Buying Computers for *Your* School: A Guide for the Perplexed

Your School Needs to Make Some Good Decisions—Now

Local school districts are passing multimillion-dollar bond issues to buy technology for their schools. In Michigan, for example, Ann Arbor has just passed a \$4 million bond issue; Willow Run, a neighboring community where GM just closed a 4,000-person plant, recently passed a \$2 million bond issue. Plymouth-Canton, another neighboring community has bought in for \$3 million. The money is there, collecting interest fortunately, waiting to be spent. Schools are girding themselves for another wave of computer buying.

While buying computers is exhilarating, choosing among the variety is no mean feat. Consider then what *your* local neighborhood school faces: should it be Mac, IBM, or clones? What kinds of network(s)? Token-rings—are those like friendship rings? Who will service the equipment? What about software? Whose videodisc-based curriculum is really worth the money? And, oh, by the way, who will help the teachers learn what those expensive boxes are good for?

All across the U.S. essentially every school is confronting these questions. A bad decision now can make life hard for lots of folks for a long, long time. Textbooks are purchased every eight years; the last major round of computer buying was in the Apple II heyday. What schools buy today will, most likely, be with them in the year 2000. At least.

Some schools hire professional consultants to draw up "technology plans." While the services of someone who has done that at least once before are, generally speaking, worth the cost, most schools cannot afford consultants. The technology budgets cannot, typically be used to pay for consultants—only for "boxes."

Here is our cue: we, as computing professionals, can make significant contributions to our community by helping our local school and school district develop and implement a reasoned, coherent technology plan. I am part of a group of computer professionals in Ann Arbor who are helping the city's schools create both a vision for technology in education, and a concrete plan-of-action for closure of (and revising, and revising!) that vision.

As anyone who has served the public knows, the emphasis in any plan is definitely on *process*. Since it is everyone's money, everyone has a

right to put in his or her two cents. The result is that it is *time consuming*—meeting upon meeting with all sorts of individuals in order to seek some form of consensus and buy-in. It is also *frustrating*—decisions are not necessarily based on rational argument (translation: they don't always agree with me). That said, I get a genuine thrill when I walk into Community High in Ann Arbor, and see

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the students and the teachers engaged with the computers that I helped bring to the school. That thrill, quite honestly, has not diminished over the four years I have been working at Community.

Lest you go into the lion's den unprepared, perhaps you can learn something from my experiences in Ann Arbor and my experiences in other places such as Augusta, Maine, Tacoma, Washington, and Kentucky (that state is putting \$400 million into technology for education—and that's *not* a misprint!). Here then is my story. Two columns worth of it, in fact.

In this column, I will discuss hardware issues: networks, computers, and peripherals. In my next column, I will talk about the really difficult issues: software—"curriculum" in edu-talk, teacher education, and the impossibly difficult issue of negotiating all this with well-meaning individuals, who simply do not think the schools need to spend so much money on "techie toys."

Computer Networks: Facilitating Communication

In the 1980s schools were buying standalone computers. Teachers and students used *pieces* of software just as they used filmstrips and other audiovisual aids (e.g., drill-and-kill arithmetic programs, multiple-choice practice tests). In the 1990s, however, computers are moving beyond being adjuncts to learning and teaching, and becoming more integral to those activities. For example, computers are the new workbenches where students create a broad range of artifacts such as text, tables, drawings, and simulations. For the fullest impact, those artifacts need to be shared and critiqued; networking the school's computers facilitates just such interaction.

For the baby boomer generation, each classroom was an island unto itself, with the PA system serving as the communications bridge. As education moves toward an inte-

grated curriculum and community involvement, however, classrooms can no longer remain so isolated. The communications bandwidth must be dramatically increased. Email and bulletin boards will become standard modes of communication in schools.

That said, networking is a big-ticket item. Contractors are bidding in the \$50,000 to \$100,000 range. Buildings need to be rewired at substantial cost; asbestos is the standard wall filler, and there are no phone lines or convenient wire trays and raceways. Eastern Europe is going cellular since they cannot afford the time and cost to put in copper; American schools are in a similar situation.

Frankly, going cellular is too revolutionary a solution for school boards. Therefore, prepare yourself to talk intelligently about such arcane components as four-pair-shielded-twisted wire, star-couplers, and broadband amplifiers. Since my AI upbringing has not prepared me to play at this level, I have latched onto some young hardware types (undergraduate CS students) who serve as my coaches.

At Community High, we are putting in wire trays in the halls and raceways in each room, with RJ-45 jacks sprinkled liberally throughout. Now, will we have money to buy computers to plug into those jacks? If only some hard decision would be made on the school system's budget, enabling us to make a rational plan!

Through the same wire trays and raceways, we are laying cable for phones in all classrooms and offices. Question: which white-collar workers making upwards of \$30,000 a year would not have a phone on their desk? Answer: teachers. Thus, it is no surprise that it may be difficult for teachers to imagine what they might do with a computer network; they are still asking for *phones*.

Intra-school networks are not enough. Just as professionals rou-

tinely interact over email and bulletin boards with others outside their building; students who are engaged in authentic learning activities need to interact with students in different schools. Fortunately, Michigan has an innovative agency, Merit Inc., that is spearheading a statewide linking activity.

Video is also compelling and authentic. It is a mistake to not include TV in your overall technology plan. So, should you go analog or digital? How much risk can you/the school tolerate? At Community we are putting in an extensive cable TV system, again through those same raceways.

We envision classes, such as social studies and ecology, working together on projects. A cable TV network will allow the different classrooms to communicate. Schools in Michigan are currently exploring two-way video. Classes in *different schools* working on projects together use teleconferencing to coordinate their efforts, similar to a real workplace.

There are now approximately 75 computers (for about 350 teachers and students) currently in Community High. In addition to the new IBMs and Macs, we count the Apple II's and MS/DOS PCs—they are going to be used for word processing stations. Given that type of heterogeneity, a vanilla networking scheme is not sufficient. Why bother keeping those old computers around? They still represent a significant capital investment, and they still can provide valuable services. Waste not; want not.

The real challenge, of course, is hedging your bets and still keeping it simple and flexible. For example, in five years we will need docking ports built into the desks for the students' picocomputer-based notebooks. Scoff if you wish, but businesses will surely be so equipped, so why not schools?

Perhaps though, you really do not believe that students need such technology. After all, you didn't have any of it when you were in

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school, yet you turned out just fine. In order to seriously think through the technical issues, I have had to confront deep and implicit beliefs I hold about learning, about young people, about living. If only I could limit my involvement to recommending one hard drive over another! Well, maybe you will have better luck.

Peripherals: Making More Contact With the Outside World

A computer network is only the first step. After all, a network only lets one computer talk to another computer. By definition, however, to integrate technology into schools means to connect the computer to its surroundings. Now, this is not anything particularly mystical; you just need a good scanner to call up images, and a VCR on the other end to output those color creations—stills and more likely, animations and video.

Students routinely interact with newspapers, magazines, advertisements, and comic books. An authentic learning environment must enable students to incorporate *their* environment in *their* documents. If cost is really the driver, then you can live with a hand-held scanner to input line art and text. Ideally, a flatbed scanner is the way to go; gray scale is certainly acceptable, though if the budget permits it, a color scanner would be the optimum.

Students' work cannot stay inside the computer; they need to take it home to show their parents they actually do something in school. Color printers are either out of the price range, or just too difficult to keep running in a school environment. A "print to VCR" capability though, is perfectly doable with just a few extra little boxes. (Instead of sending the signal to the color monitor, feed the output through a RGB-to-NTSC converter, and from there it is extremely easy to go to the VCR.)

In the Ann Arbor middle

schools, we are really stepping out. We are putting in video digitizing boards now. There is an interactive multimedia setup in the Media Center (once known as the Library) that enables students to input video they have recorded. The clips are short and small—we are budgeting for 128MB magneto-optical cartridge drives; nonetheless, it is still their video!

The scanner for input and the VCR for output are for everyone, from composition class to physics. The art and music folks will want some extra goodies: MIDI interfaces and keyboards, digital cameras and drawing tablets. (N.B. pens from those tablets have a funny tendency to wander off. Suggestion: make do with a mouse).

The Media Center needs to begin the movement into CD-ROM. It is advisable to be careful here. I am not impressed with the current CD-ROM encyclopedias; they do not do justice to the text (reading paragraph after paragraph of text on a screen is just no fun), and they do not do justice to the images. A quality scanning job needs more than a once-over on the image. And finally, the interface for browsing is thoroughly confusing and very slow. Be careful too of buying CD-ROMs full of bibliographic indexes; getting to the actual reference can be next to impossible, since full-text CD-ROMs can be very expensive for a Media Center to purchase.

Good CDs are coming. The Voyager Company in California just published a series of electronic books that include *Jurassic Park* and *Illustrated Alice*. If only NASA could figure out how to mine their image databases—we could be taking virtual field trips to places like the moon, Venus, and the stars on a daily basis.

And back on Earth, a real problem is what cart to buy: if you have a mobile interactive media setup that teachers can wheel into their rooms, you might be tempted to put the 27-in video monitor and the videodisc player on one cart, and

the rest on another cart. Picture a teacher, however, pushing two carts down school corridors, in the eight minutes between classes, and then trying to get the cabling right. It is worth the struggle to find a one-cart solution.

Finally, what about projecting the computer screen to a classroom? Clip art, ala animations and digital video shorts, are becoming more commonplace. The blackboard simply cannot compete with a computer animation of the "water cycle." How, though, do we turn the personal computer screen into the size of a blackboard? I know the projection plate folks will probably vehemently disagree, however, I am not sure that the current crop of LCD plates are all that teenage-ready. How many hands can this type of plate pass through before those fine filaments break, before the glass is scratched beyond recognition, before the small pins on the cables and connectors are bent out of shape? A viable alternative is to simply use a large screen video monitor; it's big enough. Moreover, the monitor colors are truer and the frames of the video and animations will not bleed into each other—unless you get an expensive LCD plate, it simply won't be fast enough for video and animation.

Computers Are Generic Commodities

So, what brand/make/model of computer should you recommend? As techies, our first response is to think of issues such as "which microprocessor should be inside?" "Which graphical interface is better?" This is the *wrong* place to start! Rather, start with usage patterns and educational goals. For example, whatever computers you finally recommend, they had better provide for three basic needs:

- First, there should be enough readily available computers for two basic functions: (1) Routine wordprocessing, spreadsheeting, painting/drawing, and telecommunications. All students (and teach-

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ers) need to be able to effectively use the basic tools of the Information Age. (2) Didactic instruction is not going to disappear overnight. With a 1:30 teacher/student ratio, we need to better support teachers in their lecturing activity. In every classroom, we should add a computer (plus a suitable projection mechanism) to the chalkboard, overhead projector, and TV.

- Second, each subject domain and each student population has its own special needs. For example, the music teacher wants a MIDI keyboard, while the physics teacher wants the computer to run number-crunching, color simulations. Special education needs alternative input and output devices. The more pioneering students and teachers need to be supported as they venture out into uncharted territory, for example, digital video.

- Third, the computers should be capable of growing as the students, teachers and administrators mature in their understanding of technology. Slots and ports, sufficient cpu zorch, memory expansion capability are not frills; remember that you are buying computers that will last for 8 to 10 years.

How do you manage the inevitable trade-offs? You must understand what the school educators and administrators think their goals are and provide them with a spreadsheet of options. Then iterate and reiterate, revising goals and priorities in concert with revising the technological options.

I am quite serious about the spreadsheet. In addition to providing a concrete forum for discussion, such a spreadsheet clearly demonstrates how technology can be used to manage what would otherwise be an overwhelming amount of information. We need to practice what we preach; and I assure you the educators will be extremely grateful for that spreadsheet of options.

Second, eschew elaborate solutions; make Occam proud—keep it

simple. No matter how much pain it causes you, try to compromise, compromise, compromise. For example, buying as many of the same boxes as possible is a big win in a situation where maintenance support is low and entropy is high. For all intents and purposes, (almost) one size will have to fit all.

Here Comes A Giant Curve Ball

Now that you have developed a rational plan of action, here comes a definite curveball: consumer-priced, hand-held information appliances that millions of school-age individuals will have. These next-generation Walkmen will play CDs, have a LCD color display, pen (and voice, sooner than we think!) input, wireless communications.

Following in the footsteps of calculators and Nintendo, schools could simply ban them. While such a strategy did not work for calculators, and is not working for Nintendo, it is still the most likely scenario. Can we, just this once, not make the mistake of taking what kids do—interacting with personal technologies—and telling them it is not worthwhile to bring to school?

Hardware Is Only The Beginning of the Story

If you were not perplexed before you started reading this column, you surely are now. The welter of detail, of options, is truly significant. Literally, you will be ordering hundreds of different and expensive boxes. So, where is the "guide"?

My suggestions for organizing your advice to educators are to ensure that a baseline of service is provided by the configuration of network, computer, and peripherals and to identify one component of the system as the flagship service.

For example, in Ann Arbor, the "interactive media workstation" is the stand-out component. It is a powerful processor with ample slots for expansion, lots of video (disc, tape, and even digital), all integrated into one, easy pushcart package. While our networking

scheme and the computers themselves are unquestionably adequate, those interactive media carts—30 of them for five middle schools and three high schools—are the shining stars.

Now, declare success, take a big, relaxing breath, and read my next column to prepare for your next set of trials. Getting the hardware order together—and getting it through the teachers, administrators, school board, vendors, and service personnel—are fearsome tasks in and of themselves. That is just the beginning. What about software? What programs should you recommend?

What about the teachers? Most of them do not live and breathe windows, mice, and Ethernet. To them, a cart loaded with mountains of electronics gear is *not* inviting in the least. Moreover, given the substantial demands already made on their energy, time, intellect and psyche, they don't need much encouragement to simply leave those magnificent carts locked quietly in the closet.

And that brings me to the next logical question: what are all those boxes going to do to improve test scores, or to ameliorate ethnic achievement differences? Take it from me, you are going to be asked that question. It is at about this time that you find yourself asking the following question: why am I so concerned with helping the schools? It is certainly not for the money. How about this: Our parents did it for us; we do it for our children. It is that simple.

Acknowledgments

This article is the result of a (still ongoing) process involving all sorts of folks; thanks for your conversations and arguments—Judy Musket, Peri Weingrad, Dan Schultz, Bob Galardi, Joe Riley, Janet Kahan, Tom Dodd, Bob Kinel, Mike Mouradian, Steve Eisenberg.

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