when it included the computers.

What Crochu Teaches Us About Sustainability

Today, CAI is still being used in Crochu. Unlike some evaluations on educational interventions elsewhere, the CDC and the evaluation team suggest that increased achievement has also been sustained.

People in Grenada, particularly outside of the Crochu town, know little about the Crochu project and may not marvel at the school's ability to keep the machines running and effective. What might have been a cause of national pride, does not exist as such. In Crochu, this lack of recognition was unfortunate as it might have helped sustain the project during troubled times. But still, the key advocates and their informal cadre of supporters continually muster together the energy and experience required to maintain the CAI system.

Because of the particular circumstances of this CAI experiment and the intuition and dedication of key people, Crochu's long term use and maintenance of CAI in Crochu over the past few years cannot be assumed to be transferable to every setting. The implications of the project success suggest that CAI can function over the long term in a developing country environment, however, given a certain combination of factors.

Longevity of any educational technology and associated improvement in achievement for eight years anywhere deserve applause. In Crochu, the WICAT IIS was an experimental investment which was not supposed to last nearly a decade. It

was not planned that the computers be sustained and continue to reaffirm the results of the longitudinal study, particularly on the informal connections of a few people and institutions.

The use of CAI is also still connected to academic achievement and increased opportunities for entrance into secondary schools. While the individual contributions of individuals and organizations played a key role, it is difficult to pinpoint a single factor to explain why a high-tech educational intervention has been sustained for eight years in this difficult environment without planned and organized financial support.

But the Crochu project is unusual for many reasons. It combined many factors including good management and commitment and an integrated educational system compatible enough with the culture and environment to be sustained. Some contributing factors are common knowledge among development practitioners. Others are specific to activities where the technology chosen may not immediately match what is typically used in the proposed setting.

1. *Low immediate dependence on new skills or immediate attitudinal changes.* It is likely that the impact of the CAI system could have been enhanced by the increased skills of school personnel to use the system effectively or in curriculum orientation.[5] Significantly, however, the WICAT CAI system did not *depend* heavily on new and immediate teacher skills or changed attitudes. A few well-trained individuals could begin the ILS process and others who were more skeptical could come on board when they were ready. This meant that the computers could begin to have effect on children's achievement without changing all the teachers' attitudes towards technology.

2. *Well-designed instruction and active learning style.* The intervention was not just technology driven. It was also driven by well-designed instruction and an interactive learning style. Low tech or high tech, pedagogical integrity makes a significant difference.

3. *Careful project design and flexibility.* The Crochu

project considered early on the capacity of the people and environment to sustain the project. Some decisions resulted in changes to the physical environments of the school. Other decisions resulted in the provision of training time between employees and financial arrangements with the Ministry. It is important to note that when the actual project ended, Catherine Simeon and her colleagues continued planning ahead and creating systems to maintain the lab and its functions.

4. *Institutional and individual networks.* For the Crochu project, this factor may be the most important. The institutions and local groups, the Church and particular individuals in Grenada and abroad formed an informal network of interdependence on which the project system could rest. It was not perfect and at times floundered close to demise, but its cohesion kept the project alive.

   Importantly, the success or failure of the project was not fully dependent on any one entity such as the Ministry of Education. Neither did any one entity stand in its way.

5. *Strong individual advocates.* One of the original project considerations involved positioning the project with a strong project advocate. A review of events affirms this decision.

6. *The demonstration of results.* CAI was proven to be successful both by international quantitative standards and by standards relevant in Grenada. When interviewed, people associated with the project suggested that the amount of effort that the community and individuals devoted to maintaining CAI in Crochu was connected to measurable results.

7. *Positive social and cultural value.* In Crochu, CAI had positive value educationally and culturally. The community gained pride and cohesion around the academic success it brought the students.

Grenada was also in the first stages of experiencing the computer age. While parents or teachers may have felt threatened by their use personally, they did not perceive them as counterproductive culturally.

8. *Local capacity in project maintenance and crisis management.* Project and equipment maintenance were both considered in this project and training or incorporation of technical computer experts in the Government (Mr. Finley) and in the private sector (Osmore Gall) were both planned for. Elizabeth Phillips' careful logging of problems and mechanical kinks in her logbook also contributed to the local ability to problem solve and keep the CAI active.

9. *Decreased risk of "all or nothing."* High tech interventions are often low on the development totem pole because while the machinery is functioning everything is great, but when the machinery fails, the particular intervention is not adding value to the education system. As compared to investing in an intervention like teacher training or textbook revision, technology-based interventions rely on the functioning of the machinery. And keeping CAI operational can be tricky for remote rural communities.

   Whether or not the equipment was functional was the central concern associated with CAI throughout the life of the project and beyond. The risks of "all or nothing" were diminished, however, by some of the other factors, such as the local computer expertise, strong advocates (particularly placed in strategic funding positions), institutional networks and local capacity. "All or nothing" will always be of major concern to technology-based interventions, but does not have to render them ineffectual.

Closing Words

The post decade suggests that shifts in the international definition of sustainability and views of high-tech educational solutions in developing countries will continue to not affect what is

happening at Crochu. Ultimately the experience with CAI was not just about learning technologies. It was also about a powerful combination of people and dedication. It is an example of how a education project can be flexible enough to adapt if necessary and rebound in the face of obstacles. The sentiment is clear in Crochu. Because people believe that CAI can positively affect learning, they continue to work towards its longevity. If this is indicative of the success of learning technologies in this Caribbean nation, it not difficult to imagine eight years down the road a new generation of technologies existing in Crochu and a new group of learners logging in or signing on to learn skills and basic education despite the traditional obstacles they might encounter.

Endnotes

1 Freeman, Carla, *Computer Classroom Ethnography, Crochu. R.C. Primary School, Saint Davids, Grenada (May 25 - June 15, 1987)*, Learning Technologies Project, Institute for International Research/ Agency for International Development, p.2.

2 Ibid, p.6, p.7.

3 Greene, B.A., Royer, J.M., & Anzalone, S.J. (1990). A new technique for measuring listening and reading literacy in developing countries. International Review of Education, 36, 57-68.

4 Royer, James M. & Carlo, Maria S. (1992). Computer-Assisted Instruction in Grenada: A Summary of Research Evidence. Arlington, VA. Institute for International Research, Learning Technologies for Basic Education Project. Royer, James M.; Greene, Barbara; and Anzalone, Stephen (1994). Can U.S. Developed Computer Assisted Instruction Work Effectively in a Developing Country. Journal of Educational Computing Research. vol. 10).

5 Royer, James M., Barbara Greene, Stephen Anzalone (1994), "Can U.S. Developed Computer Assisted Instruction Work Effectively in a Developing Country." *Journal of Educational Computing Research*, v. 10, no. 1. p. 54, 56.

6 Ibid, p 59.

References

Awa, Njoku, Jack Barwind and R. Arnold Gibbons, "Educational Technology in the Third World: A General Systems Perspective."

Collis, Betty, "Relating North American Experiences with Computer-Related Technology in Education to Developing Countries." Paper presented in the Annual Meeting of the American Educational Research Association, (New Orleans, LA, April 5-9, 1988).

De Vries, Peter, "Technology Transfer: Introducing a Computer to Teach Number Skills to Adults in Soweto." In *Convergence: An International Journal of Adult Education*, v. 21, no. 1, 1988, p. 5-15.

"Educational Technology: Sustainable and Effective Use," Lockheed, Marlaine E., John Middleton, Greta S. Nettleton, Eds. PHREE Background Paper Series, Education and Employment Division, Population and Human Resources Department. Washington, DC: The World Bank. PHREE/91/32.

Freeman, Carla, *Computer Classroom Ethnography, Crochu R.C. Primary School, Saint Davids, Grenada (May 25-June 15, 1987)*, Learning Technologies Project, IIR.

Greene, B.A., J.M. Royer, S.J. Anzalone (1990). "A New Technique for Measuring Listening and Reading Literacy in Developing Countries." *International Review of Education*, 36.

Gray, Robert A., "Educational Technology Use in Distance Education: Historical Review and Future Trends." In *Educational Technology*, v. 28, no. 5, May 1988, p.. 38-42.

Hawkridge, David, "Computers in Third World Schools: African Advances." In *Education and Training Technology International*, v. 28, n. 5, p.. 38-42, May 1988.

Hawkridge, David, "Computers in Third World Schools: The Example of China." In *British Journal of Educational Technology*, v. 21, no. 1, p.. 4-20, January 1990.

Hawkridge, David, "Who Needs Computers in Schools, and Why?" CITE Report No. 73. Open University, England: Walton, Bletchley, Bucks, 1989.

Jegede, Olugbemiro J. and Peter Akinsola Okebukola, "Adopting Technology in Third World Classrooms: Students' Viewpoint About Computers in Science Teaching and Learning." In *Journal of Educational Technology Systems*, v. 20, no. 4, 1991-1992, p.. 327-334.

Jegede, Olugbemiro J., and others, "Attitude to the Use of the Computer for Learning Biological Concepts and Achievement of Students in an Environment Dominated by Indigenous Technology." Paper presented at the Annual Meeting of the National Association for the Research in Science Teaching (63rd, Atlanta, GA, April 8-11, 1990).

McIsaac, Marina Stock, "Networks for Knowledge: The Turkish Electronic Classroom in the Twenty-first Century." In *Educational Media International*, v. 29 no. 3 September 1992, p.. 165-170.

Royer, James M. and Maria S. Carlo (1992), "Computer-Assisted Instruction in Grenada: A Summary of Research Evidence." Arlington, VA: Institute for International Research, Learning Technologies for Basic Education Project.

Royer, James M., Barbara Greene, Stephen Anzalone (1994), "Can U.S. Developed Computer Assisted Instruction Work Effectively in a Developing Country." *Journal of Educational Computing Research*, v. 10, no. 1.

Thurston, Linda P., "Girls, Computers, and Amber Waves of Grain: Computer Equity Programming for Rural Teachers." Paper presented at the Annual Conference of the National Woman's Studies Association (11th, Towson, MD, June 14-18, 1989).