Techniques for Integrating Computers and Education

Planning, creating, and running an after school computer center for students.

An Interactive Qualifying Project Report

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Table of Contents

Abstract

Computers are beginning to play an important role in the education of American students. When trying to integrate computers into the existing educational system, there are a variety of approaches that may be taken. One such approach is to create a privately funded, public computer lab that is not part of a specific school. This paper looks at the issues involved in the planning, design and implementation of such a lab.

1.0 Introduction

1.1 A Brief History of Computers in Primary Education.

The use of computers as an educational tool for young children is a relatively new phenomenon in the American landscape. Computers first started appearing in schools in the late 1970s/early 1980s. These early microcomputers, usually an Apple II or Commodore PET, were the exclusive domain of those few students and faculty members with deep interests in either programming or math. It was not until 1982 when the Apple IIe arrived on the scene (complete with a huge price discount for schools) that computers became an accepted sight in both public and private schools.[1] Unfortunately, in the rush to get computers into the schools, very little attention was paid to *how* the computers would actually be used. Microcomputers were, at this point, a mystery to the general public and schools had very little idea what to do with them once they bought them. While "Educational" software was slowly becoming available, such titles were either in the vein of pure-text quiz type programs or "Edutainment" games such as "The Oregon Trail".

Little changed in the educational software market, aside from small advances in graphics and content, until the mid-Nineties. At this time, educational software suddenly began to make revolutionary leaps in quality. Gone were the clunky interfaces and limited selection of titles from earlier years. Suddenly the market was flooded with a wealth of high quality titles featuring beautiful graphics, solid lessons and engaging

interactivity. What caused such a sudden change over just a few short years? It was the convergence of three phenomena that brought about such an advance.

1.2 The Evolution of Educational Software.

The first phenomenon was the advance in PC hardware technology. It began with the introduction of the Pentium™ class processor. Home PC sales began to skyrocket thanks to ad blitzes by Intel and PC distributors such as Dell and Gateway. Americans became convinced that they simply could not live without a PC in the house. This heretofore unprecedented amount of power in a home computer, when coupled with new peripherals such as CD-ROM drives, 16-(and 32-)bit sound cards and powerful video cards capable of resolutions of 800x600 pixels and greater, gave developers the ability to add high resolution graphics and full-motion video to their products. No longer shackled by the storage requirements of floppy disks and with the ability to stream data quickly off compact disks, developers now had a ridiculously large amount of space to fill with as many lessons, high resolution pictures, and full-motion videos as their hearts desired.

The second phenomenon was the explosion of the Internet. Almost overnight the Internet went from being the personal toy of college students, scientists and hobbyists to an eagerly embraced part of the American culture. Email addresses began appearing on business cards. Web addresses went from being small print at the bottom of an advertisement to the main focus of the ad itself. William Gibson's "Cyberspace"

became a household term; and, in living rooms across the nation, the warbling screech of a modem connection became almost as common as the sound of the television.

The final phenomenon of the mid-Nineties was a stunning rise in the number of children being home schooled. Throughout the last decade, parents had become increasingly disillusioned with the public education system. A 1996 poll of homeschooling parents in Florida showed that "42 percent said that dissatisfaction with the public school environment (safety, drugs, adverse peer pressure) was their reason for establishing a home education program."[4] The number of children being homeschooled is estimated to have tripled in the years between 1990 and 1995 from 76,000 to just under a quarter of a million children.[2] The actual number of homeschooled children is considered to be much higher than the given figures since many states do not require parents to register a home-schooled child.

1.3 The Role of Independent Labs.

The educational software industry has invested great effort to evolve with the times. Much like the situation in the 1980s when microcomputers were first introduced to educators, many administrators and school boards are purchasing computers without any forethought on how they are going to be used [5]. In today's schools, computers are utilized one of two ways; either in a dispersed approach where one or two computers are placed in every classroom, or a centralized approach where a dedicated "computer lab" is created.

There are advantages and disadvantages to both approaches. The advantage of a dispersed strategy is that every class can be using a computer at the same time, without the need to share a common resource (and thus avoid scheduling conflicts). A disadvantage of this setup is that there is only one computer trying to serve the needs of an entire classroom. This removes the interactive element from all but the one person using it (usually the teacher) and turns the computer itself into just another projector or TV for the children to watch but not interact with.

The second approach, creating a dedicated lab, is great in that it allows many students to work on computers at the same time. However, the disadvantage of a dedicated lab is that it brings management problems. Dedicated labs require a level of funding, space, and expertise that are simply not feasible for the majority of schools.

For areas whose schools are either unable or unwilling to use either of these two approaches to computer labs, there is a third approach. An independently run, privately funded, public computer lab. The role of an independent lab is to act as an optional supplement to the standard education given in schools. The main purposes of such a lab are to provide children with help in subjects they're having trouble with, provide them with a means to gain in-depth knowledge in subjects they have specific interests in and to act as a resource center for projects and homework help. Independent labs have the advantage of being privately funded, either by corporations or individuals. This removes the financial stress from a specific school and places it with either a corporate entity or, in the case of a lab funded through private donations, the public at large. A second advantage of a public lab is that it can service the students of several different schools at the same time.

The disadvantage of public labs is that funding can be difficult to obtain. Private companies will not sponsor public projects unless they see it as a chance to eventually make a net gain. Private donations are similarly difficult to obtain, and the amount received can vary widely from year to year.

1.4 The Purpose of this Paper.

Each approach to using computers in education has distinct advantages and disadvantages. Depending on each area's specific circumstances, one approach may be preferable to the others. This paper is intended for those who feel that an independently run, public computer lab may be the best solution. It will present the issues and steps involved in planning, designing, and implementing such a lab. The purpose of this is to help the reader make an informed decision as to what approach is best for their circumstances.

The paper itself is divided into two main sections; "Pre-site Preparation" and "On-site Planning". I have tried to keep this paper as general as possible when it comes to working around certain problems. Everyone's situation is different and what works for one person may not work for another. However, in order to illustrate certain points, I will draw upon examples from my own personal experience in creating such a lab.

2.0 Pre-site Preparation

2.1 Introduction.

Before jumping in and actually putting a lab together, there is a great deal of work to be done. This work, which I have dubbed "Pre-Site Preparation", centers heavily on information gathering and research. This is the initial planning stage of the project. There are a lot of variables that go into planning a lab like this and the sooner the information can be gathered, the more complete the design will be. It is important that the initial planning be as complete as possible and not rushed through. Putting extra effort into this stage of the project can save an immense amount of time and frustration later on. The majority of the information that will be needed comes directly from the project director.

It is important to define two key terms: the project director and the sponsoring entity. The "project director" is defined as the person (or committee of persons) in charge of the project as a whole and is generally an employee of the sponsoring entity. The "sponsoring entity", referred to from now on simply as the "sponsor", can be anything from a large corporation to a small community group. The sponsor will be the source of the money and other resources used in the creation of the lab. The sponsor is, in essence, the one footing the bill.

The director plays two important roles in the life of the project. First, and most importantly, he or she has the final say in all executive decisions. These can be decisions concerning the budget, the scheduling, or anything else having a major impact

on the lab as a whole. Secondly, the director will generally act as a liaison between the lab coordinator and the other members of the sponsor.

The lab coordinator's first goal should be to schedule a few meetings with the project director. If all goes well only one or two meetings should be necessary to obtain all the initial design information needed.

2.2 Defining the Project's Scope.

The "scope" of the project is a way of defining just what it is that the lab is supposed to accomplish. The goals need to be clearly defined before the construction of the lab begins. The design of the lab should contain as much specific detail as possible. Below are some sample questions to go over with the director that will help define the purpose of the lab.

Who will be the main users of the lab? Is the sponsor aiming at a specific age group or grade level? Do they want this to be a general education lab for everyone or would they rather focus specifically on helping students with learning disabilities? Is there another way of grouping the target audience? In my case, my sponsor was a local "Youth for Christ" organization that was having the lab created as a resource for those students who were already a part of the organization. Because of the sponsor's location (downtown Schenectady, NY) this meant the lab's primary targets were public middle school students from low-income families.

How big is the lab going to be? How many students can it accommodate at once? Are the students going to be working independently (one student per computer) or will they be working in small groups? At first the idea of small groups may seem like a good one. It allows the students to learn group ethics while maximizing the number of students that can be in the lab at once. However, in a group only one student can actually use the computer at a time. This causes the other group members to lose the interactivity that is so paramount to the computer experience.

Another thing to think about is whether or not the lab computers should have access to the Internet. My director and I struggled with this for while before we decided that no, it was a bad idea. Our reasoning was that while Internet access held a great potential to help teach the students about computers and technology in general, we decided that the primary purpose of our lab was to help supplement the students' general education (reading, math, science, etc.) and that exposure to new technology was secondary. Also, we felt that there was simply too much potential for abuse and distraction with the age group we were dealing with.

2.3 Developing a Budget.

Once the scope of the lab has been clearly defined, it is time to move on to discussing the budget. What kind of budget is allocated to the lab with will depend a great deal on who the sponsor is. If a large company or corporation is sponsoring the lab it means the project will be privately funded. The entire budget will be coming from that

one company. One the other hand, if the sponsor is a non-profit organization, the lab will be publicly funded since all the organization's cash will be coming from donations. The budget should divide it into two main parts: the initial set up cost and the ongoing cost to run the lab.

The initial setup cost is going to have to cover the purchase of hardware (the computers themselves), software, peripherals such as keyboards and mice, furniture such as chairs and desks or tables, and sundry equipment such as surge protectors and extension cords. If the lab is going to be wired for Internet access, add in the cost of network cable, network cards, hubs, the cost of a dedicated host machine and the initial installation of the data line.

The ongoing cost of the lab is what the lab is going to cost over a long period of time to stay running. This could vary greatly depending on the actual setup of the lab. If the lab is being built in a satellite location not directly owned by the sponsor, there will be rental costs to deal with. Also, the cost of electricity used by larger labs can be considerable. If the director elected to install an Internet connection, there is the monthly cost of that added in as well. Another thing to think about is who is going to actually be there with the students while the lab is in session. Depending on how the sponsor wants it set up, there may be salary expenses incurred. Also keep in mind the possible need to update the software library on a semi-regular basis. As regular lab attendees begin to complete all the lessons offered by the software originally purchased, the sponsor will need to update the lab's library of available titles in order to keep the students' interest.

2.4 Allocating Initial Resources.

A great way to save on budget expenses is to look at what resources are available to the sponsor at the start of the project. Find out from the director what is available for use in the lab.

One of the biggest initial resources is a location for the lab. If the sponsor has already set aside a place for the lab, it will have to be examined to determine if it is suitable. Is it big enough to comfortably accommodate the number of computers and students the sponsor is trying to attract? If not, they will be faced with the choice of abandoning the site and trying to find a new location (and incurring the possible expenses and time needed to do that) or scaling down the size of the lab itself to fit the location.

Are there enough outlets to power a lab this size? It is not just the number of outlets that is important, but their placement as well. If the location was wired for electricity a long time ago, it may need to be inspected by a certified electrician to determine if the electrical lines can handle the amount of power that will be drawn.

If an Internet connection is to be installed, is the location in the coverage area of a local provider? This will depend a great deal on what kind of access is being installed. If the lab is going to use a simple modem, all that is needed is a working phone line. DSL (Digital Subscriber Line) service, which can be 50 to 100 times faster than a standard modem, uses standard phone lines as well, but requires the site to be within a specific distance from the provider. Cable modems, which have become very popular recently, do not require the use of a phone line but instead transmit data over the standard coaxial

cable used by the television cable companies. If the location is wired for basic cable, it should be all set, assuming the local cable company offers high-speed Internet access.

Something else to keep in mind is the lab's location with respect to local schools. The closer it is to the schools the sponsor is targeting, the more likely students will make the effort to attend lab sessions.

Another initial resource, aside from the location used for the lab, is the computer equipment that is available for use in the lab. Depending on the sponsor, the equipment could come from different places. If the sponsor is a large company, chances are it may have old computers from when it last updated its systems. If these systems are suitable for the lab, the sponsor can save itself the expense of purchasing all new systems. If the sponsor happens to be a non-profit organization, it has a great opportunity to get free equipment. Because it is non-profit, any company or corporation that donates equipment can use that donation as a tax write-off. This is a great chance to stock up on high quality used computers from larger companies looking to get rid of older equipment. Another avenue to explore is to seek out private donations. Half of the computers used in the lab I built were private donations from individuals and small businesses. Contacting local radio stations or newspapers is a great way to get the word out to the public about the opportunity to donate equipment.

2.5 Setting Up Secondary Contacts.

Once the initial planning is finished, the lab coordinator should set up secondary contacts. These contacts are people both external and internal to the sponsoring organization who can aid the coordinator in the planning or set up of the lab.

A good example of a secondary contact is a local principal. When I spoke with my director I was informed that the majority of students who were going to be using the lab would be coming from the same middle school. When it was time for me to choose the software for the lab I decided to contact the principal and get course outlines from all the teachers at that school. This helped me decide which software would best cover the subjects they were learning. Unfortunately, contacting the principal and having him return my calls with the information I needed took almost a week and a half. All that time could have been saved if I had contacted him at the beginning of the project, when I was still working on other things, instead of waiting until I needed him and assuming it would only take a day or two.

3.0 On-Site Planning

3.1 Introduction.

Now that the preliminary details have been hammered out, it's time to decide on what kind of equipment to obtain for the lab. This is when the specifics of the hardware, software, and peripheral equipment such as furniture are decided upon. The order in which this equipment is chosen is largely dependant on individual circumstances. If, for instance, all the lab's computers were already obtained through donation, then the software will be purchased based on what is compatible with those systems. If the sponsor happens to be an educational software company, they will most likely be using their own software exclusively and can choose the hardware based on their software's requirements.

If the coordinator is in a position where there are no constraints on choosing either the software or the hardware, I strongly suggest that software titles be decided upon first. Afterwards, the hardware can be modeled around the requirements of the programs chosen. If hardware is purchased first, it will be limit the range of software titles to what can run on the computers just bought. Another possible case is one where the sponsor purchases computers that are so powerful they can run anything, but because of the software eventually picked only a fraction of that power was actually needed and the sponsor ends up wasting money on power it didn't need. All in all, if the option is available, plan the hardware around the software.

Why is it so important that the software be chosen first? The main purpose of a lab such as this is to aid students with their schoolwork. This is accomplished by the students interacting directly with the software offered. The computers themselves are simply tools to run the software. Computers themselves have no innate ability to teach. Thus, it doesn't matter what *kind* of hardware is used, so long as it runs the desired programs well. Let us take a look at some of the specifics of deciding on what software to invest in.

3.2 Choosing Software.

Which software is used in the lab will be the most important decision made concerning the lab. Before the coordinator starts looking at titles, find out as much as possible about the curriculum of the students that the lab will be helping. Start by finding out which schools the majority of the target students attend. By making contact with the principals of those schools and requesting course outlines, the coordinator should be able to get a general idea of what subjects to look for in the software.

There are generally two types of software available, general education titles that cover a wide range of subjects at a certain grade level, and subject specific titles that go in-depth in only one or two related topics. To build a lab that will be fun and interesting to students, a great deal of variety will be needed. Educational software can run the gamut from formalized question and answer lessons to game show competitions to arcade style games. Which style of software is best for a lab is dependent on the goal of the lab.

If the purpose of the lab is to entertain students while at the same time helping them learn, the more arcade style programs will work better that keeping their interests. If the lab is meant more for purely educational purposes, the more formalized software will be a better choice.

When researching what titles to invest in, an important resource is the Internet. There is a wealth of sites available that offer reviews, rankings, and descriptions of just about every educational software title on the market. The best way to find these sites is to do searches on the more popular portals (such as yahoo.com and altavista.com). There is also a small list of sites in the appendix at the end of this paper.

When it comes time to actually order the software, there are advantages to both local purchasing and Internet purchasing. If the sponsor is concerned about support issues, it is best to purchase the titles from a local shop. Purchasing from a local retailer makes returns and customer support much easier, but may limit the selection of available titles.

When purchasing software, consider purchasing more than one copy of each title. Software licensees only allow one copy of a program to be run at once. If the goal of the lab is to allow each student to choose which software they use, having several copies of each program allows the lab to better accommodate the needs of students who all want to use the same program. However, this can greatly increase the amount of money that will need to be budgeted to software purchasing.

3.3 Choosing Hardware.

Before the software programs can be used, the lab will need computers to run them on. Regardless of whether the machines are being purchased or donated, it is critical to have a solid understanding of what the minimum requirements of these machines should be. Deciding on a set of minimum requirements is easy if the software library has already been picked out. Each title will have a set of minimum and recommended hardware requirements right on the box. The best course of action in this case is to obtain hardware that is slightly more powerful than what is outlined in the recommended requirements. This is because software companies are known to set their requirements lower than they should be in order to cover a broader range of customers. If, for whatever reason, the software could not be obtained first I will provide what I consider to be the best all around computer setup.

Please note that the following outline is based on a PC machine meant to run a Windows™ operating system. When planning my lab, I decided to use PCs instead of Apple brand computers. This decision was based on four factors. First, I have much more personal experience with custom PCs, and was therefore more comfortable working with them. Second, PCs have a much larger range of available software, giving me more choices in what titles to purchase. Third, PCs hold a vastly greater market share than Apple. Since all our computers were going to be donated, I had a better chance of finding suitable PCs that were available for donation. Finally, because PC components are not proprietary like Apple computers, I had an easier time upgrading various components to fit my needs.

There are six main computer components that I will cover here. These are the six parts that will have the greatest impact on how well a computer performs. They also have the largest range of available options, and can be the most difficult to decide upon.

Central Processing Unit: This is the 'brain' of the computer. The CPU is the chip that powers everything the computer does. The best option is to try to find an early Pentium™ II style chip. The slowest speed these chips can be had at is 300mhz. These chips will provide *more* than enough processing power to run today's educational titles while at the same time being far enough behind the technology curve that they will be quite inexpensive.

CD-ROM Drive: The CD-ROM drive is required to read the compact disks that today's software is stored on. While a simple 24x speed CD-ROM drive would be more than fast enough for the lab's purpose, it is almost impossible to find hardware that old. 32x speed drives are still commonly available and can be easily bought for under $40.

Hard Disk Drive: The Hard Disk Drive (or simply hard drive) is what is used to store files and data directly on the computer. Because the majority of titles on the market run directly off the CD, programs need very little hard drive space. I would suggest the *minimum* size to invest in is two gigabytes in size. This will provide ample room for both the operating system and whatever software is to be installed.

Floppy Disk Drive: There is not much to say here except make sure the computers have 3¼ inch floppy drives. While they will not be used often, they are very useful when they *are* needed. Floppy drive technology has stood unchanged for a long time, so any brand of drive should be fine.

Sound Card: The big choice here is between 16-bit cards and 32-bit cards. Which kind of card is best is largely dependent on how much the sponsor wants to spend. The audio difference between the cards, while not huge, is definitely noticeable. I was able to find 16-bit cards for around $25 each and 32-bit cards for around twice that. If the software to be used is heavily sound dependent (such as a music history program), I would suggest spending the extra money on the 32-bit card. Otherwise, it is largely dependant on budget constraints. Also, avoid purchasing speakers for the sound cards. Having fifteen or twenty speakers going at once in a small space can be very distracting. Headphones are a much better choice and are generally much less expensive.

Video Cards and Monitors: The minimum resolution the computers should be able to achieve is 800x600 pixels. Ideally, they should be able to go as high as 1280x1024 pixels. Classically, most titles only require a resolution of 640x480 to run, but more and more are starting to take advantage of higher resolutions. The monitors themselves should not be larger than fifteen inches diagonal. By keeping the monitors small, more computers will fit into a smaller space while also keeping the cost down.

If the hardware is to be purchased and not donated, the sponsor can either purchase all the parts separately and assemble them or buy them custom built. Which approach is taken will depend largely on how much time can be dedicated to the process (assembling computers can be very time consuming) and how comfortable the sponsor is with the process. Either way, everything should be purchased from local computer shops. Because of the finicky nature of computer hardware, it is invaluable to have local customer support in case something goes wrong. Mail ordering or Internet purchasing may save money, but leaves much to be desired when it comes to support.

3.4 Getting the Word Out.

Once all the computers are up and running and the software installed, it is time to open the lab to the students. Before that can be done, the sponsor will need to advertise the lab to its target audience. If the sponsor is a non-profit organization, it should have a large mailing list of donors who receive regular newsletters. This is a great place to start.

From there, find out how to get in touch with local radio or TV news stations. Try and put together a short public service announcement or arrange for a quick interview or call-in to plug the lab. Newspapers are also an avenue to look into. If the sponsor is a company or corporation, chances are they already have an official press release ready to send out.

Something else to do is to get in touch with those principals who put together the course outlines. Ask them to make an announcement to the student body about the lab.

Also, ask them to send letters home to the students' parents informing them of the lab's existence.

Whoever the sponsor happens to be, there is a good chance they will have someone in charge of public relations. This person can help get in touch with everyone needed to get the word out.

Post-Project Impressions

However comprehensive the planning and design of a lab, only time and use can tell if it is a success. In order to determine if the lab I created was successful or not, I contacted the project director and requested he give me his impressions on how well the lab operates, as well as what he felt was done right and what needed improvement. This survey was conducted six months after the lab was completed in the fall of 2000.

What went right:

There were many aspects of the computer lab that the sponsor felt went well. Their response showed that seeking donations of equipment from the local population worked well and that the equipment obtained was well suited to the lab's needs. When asked about the software chosen for use in the lab, the director replied that they were very happy with the results. They claimed that the software chosen was well suited for the educational needs of their demographic target and was enjoyed by the students who used it. The sponsor also noted that they felt no need to purchase more software at the present time.

What needed improvement:

The biggest problem with the lab was the location. While it was not excessively far from the targeted school, the distance became a problem when winter set in. While many students were willing to make the trip during late fall, winter is a very different situation. The director reported that very few (if any) students were willing to walk to the

lab's location in the cold temperatures. While they are hopeful that attendance will rise again in the spring, there are currently plans underway to move the lab closer to the schools themselves.

A second aspect of the lab that needs improvement is having a part-time staff member on hand specifically to administrate the lab and work with the students. Before, volunteers who had experience working with the students ran the lab. But as equipment and system problems began to occur, it was clear that someone with computer expertise would be needed to help keep everything running smoothly.

General Observations:

The general impression of the sponsor was that the lab, while nowhere near perfect, is an excellent foundation for future growth. By setting the groundwork for the lab and showing that it works on a small scale, the sponsor was able to expose the lab to the public in a positive manner. This will allow them to effectively garner the funds and volunteer help needed to extend the lab to meet and exceed the original vision of the sponsor.

Conclusion

Computers are playing an ever-larger role in the lives of Americans. They have become ubiquitous in both the home and workplace. One place where computers have made a large impact is in schools. Integrating computers with education is a very difficult thing to do. There are many different approaches to using computers in school, each with distinct advantages and disadvantages. Many schools are wrestling with these different approaches, trying to find what is best for their specific needs. The approach presented here, that of an independent, privately funded, public lab is well suited to areas where the local schools are either lacking the budget and/or expertise to develop labs or the community at large would prefer a single lab to serve the needs of several schools.

When developing an independent lab such as this, there are many issues that must be considered. Who the intended audience is will play a large role in the design of the lab. It will directly impact what kinds of software are to be used, and thus what level of hardware is required. How the lab is to be funded also plays a large role in the overall design. If the lab is to be created based on donations of equipment, the range of software that will be available will be controlled by how powerful the equipment you receive is. Of great importance is the location of the lab. If the lab is located too far from the targeted students, they will be less likely to use it. This becomes especially important when taking the effect of different seasons into consideration.

Regardless of the approach chosen, the computers are only teaching tools, much like a chalkboard, and are only as good as the teacher using them with the students.

Having a teacher or mentor on hand to help and guide the students is critically important to the success of the lab and well being of the student's education.

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http://www.cato.org/pubs/pas/pa-294.html

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http://www.edc.org/LNT/news/Issue14/feature1.htm

Appendix

A short list of Internet web sites offering reviews of educational software:

Children's Software Review:
http://www2.childrenssoftware.com/childrenssoftware/

Learningware Reviews:
http://www.learningwarereviews.com/

Superkids Educational Software Review:
http://www.superkids.com/

The Review Zone:
http://www.thereviewzone.com/