

Reflections on the RCDS Laptop Program After One Year

November 2000

The following are reflections on the Rye Country Day laptop program after a little over a year of implementation. The types of questions I was asking myself when writing this were of the following nature. Why are we doing this, what is working, what isn't, what new initiatives are needed, what should we change, etc.. The "Why are we doing this?" question comes up frequently in my own mind because our laptop program is extremely high maintenance; as I suspect are most laptop programs. The planning and implementation of our laptop program is the biggest project I've taken on in my 18 years of teaching computers and being a computer coordinator. (See Appendix A for a list of the tasks involved with implementing a laptop program.)

On the next page are some basic facts about our program which help provide an understanding of the parameters within which we are working. Following that are my reflections in an outline format.

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Facts about the RCDS Laptop Program as of November 2000
www.rcds.rye.ny.us/rcds_laptop_program

Date Proposed: Spring 1997

Date Implemented: October 1999

Grades and Numbers Involved: (1999 7-10 330) (2000 7-11 420) (2001 7-12 510)

Tech Support: Currently 2 Full Time (probably 3 FT next year)

Curricular Support: 1/2 time person last year, 3/4 time person this year

Professional Development: Most advances made over the summer. We have courses for faculty and we offer stipends for curriculum development integrating technology. Curricular support person works one-on-one with faculty and does some small group training sessions. This year the focus is on getting faculty to develop web pages for their courses.

Faculty Computers: Most faculty in the laptop grades have school supplied Wintel laptops. Some have opted to purchase laptops of their choice through a laptop subsidy program. A few opted for desktop machines.

Student Computers: 250 Wintel / 170 Macintosh (roughly 60% / 40%)

Operating Systems: Windows 98 and Mac OS 8.6 and 9

Networking: 11 Mb wireless (802.11) cards communicating with 22 Lucent WavePoint II hubs. Placement of hubs was determined by a Lucent engineer's site survey. Cards are owned by the school. WavePoint Hubs are connected by Cat 5 cable to Asante switches.

Standard Load Software: AppleWorks 5 / FileMaker Pro 4 / Homepage / FirstClass / QuickTime

Other Software Required in Certain Grades: Geometer's Sketchpad / Inspiration

Servers: Two Appleshare 6 file servers running on G3 Macs / One FirstClass server running on a G3 / Three web servers running WebStar 4

Student Training on Laptops: Done in a year long 7th grade course. In the Upper School each department is responsible for covering a particular productivity application. English-word processing, Math-spreadsheets, Science-graphing, Foreign Language-databases, Humanities-web page creation, Art-painting and drawing

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I. Why laptops?

- A. Students face a huge information integration/organization/management task. Computers are the most powerful tool we have available for working with information. Therefore, students should be provided with computers to help them with the information management tasks they face.
1. Computers don't replace existing tools like paper, pens, pencils, calculators, etc.. They supplement these tools.
 2. Computers alone don't solve the information management tasks students face. Rather, computers are part of the whole milieu of student development/support/molding which exists in a school.
 3. One of the problems of a laptop connected to a network is that it can spew out information like a fire hose spews water. There is a lot of power in the flow, in both cases, and in both cases it takes time to learn how to control the power and use it effectively to solve a problem.
 4. What is accomplished with a tool will reflect the skills of the user and the training the user had in learning how to use the tool. In order to gain more value from computers we must make sure that students have adequate training in the tool. We need the equivalent of drivers ed except in the case of computers it must be ongoing and frequent. This needs to be done with teachers as well as students.
- B. Computers provide a virtual playground for an increasing number of knowledge domains. By a virtual playground I mean they allow for the playful (or at least relatively painless) manipulation of information. For an activity to be playful there must not be a significant cost to experimenting. By handling rote (or mindless) information management tasks computers significantly reduce the cost of experimentation and free the mind to deal with non-rote (or mindful) tasks. All of the virtual playgrounds described below can of course be provided on either desktop or laptop computers. What laptops can do is create an infrastructure that will allow these playgrounds to be entered into wherever and whenever needed. As computers steadily increase in power new realms and capabilities become available for virtual playground creators (software development teams). The pedagogical richness of virtual playgrounds will increase and parents and teachers will want students to spend more time in them. Most schools will not, even if it is physically possible, put a desktop computer in every classroom for every student. The logistics just don't work due to everything from classroom size to electrical outlets. If ubiquitous, or even widespread, access to virtual playgrounds is

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desired, laptops are the only viable solution.

1. Word processing is still one of the best examples of a virtual playground provided by computers. The costs of rewriting and editing become so low that much more time can easily be spent on these activities. Increasingly there are examples of the playful integration of text and images creating a synergistic effect that can potentially deepen and strengthen the intended message of a work.
2. Geometer's SketchPad is perhaps the best example of a virtual playground in mathematics education in the secondary schools. It is rapidly becoming an essential tool for teaching Geometry. Graphing programs are increasingly being used for other math courses. Mathematica is being used with increasing frequency in the advanced Calculus classes.
3. In the study of History a virtual playground is created by the much easier access to information sources of all kinds that the Internet provides. The sources of information available are going to become steadily richer over time as more institutions digitize their collections and improving computer technology allows audio and video collections to join text and image sources. The computer does very little, if anything, to help with interpretation and analysis of all this information (that remains the job of the student and teacher) but it does, by making it much easier to get to the information, make more time and effort available for thoughtful consideration. Of course, word processing and web page design, make the technical production of formal interpretations of data much easier and therefore students are more likely to modify the presentations to make them more accurate and compelling.
4. Immersive environments are generally considered the most effective way to teach foreign languages. Teachers can provide this for a brief period each day in class. Virtual foreign language playgrounds can be created on computers so that the immersive environment can be experienced multiple times a day. It is not difficult to imagine that this capability might lead to significantly greater success in the acquisition of the foreign language. Such a virtual playground is provided by the LaserDisc "Le Recontre de Phillip." This ground-breaking work is likely to be frequently imitated as DVD drives bring LaserDisc sized storage capacity to a rapidly increasing percentage of new computers.

At RCDS we have already made progress, in a way commensurate to the resources at our disposal, to the creation of immersive environments on the computer. A FileMaker database, built around the sound files accompanying the *Panorama* text along with the recording of hundreds of words and phrases by a French teacher, provides a visual and aural information environment that

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students can “play” in.

The next step we are taking is to provide video clip files to students. These will be QuickTime clips and may or may not be presented in a database format. We are currently experimenting with different compression schemes to achieve a viable balance between image and sound quality and file size.

5. In Science the virtual playground is created in at least two distinct ways. The first is along the lines discussed above. Students can experience virtual worlds where the parameters that control natural forces and processes can be easily manipulated and the effects observed. For example, there is a computer program that allows students to build virtual bridges and then apply virtual forces to the bridge. This allows for very rapid experimentation with different designs, experimentation that would be very unlikely to occur with real models really breaking under stress tests. Real models should be built and tested but such models can be built with a much greater depth of understanding if there is first experimentation with virtual models.

The second virtual playground is that created when computers are used with data collection probes of all types. What in essence happens is that computers and probes do the dull and tedious work involved with data collection and students are able to focus their energies on problem solving, analysis and theory building.

6. In Art there are esthetic qualities and values to the medium of presentation itself which will always keep computers as just one of many media. The computer can provide a rich database of visual imagery as well as a new and different medium for the creation and presentation of visual images. There may well be a new burst of creativity in photography as the resolution of digital cameras continues to increase, computers develop the memory and speed to handle these images, and printer output quality rises to match that of photographic prints. Photoshop is a classic example of a computer program providing a virtual playground for the manipulation of digital images.

With laptops the computer screen itself often becomes a surface on which to present visual imagery that is esthetically appealing and meaningful to the computer's owner.

7. Music, like Art, is a subject where the method of performance is of overwhelming importance. A jazz band, choir or orchestra will find computers of very little use except perhaps as support tools in the preparation or practice stages of molding a performance. A music teacher could distribute a sound file to

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all the members of a group (provided they all have laptops) and ask them to listen to and presumably learn something from the musical content of the file.

Computers provide a virtual playground for the production of musical scores. MIDI systems allow for easy experimentation and remove much of the drudgery from the score production process. Again, the goal is to allow energy and time to be focused on creative endeavors.

Computers also provide a new and extremely flexible platform for the playback of recorded music. As never before people can control what music they will listen to, and when and where they will do that.

8. The use of computers in Drama is very similar to Music. Drama is a subject where performance is the end goal. Computers can be of assistance in achieving this goal by presenting models to students. Drama teachers can distribute QuickTime videos to students of particular performances, the study of which would help develop various techniques. Drama teachers can also distribute to students clips of the students' own performances which could very well help them in the development of their craft.

II. Issues with our Current Laptop Program

A. Hardware Deficiencies

Our current laptops are workable but far from ideal. They are relatively heavy and fragile, and are not modularized in a way that facilitates repair. The short battery life, nib pointer, and external wireless card of the Toshiba laptops are distinct negatives. The design of the iBook CD-ROM door and keyboard are negatives for it.

Dell currently offers an ultra-light laptop (Latitude LS) which is proving to be popular at other laptop schools. This unit has the same size screen as the iBooks and Toshibas yet only weighs 3.5 lbs. It has a full size keyboard and a trackpad. It comes with an external CD-ROM or DVD-ROM; which can be left home most of the time. Repair of the laptop is handled by Dell onsite at either the student's home or the school tech room. It appears to be designed in a modular way that quickly allows for broken parts to be swapped out. It doesn't yet have the battery life or built in wireless card of the iBook but otherwise it is a big step closer to an ideal student laptop.

The laptop computer market is very aggressive and laptops are evolving very rapidly. Over the next few years a laptop should become available that puts all the pieces together into an ideal package. At that point the major drive will be to get the price of

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this package down to a more affordable level.

B. Software Deficiencies

1. Operating Systems

Both the Mac OS and Windows are far from ideal. They each have quirks and instabilities which cause valuable time to be wasted and too often cause the computer to be non-functional when it is needed. Apple and Microsoft are rapidly developing new operating systems which promise to be more stable and less troublesome.

In the meantime students can do a great deal to make their machines more stable by simply refraining from installing games, frivolous utility software, and public domain software downloaded from the Internet. We have found that once students are required by their teachers to have their computers in class and working (with a negative consequence if they don't) they are reluctant to "mess around" with installing unneeded software.

2. Productivity Suites

At present the two main options remain AppleWorks and Microsoft Office. Both have advantages and disadvantages. AppleWorks' advantages are that it is small, tightly integrated, feature appropriate, very easy to use, and does not have the virus issues plaguing Office. Its disadvantages are that it is missing some wanted features (primarily in the graphing and word processing modules) and it is not used extensively in the world of work. Office's advantages are that it has more features than anyone will ever need and it is the dominant productivity application in the work world. Its disadvantages are that it is huge and cumbersome, has many features which are not appropriate or easy to learn (we are a school, not an office), and has had numerous serious virus issues over the last few years. Overall I think the simplicity and relatively problem-free nature of AppleWorks continues to make it the better choice as our standard. We hold out hope that Apple will fix some of the holes in AppleWorks in the next upgrade. Students and teachers are free to use Office on their machines but must use AppleWorks when creating files that must be shared with the community.

3. Other Productivity Software

a) Database

FileMaker continues to be useful as a platform for developing what are in

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essence small applications. We use it for the note taking program, the planbooks, what in essence is a biology “text”, and the introductory French database discussed above. A prototype multiple choice test giving program was developed last year and should be ready for general use this year. Student initiatives using the program have not developed as I hoped; perhaps because there has been no class or workshop in how to develop databases.

One glaring problem with FileMaker is that sounds recorded into container fields do not work if the database file is used on a different operating system. There are a number of foreign language teaching opportunities we are losing because of this. We will shift all students to FileMaker Pro 5 (or perhaps 6 if it is out by then) next September.

b) Web Page Design

Home Page is showing its age and we will need to find a replacement as the web continues to rapidly evolve. We get Home Page free as part of purchasing FileMaker. It still works fine for simple page design but doesn't do so well for more advanced web design work. A stripped down version of Dreamweaver would be great.

c) Email

FirstClass continues to do an outstanding job for email and conferencing. It is evolving at a steady clip and currently has features, such as the calendar, which faculty and students are barely starting to understand and use. The file transfer capabilities of FirstClass are excellent and it is frequently used to move files to and from students.

Recently we have begun using the web serving feature of FirstClass to distribute the management of web pages out to faculty and staff. All faculty in the MS and US are expected to make web pages during the 2000-2001 school year. The Alumni Office currently maintains its own pages in a FirstClass account. We are encouraging other groups within the school (such as the Athletic Department) to do the same. The great advantage of this approach is that those responsible for pages can change or update them directly from their desktops.

d) Presentation Software

AppleWorks has a slide show capability which is adequate for many

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tasks. We have recently started using a program called UPresent. It has a very educationally appropriate set of capabilities which encourage students to focus on the content of the information being presented instead of distracting bells and whistles. One great advantage of UPresent is that handles multimedia files as cleanly as still images and text.

4. Curriculum Software

Good curriculum software creates the virtual playgrounds discussed above. The best curriculum software allows students to play with the variables of a knowledge domain in a very serious way (curiously enough).

So far we are requiring students to purchase Geometer's Sketchpad and Inspiration (in some grades). Some additional math program such as TI-Interactive, Mathematica or Maple may well be required in certain grades in the future.

We are always looking for "killer apps" in the other subject areas but the more general productivity applications discussed above may prove to be more valuable than specialized curriculum software.

Another possibility is that small very focused applications may prove to be extremely valuable in certain areas. These may be traditional computer programs, Java applets, or perhaps even Flash animations.

5. QuickTime

QuickTime is quite simply an outstanding technology for dealing with audio or video files. We are using it now in the introductory French database mentioned above and will increasingly be creating video files with it. We plan to start doing video streaming with a QuickTime server over the summer of 2001.

C. Student Training

We currently have two approaches to student training. In the middle school all 7th grade students take a year long course that meets once a cycle. In this course they receive training in how to use their computers and in the basic productivity applications. In the upper school the basic productivity applications are taught/reviewed/reinforced by the various disciplines. English does word processing, math does spreadsheets, science does graphing, humanities does web page design, foreign languages do databases, and art does painting and drawing apps.

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Curricular support software is taught to students by the teachers using it.

I believe that many students fail to develop many useful computer skills despite the attempts mentioned above. Because of this I hope to develop a web based set of instructional materials which students will be required to master. They will prove their mastery by taking tests that will be offered periodically via computer.

D. Furniture

Furniture is something that we have yet to adequately resolve. Part of the problem has to do with depreciation cycles. Many of the school's desks were replaced in the last three years and we don't appear ready to throw away that investment yet. We have been purchasing some wider desks and are evaluating how they work. It would be interesting to take a few classrooms and redo them to work better with laptop enabled students.

E. Facilities

Our repair facility is adequate but very cramped. This should improve when a new computer lab is created and all the computer teaching staff move into that space. We need a better space for the production of multimedia files and that space should also be available in the new facility. Finally, we need a better space for housing servers. A complete redesign of the current tech center should provide this space.

III. Common Arguments Against Laptop Programs with Replies

A. There is no good evidence of an educational benefit

The studies of laptop schools that are available, such as the Rockman study (financed by Microsoft), do show a decrease of lecture based teaching but they do not show any strong increase in student scores on standardized tests. Alan Bain of Brewster Academy (a laptop school for five or six years now) has recently published data showing a significant increase on standardized tests. These data are not unambiguous however because Brewster put in place a very elaborate and carefully developed set of pedagogical practices over the same time period they were integrating laptop use. Alan Bain would argue that any test score changes are much more likely due to the new pedagogical practices rather than laptop use.

What is interesting about the lack of clearly measurable educational benefits to laptop use is the almost equal lack of "hard" evidence that **any** computer use in schools is beneficial. In fact, there is considerable controversy about whether computer use in the larger society has created measurable increases in productivity.

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Yet almost anyone who uses a word processor knows that the writing process is “better” than with a typewriter. However, I’m not sure anyone has developed a rubric to measure how it is better. What suffices as evidence for most people is the experience of having to retype a typewritten page because of some mistake made near the bottom of the page. There are also horror stories about lost computer files but these losses generally occur in the novice stage of computer use before the user adopts various precautions like frequent saves and regular backups.

There is a well developed argument that the reason productivity increases have not shown up from increased computer use is that in a broad sense we are in the novice stage of computer use. We know that computers definitely make many things much easier but we haven’t discovered or incorporated all the changes needed to take full benefit of what computers can do. To use the word processing analogy, we are still learning to save frequently and make backups religiously.

A strongly related argument is that we are using computers to automate the old way of doing things rather than changing what we do to take advantage of the new opportunities provided by the computer. So, for instance, we have this wonderful tool that provides the virtual playgrounds described above yet we continue to march students from class to class every 45 minutes throughout the day so that they can be placed in traditional teacher-centric classrooms. In these classrooms most students adopt a relatively passive attitude and progress is determined by the pace and method set by the teacher. This pace and method may or may not be skillfully chosen but in either case the teacher must take into account the range of skill and interest exhibited by the students in the class. Inevitably with this type of teaching, the pace will be too slow or too fast for some, and the method will work better with some students’ learning styles than others. For those students out of sync with the pace or the method the learning experience becomes suffused with anxiety or boredom, or in the worst case, some perverse amalgamation of the two.

I am increasingly certain that until the tyranny of the schedule can be creatively “broken” the educational gains from using laptops will be much weaker than they would be otherwise. I’m also certain that schools will figure out ways to break free of their schedules over the next few years and that the ubiquitous presence of computers will be a necessary condition for this to happen. It is in the schools that make strong breaks with traditional practices, like Brewster Academy, that significant measurable performance improvements will start to appear.

B. The current laptop computer is not the ideal device

This is undoubtably true. However it is hard to see that the ideal device will be anything

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other than an evolution of current laptops. A large screen is needed. A general purpose computer that can run “regular” software is needed. A keyboard is a very efficient input device once touch typing is mastered. My guess is that the trackpad on laptops will become larger and pen input will be added through using a stylus on that surface. Otherwise I think movement toward an ideal device will involve shrinking size (limited to the screen dimensions) and weight, longer battery life, more rugged components, and improved screen resolution and brightness.

C. Much learning and many subjects work best by traditional methods

Critics of laptop programs often make the mistake of assuming that laptop use is meant to replace all other teaching and learning techniques and approaches. This is nonsense. New technologies rarely replace old technologies, they instead supplement them. In a time of HDTV and the Internet, per capita book sales are probably higher than they have ever been. Laptops simply add a new tool, albeit a very powerful one, to the existing inventory of pedagogical tools educators have at their disposal.

D. For students to learn they must take notes.

Given the data that is available about the very low retention and recall rates for information learned in traditional lecture based instruction, it amazes me when this old saw is trotted out. People seem to be able to remember and recite the lyrics of songs, extensive dialogs from movie and TV shows, and entire plots of books – all without putting pen to paper.

There are certainly subjects where it seems to be easier to record information on paper than it is on computers; basically any subject with complex symbolic formulas. When note taking is required in these subjects paper is probably a better choice than using a computer. The larger question is should students be spending large amounts of time taking notes on either paper or on a computer while passively listening to lectures? Probably not.

E. Laptops are too expensive.

Laptops are expensive and I would like the cost to drop. However, I would also like laptops that are lighter, more rugged, have a longer battery life, have larger hard drives, more RAM, and better screens. My guess is that the price of the laptop that schools recommend will gradually decline but only slowly because we will keep raising the bar on what we consider an ideal machine.

If it is taken as a given that the cost of an ideal laptop is not likely to drop rapidly then is the current laptop cost of around \$2500 a good investment? (Note: \$2500 includes 3

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years of warranty coverage, 3 years of insurance, and the basic software load.) Our assumption at RCDS is that the useful life of student laptops will be 3 years, so the cost per year works out to about \$850 a year. This does not include the cost of in-house technical support, which at RCDS works out to be about another \$250 a year, getting us to a figure of say \$1200 a year, or \$100 a month. In the New York metropolitan area \$100 will purchase somewhere between one and two hours of tutoring from a teacher. There are obviously an infinite number of ways \$100 a month could be spent on education. However, if the choice were between a computer that provides access 24x7x365 to all the productivity tools and virtual learning playgrounds described above, or 1 to 2 hours of tutoring a month, I think the computer in most cases works out to be a much better investment. If you add to this the fact that in the everyday use of their laptops students become very proficient with a tool which will be an essential partner for most of their lives, the investment looks even better.

F. Carrying laptops outside the school may be dangerous.

This is obviously a concern when students walk significant distances, or take public transportation, to and from the school. There are basically two ways to deal with this issue. One, teach the students not to be high profile targets. In other words, the laptops should be carried in luggage that doesn't telegraph the presence of the computer. Two, students should be educated to give up the laptop freely if someone tries to take it. That is one of the reasons you buy insurance.

G. Laptops provide too many distractions in the classroom.

Having laptops in the classroom presents the student with tempting new opportunities to lose focus. These "opportunities" provide significant new variations of old classroom management issues. Teachers have always had to deal with students passing notes, doodling, day dreaming, or simply staring out the window. The new computer based variations of these classic student activities involve AOL Instant Messaging, playing computer games, or surfing the Net. The one significant new aspect that we've been told about by students is the distracting nature of the screen content of other students' computers. If one student is playing a computer game then other students sitting behind may be distracted by the moving images on the game playing student's computer.

There are tactical and strategic solutions to classroom management issues with laptop enabled students. Tactical solutions involve practices like rearranging desks so that student screens are more visible, increased teacher movement around the classroom, having students put their screens down at certain times, and attunement to which students are paying attention. Strategic solutions involve changes in pedagogy, like decreasing the time spent lecturing and increasing the time students spend on projects.

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IV. Likely Future Issues

A. Network bandwidth

With increasing use of audio and video files network bandwidth will be subject to much “heavier” loads. Increasing use of computers also puts stress on all the other network components. File servers need to handle larger multimedia files and more frequent use for the backing up of files. Email servers need to handle larger volumes of messages, many with attachments. Web servers need to handle video and audio serving as well as traditional text and image files. Our routers and DHCP server are designed for certain loads and we are already seeing issues with the DHCP server running out of addresses during peak periods of use. All of these issues are solvable provided that enough resources are made available.

Our current wireless network bandwidth (802.11) is adequate for text and image files but starts to strain when used for transferring large audio and video files. If video streaming becomes popular this will put a further heavy load on the network. We will deal with these issues in the short term by taking a number of steps such as increasing the number of wireless cells in the network, encouraging the downloading of large files via 100 Mbit wired Ethernet, and discouraging frivolous downloading of large files. Over the long term wireless networks should move to new technologies which will provide more bandwidth.

B. Scheduling

I’ve already touched on scheduling above. This is a huge issue which I believe schools must revisit and rethink when they move to requiring laptops. Laptops provide the necessary infrastructure to break out of traditional scheduling and the promise of laptops won’t be fulfilled until schools take advantage of this new opportunity. As with other aspects of existing education practice, laptops don’t require that the existing scheduling practices be thrown out, rather they require the modification of those practices.

My current thinking is RCDS should start by pulling one day of our rotation cycle (we have a six day cycle) out of the schedule. On this day students would be relatively free to allocate their time to their studies as they see fit within reasonable constraints set by the school. In essence these days would provide time for students to spend extended periods in the virtual playgrounds discussed above. Academic disciplines could use this day for projects or labs that require extended time and students would have extended periods of time to really dig into projects of interest to them. Computer programs could easily be developed to coordinate, manage and track the available activities and the time students spend on those activities.

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If after an appropriate evaluation period the above scheduling change proved to be ineffective it would be very easy to simply return the day back to the old schedule. In the more likely case that the schedule change proved to be effective then the day would remain out of the schedule and additional days could be pulled based on an ongoing evaluation of the relative benefits of the scheduled day versus the unscheduled day.

C. Increasing computer inventory variety

The increasing variety of computer hardware and operating systems that we will need to support may become a significant issue. It is quite likely that next year we will be supporting computers running Mac OS 8.6, Mac OS 9, Mac OS X, Windows 98, Window ME, and Windows 2000. This actually sounds worse than it is because our tech support staff really needs to work with only a few parts of each of these operating systems and the operating systems themselves are designed to work in heterogeneous environments.

I often use the analogy of the car and car transportation systems to help people understand the scope of our laptop program. In order for the whole car based transportation system to work you need cars (laptops), roads (networks), destinations (programs, and files on servers), driver education (computer use courses), road and traffic planning (tech coordinators), ways to handle cars at destinations (teachers moving curriculum into computer based formats), cops enforcing traffic laws (administrators enforcing acceptable use policies), and repair facilities (tech centers). Car repair facilities are able to handle a wide variety of models and model years. Computer repair facilities will develop the capabilities to handle a variety of computers and operating systems.

Schools do have an advantage in that they can mandate to their students what computers and/or operating systems are required. This control can be used to limit the computer and operating system variety a school has to manage. My expectation is that in about a year and a half we will mandate that all student laptops must be running OS X or the current Microsoft consumer operating system. What I envision is periods where the variety grows (we are in one of those periods now) punctuated by periods when consolidation is required.

D. Blurring of school/world border.

A networked laptop computer, connected to the Internet, can perform the functions of a phone, a television, a CD player, a DVD-player, and a beeper. Students can be in touch with the outside world, while in school, in ways that we have yet to fully grasp. With current digital technology an innovative student can already share with the outside world

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what is going on in their classroom. Imagine the implications when large numbers of students have laptops with built-in video cameras. (Sony currently makes a laptop with this feature.) Parent observations of teachers will no longer be limited to the highly artificial once a year visiting day.

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Appendix A

What Implementing a Laptop Program Requires From the Information Technology Coordinator

I. Creation of infrastructure

- A. Network
- B. Repair facility
- C. Classroom furniture
- D. Electrical system

II. Purchasing decisions involving hundreds of thousands of dollars

- A. Laptop platform and brand and model
- B. Printers
- C. Insurance
- D. Networking hardware
- E. Servers
- F. Software choices

III. Supervising increased staff needed for technical support and professional development

IV. Education and training of faculty

- A. Creation / nurturing of learning culture and attitude
- B. Long term perspective as many faculty move slowly
- C. Many faculty have great anxiety about their own computer use let alone helping students with the use of their laptops
- D. Incentives of all kinds are needed (money, encouragement, acknowledgement, personal attention)
- E. Sharing information with peers at other schools implementing laptop programs

V. Teaching students how to care for and use their computers

- A. Creation of new courses
- B. Workshops
- C. How do you train a large population to use a new software tool when the population isn't meeting in a course?

VI. Dealing with Parents

- A. Almost daily contact with parents regarding computer issues

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- B. In some cases contact involving significant stress due to the value of the computer and/or frustrations that computers can cause
- C. Significant ongoing need to communicate with parents via letters home or articles in school publications