

Summarizing the Case Studies of Technology-Enriched Schools

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Introduction

In Section 2 of this book are reports about 19 different technology-enriched schools, discussed in nine different case studies. How can we summarize these studies? In Section 1, we noted the importance of trying to pull together the experiences of different technology-enriched schools in order to better learn what to expect in other situations where a school becomes technology-enriched with or without the framework of a special project. By asking each of the case study authors to develop his or her report around five standard headings, we hoped to help facilitate this comparing and summarizing process. In this chapter we will offer our own summary of the nine case studies. In particular, we compare and contrast the case studies around the following questions:

1. *How did the "technology-enriched school" projects get started?*
2. *How do the goals of the projects compare?*
3. *How are technology-enriched projects organized from a point of view of personnel and time?*
4. *How is technology being integrated into instruction in technology-enriched schools?*
5. *What about technology-enriched schools from the perspective of the classroom teacher? What are strategies for teacher involvement, motivation, support, and training?*
6. *What results are emerging from technology-enriched school situations?*
7. *What recommendations do persons involved in technology-enriched situations make to others moving into similar projects or situations?*

1. How did the "technology-enriched school" projects get started?

Is there a clear pattern in the case studies in Section 2 with respect to how their respective technology-enriched school projects got started? What are the characteristics of the schools involved in the projects? Who are the major partners in the projects? In Appendix A we give a detailed summary of each of the nine case studies with respect to these questions; in the following paragraphs we give the major trends.¹

1.1 Initiation of the projects

To start a project someone or some combination of partners has to take the initiative. There are different ways to group our case studies with regard to this point of initiative. We see one distinction relating to the origin of the TES activities: if it were within or outside the participating schools. A second distinction relates to the degree to which the TES activities can be seen as evolving from other computer-related activities and projects.

In six of the cases, the TES project was initiated outside the school. Schools competed to become involved, but the basic shape of the project was already established. In three cases, the schools were centrally involved in the instigation of the TES initiatives; as an extreme, the Netherhall School in the UK is a study of how one school can take its own initiatives or can move to capitalize on external initiatives that become available. However, it is clear from the cases that the initiative for a technology-enriched school project can come from a variety of levels and sources.

No school activities happen in isolation and certainly not TES projects. A major point of similarity in the cases is that all occurred in the context of already extensive experience with computer use in most of the schools involved (although "extensive" is a relative word). None of the projects is investigating if computers can or should be used in schools, but rather how to better use them and what happens when they are used more extensively than is currently normal for a system. (These background motivations also relate to the goals of the TES projects; we summarize these separately in the next section of this chapter.)

However, at least five of the cases can be seen as evolving fairly specifically out of prior regional-level and school-level projects and initiatives, while the other four begin more specifically as special projects (although two of these could also be seen as attempts by a state or region to consolidate its extensive past experience in a "demonstration-type" project).

¹This will be our pattern in this chapter: we first synthesize the case studies in outline form (with these summaries in appendices at the end of this chapter) and then we do a further synthesis here. The appendices may be interesting to those who want to see the major aspects of the case studies organized around different topics. They also serve as a reliability check on us, so that readers can see the decision making we went through in selecting main points out of the cases.

1.2 What are the selection criteria for schools to participate in TES projects?

In some of the cases a school was selected as a project school because the school already had more experience with the use of computers than an average school. In some cases the school and its teachers had no special computer experience. Sometimes a key criterion for selection was the school leadership, for example, a combination of a highly talented principal and a knowledgeable and reliable teacher-technologist. Sometimes there was a demographic reason for the selection of a school. Sometimes the school involvement grew naturally out of previous contacts the school had had with the Ministry or district or researchers; other times the competition was "blinder" or based more on stated proposals submitted by the schools for a formal competition. The point of summary here is that the rationale for school involvement in the TES activities differs from case to case. Again, a detailed summary is given in Appendix A.

1.3 Partners in the projects

All the North American projects—except the Quinte Lighthouse School in Ontario—mention the participation of an industrial partner in the TES project. Netherhall School in the UK has also made occasional collaboration with business or industrial partners. The other European projects are funded by their government and/or Ministries of Education. The practice of sponsoring educational projects by industry is not as familiar in Europe as it is in North America; also, European projects tend to be more stimulated by researchers than are North American TES projects. Appendix A summarizes all the partnerships.

2. How do the goals of the TES activities compare?

It is difficult to compare the goals of the technology-enriched schools in Section 2. There are many reasons for this difficulty. Although the authors of the case studies were asked to explicitly state the goals of the projects in Section 2 of their articles, we found additional statements of goals in many other sections of the case studies. More problematic is the issue of implicit or broader goals underlying the TES activities. All of the case study authors might well agree, for example, that the eventual improvement of students' "ability to solve complex problems?" is a basic goal of their whole educational system, and thus is an obvious and implicit part of the context of technology-enriched schools. Because it is not stated explicitly as a goal of a TES project does not mean it is not important to the project. It is of course impossible to expect that TES projects will list all of these broader educational goals, or even that they can be listed.

Therefore, in this summary we will limit ourselves to what the authors actually stated as project goals in the second sections of their articles. These are given in Appendix B. Here we will discuss our main impressions of these stated goals. We give impressions relative to student-focused goals, teacher-focused goals, and school-restructuring goals. We contrast the goals with respect to what is expected of the various projects. Finally, we offer an observation on the measurability of the goals.

2.1 Student-focused goals

It is very interesting that relatively few of the stated goals of the TES activities directly mention students. None of them explicitly set as a target that students will perform better on traditional measures of school achievement. Only one gives detailed, measurable objectives with respect to student competencies with the use of computer-related technologies (for example, "By the end of Grade 8, all students will be able to demonstrate a high degree of skill in accessing and manipulating information stored in a computer database").

When students are directly mentioned as the focus of a goal, it is more often in terms of behaviors that are process- rather than product-oriented with high-level cognitive functioning stated or implied ("Students will become gatherers, analyzers, and managers of information...").

However, most of the times when students are mentioned, it is in terms of what the project will do for them or supply to them, rather than in terms of what the students might be expected to achieve because of what is supplied for them. This has important implications with respect to eventually "measuring the success" of the projects. Is a project successful if it has created a rich and stimulating learning environment, or must it demonstrate that there are also substantial changes in student learning?

2.2 Teacher-focused objectives

As a reflection of this tendency of the objectives to focus more on what the project will do than on what students will do, there are a number of objectives related to how teachers will integrate and use technology. These range from fairly specific ("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"), to quite general ("Utilize the computer's potential for innovative teaching...").

2.3 School-restructuring goals

Some of the goals relate to overall change in the school atmosphere, change that might go as far as leading to a "restructured?" school. Examples of this include:

"Change the general atmosphere in schools, making it more permissive, fully stimulative for pupils' creative capacities, by means of infor-

mation technologies?" and

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

The latter is an example of a goal that goes outside the boundaries of the school. However, as a whole, the goals do not particularly suggest "restructured?" schools, although they do suggest "enriched," "expanded," "modernized," and "revitalized." However, is "restructuring" something more than this?²

2.4 Goals related to the tasks of the projects themselves

The projects can be compared on the degree to which they are charged with "demonstrating effective practice" compared to "observing what happens." At least three of the cases have the responsibility of "demonstrating" the "effective, efficient" use and implementation of technology. It is not clear how and to whom these "demonstrations" must be given, although the Monterey case is the most explicit. At the other end of the "proving and disseminating effectiveness" continuum we see the Dutch project, whose goals are stated only in terms of "investigating the impact..." of a technology-enriched environment.

2.5 Observations related to the goals

If we think forward to how the "success" of these technology-enriched school projects can be measured or estimated (see the "Reflections" chapter in Section 3), one strategy is naturally to relate the project's outcomes with its goals. This will be difficult for a number of the stated goals of these TES projects, because of the complex way in which these goals have been stated. Take, for example, the goal:

"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."

How can we measure the degree to which this goal has been met? Do we focus on the extent to which the TES project has helped "Make it possible..."? How do we measure the extent to which students make independent, self-directed decisions, particularly in the context of solving "complex problems...outside the classroom"? And what does it mean to "optimize a student's ability"? How can we measure this?³

We can make another general observation about the goals: If we look at the verbs in the stated goals, we see the following collection:

...Prepare a, demonstrate the, provide guidance to, disseminate the, make it possible for, design a...model for, create an, use, become, investigate the, change the, familiarize students with, integrate, create a, create an, utilize the, integrate, develop ...

Only one of these is the start of a goal statement that specifically relates to what *students* will do. The rest of the verbs lead into goal statements that describe what the adults in the project will do. This will have a major impact on deciding if the projects are "successful?" or not in meeting their goals. A major assumption in the projects is that the activities in the projects that the adults are "doing" (all the demonstrating, preparing, investigating, creating, preparing, etc.) will result in better student outcomes.

3. How are technology-enriched projects organized from a point of view of personnel and time?

3.1 Additional personnel

Making use of information technology and integrating computers in education is still a relatively new activity for schools and teachers. It is also an extra activity, to be handled while the most of the "old" activities still have to continue. In all of the case studies teachers are doing more than their regular tasks within their regular time.

But the amount of work to be done is enormous, and there are few proven strategies and models for mastering the tasks. So in all TES projects in the case studies, extra personnel or extra time for existing personnel are involved. We summarize in Appendix C the persons with formal time allotted to the TES projects. (Netherhall School, where the activities are largely evolutionary within the schools and more or less experienced with the school's own funds and personnel, will be excluded from the rest of our summary comments unless it is mentioned specifically.)

All the projects have made arrangements for extra personnel for coordination. Sometimes a distinction is made between the internal coordination in the school and "external" coordination between different schools and/or a school and external participants in the project. The latter happens when the project is not initiated by the

²In ISTE's *Vision: TEST Final Report* it is noted that "Discussion of restructuring is difficult because there is little agreement on the definition of the word" (p. 30, in: Braun, L. (1990). *Vision: TEST. Final Report*. Eugene, OR: ISTE.)

³(By the way, it is interesting to note a cultural assumption in this goal—that complex problems are best solved by independent, self-directed, self-guided decisions. In contrast, it is also increasingly felt that complex problems outside the classroom must be dealt with through cooperation in multidisciplinary group efforts. Thus "independent, self-directed, self-guided decisions" may not be the best approaches for solving complex problems in the 21st century workplace!)

school itself but by an external initiative. In all cases at least one person is responsible for the internal coordination activities. Some of the projects have a highly structured organization, and the coordination activities are done by teams. We can appreciate that considerable time is invested in project meetings and internal communication when we look at the complicated project structures.

To be able to make use of computers and to integrate computers in the curriculum, teachers need time, training, and support. We will summarize in a later section of this chapter major trends with respect to teacher training and support. Here, we will note only that much of the project's budgets relate to personnel, and personnel for teacher support and training are a significant portion of the overall project cost. For example, at Mount Newton three teachers have released time "... to provide mentorships for colleagues, and to oversee the technical and instructional issues related to technology," and the school's computer aid "plays a key technical support role." At Monterey "assistance is provided by project personnel, consultants, and district mentor teachers" for teachers working on CIPs." In a number of the cases the lab manager in each school provides technical assistance. Sometimes project assistance comes from outside the school, from the computer company, or a research institute involved in the project.

Regardless of how projects are organized, participants agree that the support persons working on the projects are essential and kept very busy. We can conclude that inservice training cannot adequately solve implementation problems. Teachers need support on-site, especially on technical matters, to feel comfortable in using computers. It appears that even in technologically-enriched environments computers are still technically too complex for unproblematic, effective use by an average teacher.

3.2 Researchers

When researchers are involved in a TES school, their activities may range from prescriptive to descriptive. "Prescriptive" means that a researcher gives training or plays a leadership role in determining the activities at the schools. We see this in at least three of the case studies. In two other cases, researchers are involved both in describing what is going on in the school and also have an influence on some of the activities. This is the case, for example, at West High School where a researcher worked with teachers to integrate software developed by the researcher. In other cases the research is more descriptive or evaluative in function and does not directly influence the activities at the schools involved in the project. In at least one project, the Monterey project, an "independent research and evaluation coordinator" is concerned with measuring the success of the project. Thus, as a generalization, research is seen as valuable, but the projects vary a great deal in how much research informs their decision making or execution.

4. How is technology being integrated into instruction in technology-enriched schools?

In all of the cases we see computer-related technology being integrated into instruction in traditional subject matter areas. How can we compare and contrast the way this is happening? Approaches include looking at the software in use, the actual physical integration of technology and instruction, the choice of subject areas for technology integration, special instructional emphases within a project, or overall trends in instructional strategies involving technology.

4.1 Software trends

With respect to types of software in use, we definitely see applications and tool-type software in every project. Certainly word processing in support of writing appears in every school described in the cases. Desktop publishing software is important in about half of the described schools. Different types of databases appear in most of the projects, sometimes organized around hypertext software or on CD-ROM storage. In at least two schools telecommunications access to online databases is occurring. Spreadsheets are mentioned in three of the cases. "Integrated" software packages are standard in most of the cases. Curriculum-specific software such as drill and practice, tutorial, and simulations is mentioned in most of the cases, but usually given less emphasis than applications and tools. Programming languages are not often mentioned, although Logo and LEGO Logo are aspects of two of the cases.

Overall there is a distinction among the cases regarding software, but it is more of a continuum than a clear separation. The distinction relates to the use of software as **tools**, applicable to activities in many different subject areas, compared to the identification of useful **instructional software** relative to existing specific curricula. In the first of these, the end goal is, implicitly perhaps, that productivity and creativity tools are available to all, for self-directed use, not specific to a certain subject or teacher. At the other end of the continuum, the model is more that of the teacher finding content-specific software to specifically help students learn certain subject matter. The West High School case is an example of an emphasis on the tool-end of this continuum; the Dutch case of an emphasis on the "instructional" end (although each project clearly makes use of many different types of software). Each of the cases has some of each kind of software and software use within it.

4.2 How are computer hardware and software organized for access?

With respect to the physical integration of computer-related technology into the school setting, all of the cases have computers in laboratories, meaning in general that instruction must move out of the "base

classroom" and into a different room to make use of these exemplars of the technology. Most of the projects have more than one computer laboratory; most have dedicated technology also available in the libraries and for school administration, and many feature other workstations or smaller groupings of computers in addition to the laboratory computers. Many note individual computers available for the "traditional" classroom. Only one of the schools mentioned in the cases—one of the Israeli elementaries—appears to have specifically rejected the computer-room concept in order to maximize the dispersion of computers into classrooms.

Some of the cases specifically include a broad range of educational technologies, not only computers; the Monterey schools and Netherhall School are major examples. Multi-medias, particularly interactive video, are important in some of the cases and not present in others. There are no major trends about type of computer or associated equipment, as this relates very much to availability in the larger community.

4.3 Instructional applications of computers in the projects

We see many exciting ideas of instructional application of computer-related technologies in these case studies. Each of the cases gives examples; too many to summarize here. Some omissions however, are interesting to note. We see relatively little mention of MBLs—the so-called microcomputer-based laboratories—where special sensors and software serve to support and extend science instruction and experimental work. We see little mention of telecommunications activities for instruction. We see little mention of so-called "integrated learning systems," where students are individually tracked and managed through large and carefully organized curricula, usually basic mathematics or language. And, as mentioned before, we see little programming.

Another interesting distinction between the cases is the presence of "computer literacy" courses. In some schools we see informatics or computer-skills courses still in place; in others we see only a keyboarding unit; and in others we see the specific rejection of such "computer-as-an-object-of-study" courses.

Finally, we see little evidence of interdisciplinary instruction, particularly at the secondary level. There are a number of noteworthy innovative projects some of which involve interdisciplinary aspects, such as the cross-school project work at Black Middle School and of course, the impressive interdisciplinary community-related projects at West High School, but in general we do not see a "restructuring of education," at least with respect to the traditional pattern of subject-area organization, in most of these cases.

5. What are strategies for teacher training and support?

A major common theme in all of the cases is the importance of the teacher in the TES projects. In the West High School case study, as one example, we read that "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." Building this commitment and excitement occurs in a variety of ways in the cases. Appendix D contains a detailed summary of Section 3 of each of the case studies; in the following paragraphs we highlight impressions and trends.

5.1 "Traditional" inservice courses

There are, of course, traditional workshops and short courses, with many different structures, often available after school hours. Most often workshops occur in the school, under the leadership of the school computer coordinators or project specialists, such as in the Dutch, Monterey, and Mount Newton cases, or perhaps involving teachers from other schools, such as at Netherhall School. Some interesting variations on traditional workshops occur: In Quinte School, teachers invited software developers to conduct workshop sessions within the school so that the developers themselves could demonstrate their own software packages. In the Israeli schools, workshops were also offered to parents, retired senior citizens, and high school students for skills relating to the support of the teacher in the classroom or lab. In at least three of the cases researchers are called upon to design and deliver quality inservice.

5.2 Trends in inservice

A trend is clear in most of the case studies—inservice tends to begin with some relatively traditional sessions, but quickly evolves toward a more individualized approach. The Mount Newton case, for example, describes "mentorship" inservice, with personal follow-up of more traditional inservice and subsequent one-to-one assistance, and calls this choice of "an in-house model of mentorship inservice perhaps the single most important decision of the entire process." The Monterey approach, built around C.I.P.s (Classroom Intervention Plans) is focused on the needs of the individual teacher and thus follow-up support and assistance is individualized, tailored both to the ideas of the teacher's CIP and also to the teacher's psychological and social needs—"some one person to listen to concerns, fears,...the provision of moral support within the historical isolation of the classroom instruction during 'risky' instruction"...and is much helped by the SuperSub support.⁴ Black Middle School also emphasizes individual assistance, and also includes the provision of a resource bank of individualized instructional modules for the teachers, available to them to work through at their own interest. Quinte School moved toward a goal

of individual assistance, focused on personalized ideas for lesson integration, and noted that "on-going support is critical." The administration at West High School is praised for providing flexible scheduling for the ACOT teachers, so that they can meet together with project support persons every afternoon.

It is clear in all this that on-site, personalized support focused on lesson integration is valued by most of the projects participants. It is also clear that this is expensive. Not only must an appropriate person be available on-site (and most of the projects have more than one person in this role), but released time and substitute support must also be organized. The SuperSub model is particularly interesting in this respect, and the Israeli plan to involve parents and members of the community for various types of teacher support is also very interesting. With so much individualization, the development of a school-wide overview, such as the curriculum map of IT at the school described in the Netherhall case, becomes increasingly important.

There are other strategies for teacher support. Many of the projects have arrangements for teachers to take computers home, or to buy computers at a subsidized rate. Most have organized regular meetings of teachers with each other and with project staff. Model or demonstration lessons are mentioned frequently.

However, the overall trend is toward individualization—one-to-one coaching, feedback, guidance, and support. Only one case talks about the desirability of moving beyond this to more independent teachers. It is clearly necessary to have support persons who can provide curriculum-related instructional ideas and mentoring. Sending teachers to an occasional workshop outside the school is practiced by no one. And finding a way to give the teacher time for this individual interaction is a necessary component. A critical question is: To what extent can this very expensive personal component be replicated in the non-TES school?

⁴The "SuperSub" idea in Monterey involves a corps of well-equipped and well-prepared substitutes who are readily available to take over class responsibilities for a teacher when the teacher requests individualized inservice help. moving beyond this to more independent teachers. It is clearly necessary to have support persons who can provide curriculum-related instructional ideas and mentoring. Sending teachers to an occasional workshop outside the school is practiced by no one. And finding a way to give the teacher time for this individual interaction is a necessary component. A critical question is: To what extent can this very expensive personal component be replicated in the non-TES school?

6. What results are emerging from technology-enriched situations?

It is extremely difficult to synthesize the "Results" of the case studies. One of the reasons relates to the distinction between "process" and "product" results. In a sense, everything that happens in the TES projects is a "result," and therefore the evolution of the activities over time, what teachers and students are doing and trying, and the growth of strategies for teacher support and inservice, are all "results" of the projects. Thus in many cases, what the case study authors describe as "What is Happening" in Section 4 of their articles could also be called project results (for example, students starting to use spreadsheets as a tool for problem solving in mathematics). Another difficulty is that "results" often relate to a process of change, in attitude, experience, work habits, and approaches to problem solving. To attempt to label the position of growth and change in areas such as these in terms of "results" implies that the process is finished, is measurable, and can be measured for comparative purposes with "preproject" status or with what would be expected to naturally occur over an extended period of time in the well-functioning school. None of these assumptions are manageable.

However, it is not unreasonable that we look for a summary of the "results" of these sort of TES-initiatives. There were goals specified for each project, many of which can be assessed at least in terms of progress. Decision makers in other schools would like to be able to better predict what to expect if and when they develop similar technology-enriched environments in their own schools. Those who have invested in technology-enriched projects, not only in money but in time and belief, have a natural desire to know if there are "results" from their efforts.

Thus we will try to summarize trends in the "results" of the case studies. We had asked the authors to specify and summarize the "results so far" in their projects in the fifth sections of their reports. Most commented to us on the difficulty of doing this, both because of the process-product distinction mentioned earlier, and the difficulty of talking about "results" when change and exploration and growth are slowly evolving and multifaceted, rather than measurable and well described. However, each author did supply a summary in Section 5 of his or her case study of what seemed to him or her to be "major results" to date. We have summarized these Section 5s in Appendix E, and here will give our overall impressions of the trends in what the authors call the "results to date."

We can note trends in results with regard to teacher change, student change, school-level change, and project insight and transfer.

6.1 Results with respect to teachers

All of the case studies note that at least some of their teachers are "making significant progress," showing willingness to innovate, reflect, and change their instructional strategies. Teachers generally are positive and are becoming gradually more accustomed to the computer as a tool. Teachers are using computers in an increasing variety of subject areas and in an increasing variety of ways.

However, not all teachers in TES project schools become enthusiastic and insightful computer users. And even for those who are enthusiastic, the case studies generally agree that on-going support and motivation are important to teachers' sustained involvement and growth. The case studies also agree that teachers must be committed, need time, and will benefit from access to computers outside of the classroom.

6.2 Results with respect to student change

All of the case studies note that students "take naturally" to computer use, are generally enthusiastic about computer use, and are moving into more and more independent uses of technology as a tool for other instructional tasks. There are also a number of reports of gains in various measurable student outcomes, although most of the cases note that much of what seem most significant about student growth with respect to technology use is not measured on current tests or by current procedures. What is noted about student gains is particularly important from the point of view of decision makers and thus will be resummarized (from Appendix E) here in highly compressed form:

Mount Newton

Method: Comments in students' "learning logs"

Result: Positive opinions of the students about learning more with technology

Monterey

Method: Large variety of measures, including teacher reactions, student output, traditional test batteries, and achievement measures (however, "most CIP-specific data are based on observation and perception")

Results:

- Increases on standardized tests and measures of writing proficiency
- "Moderate impact" on grades
- Reduction in writing errors
- Increased enthusiasm for writing
- Increased cooperative learning
- Increased spelling skills, increases in problem-solving ability
- Increased attention span

West High School

Method: Success of "real-world projects," scholarships and job offers to graduates, traditional tests, affective measures, and observations

Results:

- Variety of successful projects in response to real community needs and assignments
- College scholarships and offers of post-high school work as technology consultants
- Success relative to control groups in writing, mathematics, and science tests, but the students "have demonstrated much more knowledge and problem solving ability than standardized tests measure"

Dutch TES Project

Methods: Observations, researcher analysis

Results: Changing attitudes of students toward learning—"more problem-oriented, independent, goal-directed...show more initiative while solving problems, more often correct mistakes...work in a more concentrated and task-oriented manner"

School No. 56

Method: Researcher observations and analysis

Results: "Pupils involve themselves enthusiastically in all kinds of computer activities and...have good results?" A deeper motivation for learning; more spontaneous contacts among students for discussions and exchange of programs

Comptown

Methods: A large variety of formal observations, interviews, researcher analyses

Results: Compared to control students, significant gains in multiple-inference problems, formulation and testing of hypotheses, data organization and identification of meaningful variables

F. M. Black

Method: Observations, achievement measures

Results: Increase in skills particularly in language arts and math, ability to develop their own solutions to problems, scores on statewide proficiency test "improved significantly" increase in morale and motivation for learning

Quinte Lighthouse School

Method: Observations

Result: Students view computers as a tool and use the tools regularly and effectively. Students are enthusiastic.

Netherhall School

Method: Ongoing assessment of student achievement and behaviors

Results: Students make effective use of technology as a tool throughout the school

From these brief summaries, we see very encouraging results with respect to the students in the TES projects in the case studies. The dramatic and undeniably valuable results at West High School (job offers, college support, strong community recognition) are particularly impressive. The shift among students in all the cases toward more and more appropriate use of technology as instructional and productivity tools is undoubtedly an important result. The consistent comment about student enthusiasm and motivation is also important. Changes in students' approach to independent problem solving, to group cooperation, to new approaches to work and learning are powerful comments.

And there are even improvements to be seen on traditional measures such as standardized tests and report card grades. The fact that all the cases cite "important results" regarding student performance that are not usually directly measured on fact-oriented standardized tests or reflected on report card marks reinforces that often-expressed need for some reliable and accepted strategy to measure and give credit for the wider range of student outcomes and growth in technology-enriched environments. Perhaps the TES projects could add this to their lists of project goals?

6.3 Results with respect to school-level changes

Most of the cases indicate positive changes in "school climate" or describe important changes in the "school ecology." In at least five of the cases, this overall improvement in school climate is among the dominant results of the project, at least as described in Section 5 of the case studies.

6.4 Results with respect to project-level insights and transfer

All of the cases discuss the insights they have gained from their experiences with technology-enriched schools as a valuable result. Since these insights are frequently discussed in the context of recommendations for other schools and projects, we will comment on them in the following section of this summary chapter (Section 7: Summary of recommendations). However, it is noteworthy that a number of projects are already transferring their instructional and organizational strategies to other schools in a variety of ways. We see specific examples of this in five of the cases.

6.5 Overall comment about "results"

In general, with respect to "results," we might say that what is occurring in the technology-enriched schools of our case studies is that exciting learning environments are being established and are evolving in ways that are in some aspects similar and in others different, reflecting their different cultural contexts. Students are benefiting; teachers are being challenged and stimulated; indeed, "good things are happening." However, describing and documenting those "good things" in a comprehensive way is extremely difficult.

7. What recommendations do persons involved in technology-enriched situations make to others moving into similar projects or situations?

From the information the authors of the cases give and the way they describe the activities in their respective schools, readers must come to their own conclusions as to how to transfer the experiences to their situation. The authors were, however, asked to make recommendations both to other "technology-enriched school projects" and to schools in general as they naturally move into more technology-enriched environments. We summarize these here.

7.1 Teacher-focused recommendations

The strongest recommendations made by the majority of the authors relate to the importance of the involvement of the teachers. For example, "Time spent with staff is the critical necessary factor in developing effective instructional uses of computers in our new school planning" and "Put people first, especially teachers...."

A strong rationale for giving priority to the teachers is: "Don't feel guilty for investing resources for staff development at the apparent expense of students (such as allocating computers to staff). An investment in a teacher will pay off for hundreds of students in years to come." And, "the participation of teachers was chief determinant of the success or failure of the project." Teacher inservice and on-going support are stressed again and again as critical.

It is not only during the project that the teachers play a crucial role as executors of the project's plans and ideas. They also play key roles by setting up a project. For example, "It is also necessary that the teachers be involved and committed in principle before a major change is introduced if a positive and cooperative environment is to be maintained." Many recommendations are made relating to on-going, meaningful teacher involvement in decision making and planning. As one author says, "must emphasize here again the importance of thorough staff involvement in planning and design."

At the start of a project most of the teachers are not familiar with the instructional potential of computer-related technology, so they have to learn many things as well as develop many ideas. This takes time. Thus most of the authors make recommendations about making arrangements so that teachers have some free time and space for exploration of their new tasks. For example, "Provide leaders/mentors with planning and support time, and provide teachers with released time for inservice and follow-up." Also, the importance of providing for individualized support and models of instructional practice appears in many of the recommendations.

7.2 Recommendations about hardware and software

In contrast to the very detailed recommendations about teacher support and involvement, few explicit recommendations are made about hardware, computer configurations, or software characteristics. Aside from comments such as "...adequacy of resources are essential factors in effective uses of technology," we more often see recommendations emphasizing a deemphasis on technology: "Too often we see schools of the future designed around equipment and facilities, without placing staff and curriculum development front and centre in planning." Curriculum integration is also emphasized: "If the hardware is put into the school without curriculum support materials then its success is going to diminish after the initial excitement... ."

7.3 Recommendations about constraints

Finally, a number of the projects make recommendations that relate to being more realistic about the constraints of a project, especially during its initial planning and goal setting. Even in TES projects with plenty of facilities, not all the desired instructional ideas can be realized. Choices have to be made.

As an example, "Monterey has 'modulated?' its technology integration by utilizing the CIP planning process." This strategy is seen as useful for schools with no special funding "because adoption/adaptation can be undertaken in phases or in modules, depending upon the priorities or mission of a given institution."

The Dutch project recommends a gradual broadening of project ambitions. Schools just beginning to add technology into their curriculum can "begin with Writing Centers that can be used by the entire school. Practically every subject involves some writing experience for students." In looking back, the F.M. Black School authors conclude that it was too optimistic to try to integrate computers into every branch of the curriculum. The new approach at Black can also be seen as a recommendation for other schools: "Today, instead of totally restructuring the delivery of instruction, the school seeks to work the technology into its current instructional organization causing change to become an evolution rather than a revolution."

7.4. Summary of the recommendations (and of this Summary Chapter)

Summarizing the explicit and implicit recommendations in the case studies, we come to the not-surprising conclusion that the success of using computers in education is dependent on people, not on technology-enriched environments. The effective integration of technology into schools is more a problem of Human Resource Management than it is of technology or even of financial or project management. Providing an environment in which ideas and human commitment can be stimulated and supported is the basic characteristic of effective schools, and also therefore of technology-enriched school environments.