

# Reflections on Technology-Enriched Schools

by Betty Collis and Gerrit Carleer

## 1. Introduction

This book had two primary functions. One was to contribute to the need for better information transfer about technology-enriched projects and their experiences. We believe that the nine case studies make this contribution well.

The second function of the book was to try to synthesize the experiences from a number of technology-enriched schools. One reason for this is to more efficiently provide recommendations and insights to others involved in technology-enriched school projects, or to others considering embarking on such projects. We hope the summary of recommendations from the case studies, which appears in the previous chapter, is helpful in this respect; the case studies themselves offer much broader and more valuable insights and recommendations.

A second reason for this book is that more and more schools, in their "ordinary" settings, are becoming technology-enriched, (certainly the Netherhall case study from the UK is a strong example of this), and thus can also benefit from the more formal TES projects. We believe the case studies offer insights of value to any school increasing its use of technology.

But synthesis should also stimulate reflection. In this final chapter, we would like to offer our reflections on a few key aspects of technology-enriched schools suggested by the case studies. One aspect relates to different ways of defining the "success" of technology-enriched school projects, a second relates to realistic expectations with respect to technology in schools, and the third to a methodology for doing research about technology-enriched projects and environments. Finally, we conclude by reflecting on the importance of disseminating our experiences to others.

## 2. Defining the "Success" of Technology-Enriched School Projects

Are these projects successful? Of course! There are many impressive results described, relating to student behaviors, teacher change, and changes in school and practice. Descriptions of student activities offer some very impressive ideas. The projects have stimulated and supported their teachers and contributed many insights to other projects. But if we think more generally about the meaning of "success" in TES projects, we could consider at least three general perspectives. Each perspective offers challenges to those involved in TES settings.

### 2.1 Success as a comparison of results with goals

One reasonable perspective for thinking about the success of a project is to compare the current status and output of a project with its planning and goals. This

approach, however, doesn't work very well in practice, as goals are often stated too broadly or in too complex a manner to measure in terms of output, or because the outcome of goals will only be reasonably seen in the future, or relate to higher level change that we in education in general don't know how to measure well. So in terms of meeting their stated goals, we may have some difficulty in saying to what extent the TES projects in our case studies are "successes," although the projects are certainly moving in directions consistent with their goals.

One recommendation, therefore, might be for TES projects, or technology-using schools in general, to periodically reflect on their own goals, in order to revise or sharpen them based on their evolving experiences. This could be very helpful to other schools as well.

A different and more measurable way to define "success" is through use/activity indicators. We could say, for example, "Are the resources being used? By how many people? Are a variety of activities happening in the project? Are people doing new things?" But we must be careful. We cannot assume that use or activity or newness in themselves have long-range educational value based on what the community expects from its schools. We must show the connection between computer use and computer-related activity and, eventually, better performing/thinking/producing students for society to finally judge our TES efforts a success.

### 2.2 Success as a function of enthusiasm

A second reasonable perspective with respect to success is peoples' enthusiasm about the project. Certainly in our case studies, and in so many other technology-using schools we know, people are enthusiastic. Students clearly like the technology; teachers who make it through certain levels of difficulty can also become very enthusiastic. The technology-enriched schools described in the case studies seem like happy places.

As educators we KNOW this is good, just as we know the opposite—an unhappy school is not good. But we have a job to do here. We must find a way to convince skeptics that stimulating enthusiasm is an important goal in itself for schools, that happy and enthusiastic students are also learning better or more or faster or more deeply. Our case studies give a number of useful examples of "achievement" results of this sort, but most of the studies also indicate that measuring "what really is happening" is still difficult to do. As a result, many of the results we value the most are the most difficult to communicate convincingly to the "outside world"—or to the teacher in the next room who has no interest in tapping the potential of even the available technology in the school. We still have a way to go, apparently, in convincing many

teachers and administrators that the enthusiasm and "good things" we believe are occurring with computer use are real enough or important enough for them to try themselves.

### 2.3 Success and "cost-effectiveness"

Perhaps the above concern about demonstrating the effects of computer use in schools through indicators that will convince non-technology-using teachers or skeptical administrators seems not so relevant given the overwhelmingly positive impression communicated by our case studies. But the concern is valid because of another reasonable perspective which is very difficult to deal with respect to appraising the success of TES projects. This is the perspective of cost-compared-to-benefit, or "cost-effectiveness."

We are thinking of the "cost /benefit" ratio in a very broad way. Given the costs of these initiatives—direct and indirect costs in effort, time, money, reorganization—are the results "worth it"? If we had spent the same (or less) time, money, effort, on some other activity, would the gain be greater?

This of course relates to a school's goals and the priority those goals have in the overall spectrum of the needs and goals of education for a school or region. Those of us who are aware of the potential benefits to students and teachers of effective use of computer-related tools believe that the benefits of TES projects and environments are worth their costs (in effort, money, time, and organizational challenge). However, we must be sensitive to the need to convince educational decision makers and the public of this cost-compared-to-benefit issue; it is the decision makers and the public, after all, who make the final decisions about what will give the best overall benefit in schools for a given amount of educational dollars and effort.

In this context, to what extent will the public and educational decision makers think the results of the TES initiatives balance or outweigh their costs? Have we convinced them that we should continue to spend effort/money/time/and so on, on technology-enriched schools or do some of them think that it might be better to make these effort/money/time/and so on, investments on something else?

The TES projects, because of their visibility and scope, will have a significant influence on the public's opinion about these questions. The extent to which they can disseminate their successes is thus very important.

## 3. Finding Realistic Expectations with Respect to Technology in Schools

A second point of reflection with respect to TES projects and technology-enriched schools more generally relates to our vision of what is reasonable to expect from such environments. From these projects, and from our experience more generally, we know that effective technology use in schools is apparently still difficult to implement. Baseline conditions include adequate hardware and software access; adequate preparation time for teachers; adequate in-service and on-going, individualized in-school support; supportive and effective principals, computer coordinators, and other support persons; willingness to change one's routine, to be flexible, to deal with uncertainty, extra work sometimes and extra organizational efforts.

The TES projects have tried to meet these baseline conditions as effectively as possible, with extra support, money, time, and resources not directly available in "ordinary" schools. (Although the Netherhall School example shows that an "ordinary" school can meet and far exceed these baseline conditions.) But when and how will we adequately meet these baseline conditions in a critical mass of ordinary schools, enough to allow technology to make a difference in the overall educational system?

Given their resources and careful planning, the TES projects can make a real contribution here, through strategies such as dissemination of some of their successful lesson ideas and providing models of classroom management for colleagues at schools not able to have the extra support personnel found in the TES projects. Dissemination is very important, and we see much potential for this in the experiences in the case studies.

But in general, what should our expectations be for technology use in "ordinary" schools? What are the dangers of expecting too much or too little? These are difficult questions.

#### 4. Reflections on a Methodology for Research about Technology-Enriched Projects and Environments.

Finally, it is no new news that doing research about complex systems such as technology-enriched schools is also very complex. In this book we have tried to anticipate many of the criticisms of such research<sup>1</sup>—we asked thoughtful educators who are well-informed about technology-enriched school projects over a long period of time, in a systematic way to supply detailed analyses of their projects. Anticipating the problems of synthesizing multiple case studies, we worked with the authors on getting comparable information.

We tried to find a balance between systematic collection of information and freedom for the authors to communicate the unique balance of factors in each of their settings. But finding this balance was difficult. The problem was how to stimulate systematic case studies with a shared frame of reference (so that there would be adequate information for comparison and synthesis) without pressing the authors into a framework where they were not able to tell their own story, to report the aspects of their schools they most wanted to tell. Perhaps the Netherhall School article shows the advantage more freedom could have given to the authors. Also, we limited the authors not only in the frameworks of their reports but also in the quantity of what they could say. Thus in this way, too, we undoubtedly have constrained much of what the authors could have shared with the readers about their projects.

However, the individual styles and perspectives of the authors and their projects still do come through. The case study authors have done an excellent job in summarizing their complex projects and in providing both descriptive and reflective comments within our requested framework.

We still see the multiple case study method and the importance of knowing as much about the context of a technology-involved project as possible as valuable methods for research about technology-enriched schools. However, we recognize the difficulties and limitations of trying to apply this methodology well.

<sup>1</sup> We originally planned to write a careful analysis of difficulties in conducting research about the effect of technology in education and about promising methodologies for this analysis. We decided, however, to communicate through our approach itself—the version of a multiple case study that we have used for this book—rather than through a description of the theoretical rationale for the approach. We, and the readers, must of course reflect on how useful our methodology has been.

#### 5. Finally, Dissemination

Our final reflection also relates to methodology but also to dissemination. How can we, all of us involved with technology-enriched learning settings, better synthesize our experiences? What and how can we learn from one another? What aspects of another's experience relate to what we can apply to our own situations? How can we, working together, as well as in our unique settings, improve the potential benefits of technology-enriched schools for our students?

*We hope this book makes a contribution.  
Enschede, October 1991*



## Appendix A

### Summary of the initial Conditions of the TES Projects in the Case Studies

#### Mount Newton Middle School

- a. *Major background characteristics*
  - 1989 and later: planning a "technology-enriched environment" (a new school)
  - the belief that the success of the new-school planning process is rooted in the staff development program, whose success is rooted in the roles of the inservice leaders and participants
- b. *Motivation for the project (before the start)*
  - preparation and planning of a new school
- c. *Initiation of the project*
  - the school district and the school
  - previous experience: 1987 and 1988: two years of exploration, an attempt to help define the role of new technologies in classrooms
- d. *Key persons*

Partners:

  - State; Ministry of Education
  - State-wide computer education institute (Education Technology Centre)
  - Information technology industry (Apple Canada)
  - Faculty of Education, University of Victoria
- e. *How the schools get involved*
  - own initiative, school and district

#### Monterey Model Technology Schools

- a. *Major background characteristics*
  - attention to cost-effectiveness
  - six sites statewide (districts); each with two to four schools (K-12)
- b. *Motivation for the project (before the start)*
  - endeavors to demonstrate the effective use of technology in instructional delivery and enhancement, as well as in school management
  - lessons learned and strategies developed must be useful to the broad range of Californian schools and students
- c. *Initiation of the project*
  - State

- d. *Key persons*
  - State Department of Education and State legislature
  - educational community
  - research and teacher-training institutions
  - information technology industry
- e. *How the schools got involved*
  - a competitive grant process

#### West High School

- a. *Major background characteristics*
  - one high school, Grades 9-12 (only secondary school of six ACOT projects)
- b. *Motivation for the project (before the start)*
  - technology (computer and other high-tech equipment) should be integrated naturally into the curriculum of the Columbus Public Schools' Graded Course of Study
- c. *Initiation of the project*
  - information technology industry: Apple
- d. *Key persons*
  - Apple
  - Columbus Public Schools
  - Universities (Ohio State University and UCLA)
- e. *How the schools got involved*
  - competitive grant process
  - previous experience of the district: Summer Tech

#### Dutch Technology-Enriched Schools

- a. *Major background characteristics*
  - Two sites, three schools; Grades 7-12
  - initiated as a research project
  - funding of the schools: PRINT (national management group for technology-related projects in schools)
  - funding of research: National Educational Research Institute
  - should include school-initiated and school-based inservice training

- b. *Motivation for the project (before the start)*
  - to investigate a broad-scale introduction of computers
- c. *Initiation of the project*
  - State (national level): Ministry of Education
- d. *Key persons*
  - Ministry of Education; PRINT
  - Universities; Twente, Utrecht, and Amsterdam (research)
  - (no industrial partner)
- e. *How the schools got involved*
  - competitive process, but based on previous experience with the researchers

#### School No. 56

- a. *Major background characteristics*
  - one school, Grades 1-12
- b. *Motivation for the project (before the start)*
  - research
- c. *Initiation of the project*
  - Ministry of Education
  - Research Institute for Computers
- d. *Key persons*
  - Ministry of Education
  - Research Institute for Computers researchers
  - National Institute for Educational Sciences
- e. *How the schools got involved*
  - the school received computers from the Ministry, and a few teachers asked researchers for help

#### Comptown

- a. *Major background characteristics*
  - ecological conceptualization
  - the nesting system
  - scope of the experiment: the entire city
  - six elementary schools
- b. *Motivation for the project (before the start)*
  - theory driven (researchers)
- c. *Initiation of the project*
  - researchers
- d. *Key persons*
  - Researchers
  - Ministry of Education and Culture

- e. *How the schools got involved*
  - community and local leadership agreed to project

#### F.M. Black Middle School

- a. *Major background characteristics*
  - one middle school, Grades 6-8
- b. *Motivation for the project (before the start)*
  - demonstrate how microcomputers and related technology could make the process of instruction more efficient and effective and also to observe the effects of a computer-saturated environment.
- c. *Initiation of the project*
  - by Houston Independent School District
- d. *Key persons*
  - Department of Technology of the District
  - Apple
  - Union Texas Petroleum
  - Compaq Computer Foundation
  - (no university or research institute)
- e. *How the schools got involved*
  - competitive grant process: proposal followed by site visit from the District

#### Quinte Secondary School

- a. *Major background characteristics*
  - one secondary (high) school
  - focus on all curriculum areas
- b. *Motivation for the project (before the start)*
  - The Ministry would like to demonstrate the effectiveness of the computer as an instructional tool (The public was demanding accountability!)
- c. *Initiation of the project*
  - Ontario Ministry of Education
- d. *Key persons*
  - Ministry of Education
  - The Hastings County Board of Education
  - (no research institutes or universities)
- e. *How the schools got involved*
  - competitive grant process

#### Netherhall School

(Note: Netherhall is not a school with a TES project, but a school which through a variety of initiatives has made itself a TES)

- a. *Major background characteristics*
  - use of computers since the 1970s
  - one comprehensive school, Grades 6-12
- b. *Motivation for the projects (before the start of the computer-use process)*
  - make use of external opportunities and funds
- c. *Initiation of the projects*
  - Initially, Government (MEP-1981: development of software within schools)
  - Department of Trade and Industry (IVIS-1986: Interactive Video in Schools)
  - Government (National Curriculum Technology-1990)
- d. *Key persons*
  - MEP (1981-1986)
  - the school
- e. *How the schools got involved*
  - competitive grant process for some of the external projects

For each of the cases, the following format is followed:





## Appendix B

### Summary of Personnel Formally Involved in TES Projects, TES Case Studies

For each of the cases, the following format is followed:

Key persons:

a. Extra personnel involvement

Name/function:

- task, responsibility, contribution
- functioning external/internal to the school(s);
- new/already present (old);
- continual/only some phases of the project

b. Other personnel support

Name/function:

- importance/contribution

#### Mount Newton

a. *extra*

three teachers

- in-service, mentorship, overview of technical issues
- intern; old
- 0.67 release time; continual

project leader

- school technology program design, staff development, new school technology design and networking, liaison with the participants
- extern;
- old
- half-time; continual

school's computer aide

- facilitates computer use, technical support
- intern; old; continual

b. *support*

principal

- educational leader

teaching staff

- must embrace new directions openly

district administration

- key facilitators
- school architect

#### Monterey

a. *extra*

project director

- external; new
- full time; continual

curriculum coordinator

- internal; new
- Year 1 and 2, full-time; Year 3, part-time

training coordinator

external; new

start: part-time; after six months: full-time

classified instructional aid

- an aid at one elementary school
- external; new
- full-time

b. *other*

- research team

#### West High

a. *extra*

- Site coordinator
- internal; old

district coordinator

- external; old

supervisor

- external; old

art support

- external; old

music support

- external; old

ACOT staff

- training and consultancy
- external

b. *support*

- research team
- Columbus Public Schools administrators
- flexibility in teachers' schedules
- principal of West High

## Dutch TES Project

### a. *extra*

#### consultants

- contacts between the participants; information dissemination
- external; new
- part-time; continual

#### coordinator

- coordination of all computer activities
- internal; old
- part-time

#### system manager

- functioning of computers and networks
- internal; old
- part-time

#### lab manager

- technical assistance
- internal; new
- full-time

#### coordination committee

- computer policy issues
- internal; old
- part-time

#### research staff

- introduction of courseware and assistance by inservice
- external; new
- part-time

### b. *other*

## School No. 56

### a. *extra*

#### specialist from Research Institute for Computers

- technical and educational assistance; inservice
- external; new
- part-time

### b. *other*

## Comptown

### a. *extra*

#### Five teams:

- Project's Management Team
- Center for Curriculum Development
- Evaluation Team
- Training Team
- Local Support Team

### b. *other*

- Ministry's Steering Committee
- Municipal Steering Committee

## F.M. Black Middle School

### a. *extra*

#### project coordinator

- daily activities and project's progress
- external; new
- full-time

#### Instructional Development Group of the District

- 
- external; new
- part-time

#### Software specialists of the District

- 
- external; new
- part-time

#### Teacher Technologist

- support of teaching staff
- internal; new
- full-time

### b. *other*

#### principal

## Quinte Secondary School

### *a. extra*

Board computer consultant

liaison school—Board/Ministry; inservice

- external; new
- full-time

computer site administrator

- inservicing teachers and students
- internal; old
- full-time

technical assistant

- internal; new
- full-time

### *b. other*

## Netherhall School

### *a. extra*

four teachers

- to design software packages
- internal; old
- half day a week; 1981-1986

### *b. other*

headmaster and senior management team

- forward vision



## Appendix C

### *Summary of Goals, as Stated in Section 2 of TES Case Studies*

#### **Mt. Newton:**

"Prepare a 'technology-enriched environment' that allows for thorough and appropriate uses of computers and related technologies for learning and teaching, as well as administration"

(Also, five explicit Planning Goals and 26 Implementation goals, 13 of which relate to what will be provided in the school to "prepare the technology-enriched" environment, five of which relate to expectations of student progress (#4, 5, 6, 9, 14), three relate to changes in schools organization (#11, 25, 26), and two relate to teacher support (#20, 21).)

#### **Monterey MTS**

Three goals of the overall MTS Project:

"Demonstrate the effective use of technology in instructional delivery and enhancement, as well as school management"

"Provide policy guidance on the best and most cost-effective strategies for using technology to meet [the state's] educational goals," and

"Disseminate the information necessary for the successful adoption/adaptation of promising practices in similar schools across the state" (p. 1)

Also, specific goals of the Monterey MTS Project:

"Make it possible for students to utilize skills and knowledge acquired from their education (content) combined with the tools now provided by technology to make independent, self-directed, self-regulated decisions that will optimize their ability to solve complex problems both in and outside the classroom," and

"Design a site or teacher-based planning and decision-making model" (pp. 7-8)

#### **West High School**

(From ACOT philosophy):

"Create a computer-saturated environment that encourages students' initiative, independence, and originality"

"Use technology in the classroom "as a tool to enhance the Graded Course of Study in the areas of mathematics, science, language arts, social studies, and keyboarding,"

"Students will become gatherers, analyzers, and managers of information..."

"the ACOT community of learners will not only support each other in learning, but will also seek to involve the staff and students at West High School, as well as the community at large" (p. 3).

#### **Dutch Technology-Enriched Schools**

"Investigate the impact of a 'technology-enriched school' environment on the school as a whole" (administration, 'climate,' curricula, roles and opinions of teachers, and the teaching-learning process) (p. 2).

#### **School #56**

"Change the general atmosphere in schools, making it more permissive, fully stimulative for pupils' creative capacities, by means of information technologies" (p. 3).

"Familiarize children with computers...as an element of their own culture", and

"Integrate computer use in schools" (p. 4).

#### **Comptown**

"Create a computer culture in schools,"

"Create a 'supportive ecology' in which a 'future computer culture' can expand," and

"Utilize the computer's potential for innovative teaching and learning, both in and outside the school" (p. 3).

(Also, see seven "Project Implementation Objectives," pp. 3-4).

### **F. W. Black Middle School**

"Demonstrate how microcomputers and related technology could make the process of instruction more efficient and effective, and also to observe the effects of a computer-saturated school environment" (p. 1).

"Integrate computers into every branch of the curriculum" (p. 3).

### **Quinte**

"Demonstrate the successful implementation of [Ontario-supported] computers and [Ontario] educational software" (p. 3).

"Demonstrate the effectiveness of the computer as an instructional tool" (p. 4).

### **Netherhall School**

"Develop good classroom use of hardware and for integrating computer applications throughout the curriculum" (p. 1).

## Appendix D

### *Teacher Inservice and Support: Highpoints from Section 3 of the Case Studies*

#### Mount Newton:

(Teachers worked together to develop a school Technology Program document as an extension of the Educational Program for the school)

Jan 1989—released time for teachers, including significant released time for three in-service leaders on staff.

“Choosing an in-house model of “mentorship in-service was perhaps the single most important decision of the entire process” (p. 16).

Worked with university research partners to build-in key components of effective in-service; also use ACOT-defined levels of personal growth of teachers (entry, adoption, adaptation, appropriation, innovation).

Under leadership of on-staff mentors, staff development program: (a) familiarity / personal productivity, (b) classroom applications; (c) curricular integration.

1989-1990: full or half-day workshops for six to ten teachers, usually for (a) above; each followed by individual follow-up by the lead teacher with teachers on their own time; then (b) on classroom use of the application.

Interests of teachers are the driving force, but “this is not an inexpensive model.”

Moving toward “peer mentorships” instead of inservice, with staff leaders providing one-on-one assistance in classroom and curricular integrations (with released time).

Teachers are encouraged to visit other classrooms to observe how others are using computer technologies.

Teachers take computers home.

People invited in to give model lessons.

Six teachers involved in collaborative action research with the university.

*Summary: Key idea: one-to-one follow up by lead teacher after productivity workshop; then classroom application; moving to one-to-one mentorship; university relationship.*

#### Monterey

Rationale is to gradually train and support in-house teachers as trainers, so that “assistance, support, and coaching would always be just a room or hallway away.”

Staff develop C.I.P. (Classroom Intervention Plans) “around their own ideas, ideas which address student needs”; CIPs also have individualized staff development plan for needs of teachers implementing the specific CIP.

Inservice: trend is away from technology to curriculum applications and instructional strategies focus.

Follow-up support and assistance needed—“some ‘one’ person to listen to concerns, fears, ...the provision of moral support within the historical isolation of classroom instruction during ‘risky’ instruction is a high value item among MMTS participants.”

- “SuperSub Service”—subs with mobile workstations, technology-based lessons aligned with curriculum; “allows teachers to sign up for customized assistance on a voluntary basis as they feel the need.” This provides for weekly release time (45 minutes to an hour) for individualized instruction.
- More requests for demonstration teaching and coaching sessions

*Summary: SuperSub allows individualized support for Classroom Intervention Plans.*

### West High School

"The key to having a successful plan is to have teachers committed to the program and excited about the prospect of using new technology in their classrooms."

- Flexibility in schedules allows team planning periods every afternoon.
- Summer Institute.
- Art support by a district media specialist and music support.

*Summary: Released time for meeting and planning every day.*

### Dutch Technology Enriched Schools Project

- Regular meetings for released-time teachers.
- Two in-school coordinators and a system manager support the teachers in the school.
- Development team, including a researcher, works with teachers for preparation of lessons, observation, and evaluation of lessons.
- Inservice consists of classes, demonstrations, and individualized support. Most courses are internally organized by the school computer coordinator.
- Teachers have opportunity to buy a subsidized computer (PC-Prive project).

*Summary: Emphasis on sharing of experiences within the department.*

### School #56

- Workshops conducted by researchers from Institute.

*Summary: Voluntary participation; mostly young teachers.*

### Comptown

- Teachers acquired "computer skills and CBI proficiency and perception"; also skills in the design of new learning materials.
- Most teachers completed a CBT training program, which met once a week and was not paid for.
- "Steady school based guidance" provided by projects' "curriculum development centre."
- Training also given to parents, retired senior citizens, and high school students for support in the lab and outside the school.

*Summary: Emphasis on change in teaching methods.*

### Black Middle School

- Teacher Technologist in the school with extensive training, functions as "technology catalyst and computer literacy teacher" (p. 18).
- Coordinators' duty is to communicate the concerns and successes of the teachers to the principal and ACOT personnel.
- Training classroom established.
- Variety of models for inservice, including before and after school, on Saturdays, during the teacher's planning period when the teacher can be offered extra help.
- Staff newsletter.
- Individual assistance from the trainer or project coordinator or another teacher during the teacher's planning period; also individualized instructional models, available in the library, with individualized instructional modules (sometimes with videos).
- Computer hardware and software issued to teachers who gained proficiency in computer use.
- Substitutes not available.
- Peer tutoring.

*Summary: Individualized modules support flexible inservice.*



## Quinte Lighthouse School

"The key feature appeared to be teacher readiness."

- First, awareness workshops; then teachers invited the developers of software to the school to run workshops about their packages.
- Then more workshops, in small groups of five and ten; "It is very important that teachers receive rather prolonged support in labs with their classes."

*"Our goal was to provide as much support (hand holding in some cases as necessary) and then gradually begin to pull back" (i.e., Coordinator in computer room replaced by network technician).*

- Then, inservice on more individual basis, with coordinator working individually on ideas for lesson integration. "Ongoing support was critical in reassuring the teachers that they were not going to be left in the lab alone."

*Summary: Gradual weaning from support.*

## Netherhall School

- Early on, four teachers were released a half-day per week to design software packages, and pupils were used to program the packages.
- Specific teacher support materials developed.
- Then, workshops extended to subject working groups in different curriculum areas, involving staff from other schools and students from teacher training institutions.
- "Curriculum map of IT at the school" allows the "whole staff to see what the students' experiences with IT are in other subjects in each of the years, and we are able to ensure that there is not repetition of IT activities between departments."
- Each department has an IT representative, these meet regularly and "ensure the dissemination of information."

*Summary: Emphasis on instructional ideas, coordination within the school.*



## Appendix E

### *Results, Summary of Section 5 of the Case Studies*

In this appendix, we include in the authors' own words, a summary of what seem to be the major points about the results to date of the TES projects, as stated in Section 5 of each of the case studies.

#### Mount Newton

- Teachers are making significant progress, whether measured on program component or on personal growth (ACOT) indicators.
- "Workshops" are on the way out...Mentorships are on the increase...and the mentors are not always our lead computer in-service teachers. The circle of involvement is widening.
- Teachers' attitudes toward microcomputers and related technologies are positive, with a desire for students to have ready access to computers.

Teachers would like time during inservice to modify and develop activities for their classrooms. 56% felt competent integrating software programs and activities from workshops into teaching; 50% felt they would increase instructional uses of computers with students; 50% expressed a desire to have a workshop leader work directly with them in classrooms; 44% felt that too much information was presented for them to absorb comfortably.

- There is a noticeable shift from personal productivity to classroom applications to curricular integration of computer use. The inservice model relies to a great extent on teacher release time, with teachers following up the inservice with considerable activity on their own time. Also important is the availability of expert mentors, including the lead teachers, for classroom support following in-service.
- The other "hard data" that we have is in the form of learning logs for the action research projects.

"Was the use of technology helpful in your learning? Why or why not?"

The teacher answered this with:

"Yes, students enjoyed the... They demonstrated knowledge of...Students are highly interested and motivated."

The following answers were given by students...

"...it helped me learn more."

"Yes, because it's more exciting than the other ways of learning..."

"It was because it showed great graphics, faster than a teacher on the chalk board."

"Yes, it made it easier to learn the information."

"Yes, because it was more interesting."

"Yes, technology makes learning fun..."

"It helped us by showing the whole class a model and the real thing at the same time."

"Yes..I think it goes quicker and we learn more. It showed us in detail what we were talking about. It is easier to learn."

#### Monterey

- Administrators and district staff (are) working in a collegial and team atmosphere to achieve.... A school-based planning and decision making process....
- The major instruments for data collection that have been utilized are:
  - Student Impact Report Card
  - Structured Teacher Interviews
  - Inventory of Teacher Reactions
  - Teacher Reflections Reports
  - MMTS Student Survey
  - Visitor Information Survey
  - Individual Portfolio Assessments
  - CIP-specific Data Collection Instruments
  - Standardized Achievement Tests
  - Picture Inventory of Student Reactions
- Findings are numerous; highlights:
  - District and state standardized achievement test scores and writing proficiency test data were analyzed. Spring scores showed relative increase at the secondary level and one elementary site while those at the second elementary site remain approximately at the same level. Writing proficiency increased at all sites. There was a tendency for achievement test scores to increase at MMTS sites.

- Teachers across all schools consistently indicated that their classroom interventions produced a moderate impact on grades of the students in the sample. Elementary teachers rated their classroom interventions between moderate and high while the secondary teachers rated theirs as slightly below moderate.
- Increased teacher commitment, interest, and confidence in the use of technology as a result of CIP specific evaluation plans
- Many CIPs are in varying stages of development ...some are beginning to produce specific findings. Sources include teacher perceptions, observations of student work, analysis of student portfolios of CIP-related work, performance on teacher-made, CIP-specific tests. Some of the findings were: (1) using the word processor caused a reduction in student errors during composition; (2) computers and Instructional Television (ITV) increased enthusiasm for writing; (3) ITV at school increased use of ITV at home; (4) cooperative learning and computers facilitated students learning from each other; (5) student self-confidence increased; (6) results from self-paced experiences increased application of technology, resulting in increased problem-solving abilities; (7) student motivation for writing increased when using the computer; (8) spelling test scores increased; (9) students were found to be motivated by ITV when it supported a thematic approach to instruction; (10) calculators improved student problem-solving abilities; (11) teacher productivity increased due to computers aiding in spell checking and editing for students; (12) student attention span increased as a result of the LCD combined with the computer; (13) students using HyperCard and laserdiscs in science increased their science grades.
- Teachers generally reported that their CIPs increased student achievement and academic performance. However, most CIP-specific data are based on observation and perception.
- Identification and dissemination of promising practices includes: a 4-part video kit highlighting MMTS, an "adoption/adaptation" guide and 13 CIP-specific "products" for packaging for initial dissemination.
- The MMTS Project offers a model for technology use planning and a variety of emerging and replicable projects and practices.

#### West High School (Ohio)

- Many examples of the transfer of knowledge and skills from the classroom to real world business solutions have occurred. Examples include: scale model building with robotics through interactive video laser disc; database management and spreadsheet designs with custom windows and dialog boxes; and a 4-color 11.5" by 14.5" forty-eight page newspaper publication.

These projects, following the knowledge construction approach, were student-created solutions for Columbus community business leaders.

- (Students in) both of our graduating classes in 1990 and 1991 were offered complete college scholarships to six universities. A total waiver of tuition, room, and board was given in exchange for students accepting the responsibility of serving as technology consultants to the universities. International businesses located in Columbus, Ohio have hired some of the ACOT students as technology consultants and are funding their colleges expenses.
- Much of the program's success is not measured on today's standardized tests. The ACOT students have demonstrated much more knowledge and problem solving ability than standardized tests measure.
- Students accelerated in both quality and quantity of their writing skills compared to control groups. The ACOT students performed as well or better on their mathematics and science tests than non-ACOT students.
- Teachers must be extremely flexible and willing to quickly change lesson plans when working with technology.
- (Based on the experiences at West High School), some modifications made by Columbus Public Schools for its other 18 high schools are:
  - Adding Macintosh Writing Centers in all the other Columbus high schools.
  - Productivity stations made up of a Macintosh computer and an Apple LaserWriter printer were placed in all the high school journalism departments. This equipment paid for itself with its publishing ability within two years.
  - LaserDisc technology has been added to several science departments and social studies department.

## Netherlands

- The general observation is that some changes are happening at different levels—the school, the teachers, the curriculum, but only in a very slow fashion.
- Introducing computers does affect the school in many practical ways: there is a constant need for (a) more facilities (hardware, space, time), (b) extra personnel, and (c) released time for teachers.
- The computer coordinator, the computer lab manager, and the system manager are new functions in the school that are absolutely necessary.
- The integration of the administrative activities and administrative automation is growing.
- Teachers constantly claim they need more released time. Lack of time is felt as a constant problem.
- The computer is becoming a normal and regular tool in the classroom for teachers as well as students.
- With respect to the existing subject areas in the schools, there is no clear indication that using computers is changing the content of the curricula. On the contrary, when teachers select courseware, their major criterion is the connection of such a package to the existing learning material, methods and textbooks. Moreover, teachers experience a heavy workload, which prevents them from engaging in time-consuming experiments with the curriculum.
- Using computers to support the teaching of informatics is the most popular application of computers in the DTES project. The second most popular is using computers in the context of learning Dutch, especially to support the writing process and in particular the planning of essays.
- Computers are not changing curricula but are changing some instructional strategies within existing subject areas: (1) the use of computers to record and interpret data collected during experiments in the physics laboratory, (2) the integration of reading and writing instruction and practice in the department of Dutch language, (3) the use of databases in the department of geography has created an opportunity to enable students to reason with raw data, to arrange data into tables, and to analyze co-variance relations between variables, (4) the use of a graphics program to depict and analyze all kinds of algebraic and trigonometric functions in the mathematics department has stimulated students to spend less time on drawing graphs and calculating function characteristics, and more time on problem solving...
- Teachers point at the changing attitude of students toward learning: more problem-oriented, independent, goal-directed.
- There is no indication that teachers in the DTES are changing from being instructors toward being managers of information.
- The use of computers in a school-related context in the DTES raised from 40% in 1987 to 75% in 1989...for instructional purposes from 27% to 53%. Thus teachers are using computers more, even if their roles are not changing because of it.
- The number of teachers that have participated in the PC-privé project (subsidized purchase of a computer for home use) has grown from 22% in 1987 to 70% in 1990.
- The teachers generally consider three didactical functions of the computer as a positive contribution to education: (a) the computer as a monitor of practice and training, providing exercise and immediate informative feedback; (b) the computer as a tool; (c) the computer as a simulator. Three functions are negatively assessed: (a) the computer as a tutor; (b) the computer as a testbank; (c) the computer as a database.
- The teachers feels that working with computers creates new challenges for them and raises their motivation. Using computers also stimulates interdisciplinary approaches between subject-areas. There is broad acceptance of computers in the school, and there is a positive relationship between having a computer at home and having a positive attitude toward using a computer in school.
- Despite all the activities in the DTES project, there is no indication that working with computers is having a positive effect on the academic performance of students.
- Students work very naturally with computers. Students develop a more independent attitude toward learning, show signs of increased motivation, work in a more concentrated and task-oriented manner. Teachers report that students show more initiative while solving problems, more often correct mistakes after immediate feedback, develop a more inquisitive and independent attitude toward learning.

## School No. 56

- To experiment with new technologies within the framework of school activities is much more complex than developing educative-instructive activities outside the school program.
- None of these (possible computer-use) activities ...can be rejected beforehand, as pupils enthusiastically involve themselves in all types of activities, and have good results from the point of view of acquired skills.
- The team also noticed positive effects as an outcome of spontaneous contacts between groups of pupils engaged in various computer activities (discussions, exchange of programs).
- In as far as teachers are concerned, experience proved that the idea of new technologies being used in schools is generally accepted but the lack of official obligation to do so leads to a neutral or even a negative response from some of the teachers.
- (Teachers) require permanent training and effective guidance for long periods of time, which means effort and time-consuming activities.
- As for the pupils, they embark on computer activities in a natural way. The novelty of computer technologies, as well as the different modality of study, obviously create a deeper motivation for pupils.
- It can be stated that implementing these technologies in schools altered the atmosphere in the school.
- Collaboration between school and the research field resulted in a valuable experience.
- The most valuable outcome was the building up of a collection of computer assisted activities, which the pupils enthusiastically embarked upon.

## Comptown:

- Results were repeatedly verified by classroom observations as well as by teachers and principals (about 40% of Emory's 1988\89 teaching staff) who reported that CBI-induced accommodations dramatically changed their instructional pace, pedagogical techniques, attention to individual students, and students "learning styles."

- ...the computer reshaped the orientation of principals, teachers, and learners. ... (the) effects were inseparable aspects of a growing computer culture; ... by initiatives and effectuations of teachers, school principals, computer coordinators, parents, and key community personalities, all of whom undertook Comptown's responsibilities and systematically continued to develop a supportive ecology for computer based activity in post-Comptown years.
- Centralized educational policies and voluntary activities affected and were affected by the innovation... (they) accelerated intersystemic dependencies and narrowed the gap between the school culture and the already expanding computer culture in the real world. ... frameworks were systematically developed in which, independent of Comptown's activity, new initiatives and new dialogues could be generated in the future.
- ...Realization of...innovative potentials of an "open" computer technology requires modifications in prevailing patterns of instruction.
- Emory's teachers were trained to use computer technologies in a mindful manner (i.e., to understand the inherent educational qualities and apply the technology appropriately), while changing their pattern of instruction... through a four-step training procedure by which (a) teachers were trained to use the technology mindfully; (b) teachers trained students to use the technology mindfully; (c) teachers trained students to apply the technology appropriately with curricular subject-matters; (d) teachers guided students to apply the technology mindfully with an independent study.
- There were no computer use gains in the word processing studies (results were attributed to Israeli children's typing difficulties), while gains of computerized simulation and data base construction were significant in specific ways: In the simulation studies (conducted with eighth and ninth-graders in two consecutive years) (a) about fifty percent of the "CBI" children handled "multiple inference" problems appropriately, while none of the "control" children could offer even partial solutions, and (b) "CBI" and "control" children performed equally in applications and "one-step" inference tasks. In the database studies conducted with fourth-grade students, the acquired skills were "general" (data organization, identification of meaningful variables, formulation and testing of hypotheses), and the correlations between IQ scores and database (pencil and paper) test scores were lower for "control," and higher for "CBI" children.

### Black Middle School:

- Over 70% (of the teachers) have regularly integrated computers into their instruction, using computers in the labs, or classroom, and for personal productivity at the very least once a week and frequently much more than that.
- Teachers used the computers in a variety of instructional settings to improve the quality of education at F. M. Black. ...over 80% of the student body was involved in computerized math instruction with over 65% of the student body involved in word processing activities and computer assisted language-arts instruction.
- The students learned and had a variety of skills reinforced through use of a variety of stand-alone mathematics software packages ...and also used the spreadsheet...to develop their own solutions to mathematics problems.
- The teachers reported that students have shown significant improvement after participating in computer-based tutorials in language arts and math.
- (In Special Education)...the computer has its own colorful way of reinforcing the child's learning process. It gives the opportunity to participate. To the student it's fun. Students look forward to going to the computer class. They remind us what day is theirs.
- Strong school leadership and comprehensive courseware were noted as key reasons that computers were in such evident use at the time of the original evaluation.
- In essence, teachers were extremely cooperative and receptive to the implementation of the computers at F. M. Black. Another unexpected benefit was that the adjusted scaled score of students taking the required statewide proficiency test improved significantly, backing up the majority of teachers' claims that the use of the computers had a positive effect on their students' achievement.
- By the final phase of the evaluation it was found that the program influenced the instructional climate of the entire school, through the enhancement of staff morale, student morale, and instructional organization.
- As a side benefit, F. M. Black's administrative staff indicated that the use of the computers had greatly enhanced their speed and accuracy in the performance of tasks.

- What was learned from the School of the Future Project, concerning computer training for teachers, software applications, teacher apprehensions and needs, student interests and abilities along with a myriad of other details is now regularly applied to new computer implementations across the district.

### Quinte:

- (A) change in attitude of numerous teachers. Most teachers did rise to the challenge of trying to utilize computers. Once they did use the software with their classes they were usually convinced although they still required support for their later excursions to the labs. About one quarter of the staff reached the point where they would use the computers on their own volition, and the use of simulation software was written into their course of study as an integral section.
- This level of use occurred more frequently in geography, math, chemistry, and family studies. Other teachers used the computers simply as an alternate instructional method. Still others tended to use the computers as a method for change of pace. A few used time in the labs as "reward time" for their classes. The more comfortable and committed the teacher was to the use of computers, the more likelihood there was of the curriculum being modified to include specific computer use.
- Continuous ongoing support...was crucial (but)... it is also necessary for support to gradually be removed from a high level to a lower level as it is very unlikely that sufficient resources will be available for an extended period of time.
- We had anticipated a drop off in computer use when the project was over. This did in fact occur (but)... There followed a period of rejuvenation about one year after the end of project that saw the dismantling of one of the cross curricular labs and the moving of those computers into individual classrooms as single computers or in groups of two or three. At the Board level, we began to experience a snowball effect as requests for computer hardware, software, and inservice workshops accelerated. Schools are now using industry-standard word processors and spreadsheets, databases, drawing and paint programs, CD-ROM-based encyclopedia and periodical indexes, external real-time measurement devices attached to computers (e.g., IBM Personal Science Lab), music editing, sequencing, and scoring software. Libraries are converting to a multi-tasking multi-user computer based catalogue and circulation system.

- Many teachers are now self sustaining in computer use. They use the computers on a regular basis and view them in the proper perspective of simply another instructional methodology to be used when only appropriate—meaning when the computers' use is the best way to get a concept across to their students. The teachers view themselves as responsible for their own inservicing and rely less and less on central support. The goal of a good consultant should be to eventually become redundant by raising the level of expertise of clients to the point at which they provide each other with the ever diminishing amounts of support needed.
- Students view computers as a tool. The word processor is used as a matter of course.
- The project was successful because of many significant factors. A computer rich environment was provided. Software was of good quality. There was a well thought out approach to inservicing. Substantial support was available from the beginning and was purposefully withdrawn later to force teachers to take ownership. It is essential that adequate financial resources be available to allow support personnel time release.

Teachers were asked to document their activities on the computers and write worksheets to be shared in other schools (in fact with the whole province). The worksheets that the teachers developed (are) currently available.

- What the project did to the school was remarkable. Teachers were rejuvenated, students were enthused, administrators were proud. The school became a leader in its educational community. Coordinators were invited to speak around the province and even in other continents. One even wrote a chapter for a book.

#### Netherhall School:

(Note: As this case study did not describe a project as such, but on-going efforts to create a "technology-enriched environment" within an "ordinary" (non-project) school, we will summarize here only the most current activities in the school:)

- By the summer of 1991 the school has been equipped with 130 computers and 72% of the staff are confident and competent classroom users of information technology in the classroom.
- We have seen a dramatic rise in the number of teachers attending workshops and asking for curriculum support.
- As a result we have been busy collating departmental IT packs that are to be distributed to departments at a forthcoming training day. These packs contain software and hardware catalogues, database files of whole school resources such as hardware distribution, newspaper articles on IT for the last two years, desk top publishing files with outlines for records of achievement and headed notepaper for letters, and so on. The training day will involve a representative from every department in the school, The IT Working Group, and this core of 14 staff will be given an update on curriculum developments, the school's IT curriculum map, IT departmental policy and the future, techniques and methods of assessing IT in their subject, and inservice needs. They will be trained to take responsibility for IT in their subject and to pass it on to others in their department and so increase not only their own professional status but increase the awareness to everybody of their role of promoting IT within the curriculum.