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CHARTER SCHOOL NETWORK

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by

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1. school
2. network
3. internet

0.1. Abstract

This project consisted of consulting with the Breakthrough Charter Elementary School located West Hartford, Connecticut. We discovered, documented, and produced the process necessary to bring an elementary school onto the Internet in the 21st century. This endeavor included producing a design for a network infrastructure for the school, providing a recommendation on software, both educational and content filtering, creation of a maintainable web site for the school, and recommendations on future project plans to enhance the students' Internet experience.

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1. Introduction

For many students worldwide, the Internet has become as indispensable as the public library for conducting research, according to new data released by the Angus Reid Group [1]. The study, which polled 10,000 youths, ages 12-24 in 16 countries, found that Sweden and Canada have the largest percentage of students who surf the Web at their schools. About 3 out of 4 students in these countries have used the Web during the school day.

Those figures are quite different from corresponding ones for American youths. Although most U.S. schools offer Internet access either in the classroom or in some other instructional facility, only 59 percent of U.S. youths said they surf the Web at school. Most young Americans, 68 percent to be precise, say they go online at home. Further, only half of the nation's libraries have access. In response to these statistics and those like them, Congress brought forward a goal last year of connecting every US classroom to the Internet. To meet this goal, the government has agreed to set up subsidies to help schools pay for the implementation and upkeep of their individual networks.

Schools in urban China appear to be addressing a deficiency in this area, as well. More than half of the students in these areas say their schools offer some type of course instruction related to the Internet. Taiwan is the leader in Internet-course instruction among the countries studied, with 75 percent of students saying their schools teach about the Net. By comparison, 72 percent of U.S. students say their schools offer similar curriculum.

Regardless of whether they go online at school, home, or both, students worldwide are utilizing the Internet for school-related research. According to Angus

Reid, 9 out of 10 students in Australia, the U.S., Canada, and Sweden go online to perform class-related research. In fact, more than two-thirds of the students in 15 of the 16 countries studied say they have used the web for research and to complete school projects.

As interest in bringing the Internet to the classroom grows worldwide, stories like the following will continue to crop up every day: consider Greenwood Elementary in Plymouth, a suburb west of Minneapolis, where years ago stood a farm and now there is a school with 673 students, broad playing fields out back, and in the media center, formerly known as the library, 31 new special-edition iMacs [2]. With merely this roomful of iMacs, Greenwood is in the vanguard of schools bringing computers into the classroom and putting students on the Internet. Driven by politics and unprecedented levels of funding, Greenwood and other schools across the country are hoping to integrate the web into everything they do. Similarly, a host of companies are hoping to ride the Internet into schools. According to Quality Education Data, $6.7 billion was spent wiring classrooms in the 1998-1999 school year, up 25 percent from the year before.

What is most remarkable about the presence of the Internet in schools is how flagrantly experimental it all is. There is no proven pedagogy for incorporating the Internet into the classroom, and yet school districts are falling over themselves to do just that. All of this prompts one very big question: What does this all mean to the children?

2. Background

With the widespread increasing usage of the Internet in everyday life, the setup of local area network networks in schools and their incorporation into Internet connections allow for improved communication and an enhanced educational experience between classrooms, teachers, and students. The use of email and other electronics collaboration tools can make organization of teaching materials and communication within class environments easier and faster, while cutting down on paper communication. Access to the web allows for easy search and retrieval of documents, images, and other media. Projects such as the Global Schoolhouse [3] allow classrooms all over the nation, and the world, to collaborate on projects and exchange electronic pen-pal mail.

With computers becoming a pervasive influence in modern life, it is important for all children, especially under-privileged children, to gain access to computers and computer networks, and to enjoy all the opportunities, educational and entertaining, that they present. However, for both the safety of the child and the supervising adults, that access must be monitored and controlled. We investigated several options for filtering and monitoring student access to certain areas of the web that may be unsuitable for children. Blocking software, filtering proxies, and filtering at the Internet gateway are three options that we explored as a part of this project.

In addition, we researched the actual impact of computers in the classroom, how computer networks are used, and if they are actually useful. There are many studies available now as to how computers affect the classroom, including federal studies by the Department of Education. We investigated what the best uses of the computer and the Internet are in grades K-12 classrooms, and how the students will benefit most by

constructively using their resources. In Section 5, entitled Software, we also provide a set of recommendations based on our findings for the best way that these resources could be implemented in a classroom environment to most benefit an elementary school.

3. Methodology

There are several key factors that were considered in our analysis of the network and software setup to be implemented at the Breakthrough Charter School. First, we worked with the administration to see which requested services would benefit both classes and faculty. This included discussing what role we would need to play in helping to bring this elementary school onto the Internet in the 21st century. Second, we also found that a major step in this process was the creation of a web site to get the school's message out for public viewing. Third, we researched software that might be useful for classroom education. Only after taking into account the current needs of the school system could we accurately design a network infrastructure that will meet their growing needs for the next five to ten years.

3.1 Current Setup

Currently, the Breakthrough Charter School possesses several desktop machines for administration use, including a single Dell desktop in the office. Finally, there is a PowerMac tower in the computer lab equipped with a scanner, digital camera, and video camera. Table 3.1 shows the complete hardware setup at the current time.

Computer	***Use***	***Quantity***
Imac	Classroom desktops	2-3 per classroom
Imac	Lab desktops	12 in use, 15 on order
Macintosh laptop	7th grade class laptops	20 in use

Figure 3.1: Current Hardware Setup of the Breakthrough Charter School

This makes for a total client count of 53 machines that will be hooked up to the network, not including several older machines that will not be connected.

All of the existing computers currently have Microsoft Works [4] installed, including Word and Excel [5]. The computer lab machines also have a small selection of

educational software, mostly shareware, including a typing tutor, math software, and others.

Currently, the main functionality that the administration is looking for is e-mail and web browsing with content filtering. E-mail will be useful to allow inter-classroom communication, as well as inter-school communication. Also, the representatives are looking to use the local area network to replace CD-ROM-based encyclopedias that are currently run on individual machines. The staff is also looking to host the school's web site on the Hartford Schools web server, and will require some web page creation software to maintain the web site. A centralized file server would be useful to make software distribution easier, as well as centralize file storage and backup.

3.2 Analysis

We began conducting background research on the current state of the Breakthrough Charter School's computer setup by collecting data on what the school possessed and what was still needed to produce a functional network infrastructure design. We also discussed the requirements that the representatives presented us with for their Internet computing needs. This included their needs for client software and a design for a web site to represent their school. Furthermore, we surveyed the school for space requirements, and built a requirements list that would stay within the $15,000 school technology budget.

The city of Hartford is currently in the process of wiring the charter school with Ethernet. The Hartford school system will be providing an Internet connection to the Breakthrough Charter School through their private network. The timeline for their

Internet connection looks to be within the next six months to a year, and the Hartford school department is currently setting a finalized schedule.

3.3 Design

After completing our analysis of the current computer system setup at the Breakthrough Charter School, we began our design phase. We took into account all of the above factors, including available budget in designing a cost-effective network environment for the school to carry out its computer usage. This included all the necessary network and client software, infrastructure consisting of servers, client educational and entertainment software, client-side content filtering software, web site design and construction, and future project goals. In our analysis, we investigated how to obtain the best possible products for the most reasonable cost, while still taking into account their feasibility.

4. Network Implementation

As the network in the Breakthrough Charter School nears completion, with the internal wiring finished and the Internet connection in the process of being brought online, there are many more design decisions that need to be made and justified. Further, a look at the current setup and recommendations for networking projects must be researched and presented to allow for a more fully developed Internet experience as the Breakthrough Charter School proceeds ahead in the 21st century.

4.1 Internet Connection

The Internet connection that the Breakthrough Charter School will be using is provided by the city of Hartford's IT Department. The connection itself is a full T1 and will allow a connection between the school and the rest of the world, through the Hartford schools department, at 1.554 Mb/s. The line itself runs from the Breakthrough Charter School to the school department building in the city of Hartford, where it is connected to a network consisting of the other schools in the district, before being routed out to the internet.

A proxy server will be used for the purpose of concealing the network used by the entire school district behind a single Internet address via Network Address Translation, or NAT [6]. This is implemented as a security measure to protect the various networks within the school system from outside attacks. The proxy server in use does not currently use content filtering software for HTTP requests, and until that is implemented, we will be recommending a software package for the Breakthrough Charter School to install on its client machines for accomplishing that task.

4.2 Local Network

Wiring of the current Breakthrough Charter School location was completed this past March, of 2001. The wiring job consisted of CAT5 Ethernet wiring throughout the school. No less than 3 drops, each consisting of 2 ports, have been placed in each classroom and office area within the building. Each of these drops is backed by a 3com 10/100 mbps Ethernet switch, located in a central closet in the school, along with the routing equipment.

For the client machines, each is using an IP in the 192.168.0.0 range, with the netmask 255.255.255.0. This is a class A group of IPs that has been delegated for use by private networks [6]. In this case, the first zero is being replaced by the number representative of a particular school in the Hartford school system, and the second zero being replaced by the actual address of the client computer. These system settings for IP, netmask, and DNS entries are all allocated automatically by servers in the school department. Each client desktop in the lab and classrooms, consisting of iMacs, is already equipped with a 10/100 mbps Ethernet card, and are already connected to the network. The laptops in use by the 7^{th} grade class are neither connected to the network, nor are there plans to do so, as these are older Macintosh laptops and will not require network connections for their intended use.

4.3 Services

While the Breakthrough Charter School network will contain its own router for their T1 connection, all of the current services that have been implemented for the local network are run and maintained in the central server hub in the Hartford school department building. The services that are currently available to faculty and students

include web browsing via HTTP queries through a proxy server, FTP access both through the proxy server and to personal accounts on the hartfordschools.org web site, SMTP mail with POP3 retrieval, and educational client software stored on shared servers. The Hartford IT department also runs DNS and DHCP services, but because they are not accessed directly at the application level, they are transparent to users in most circumstances.

4.4 Recommendations

While the current setup of the local area network in the Breakthrough Charter School is satisfactory for most needs, there are many areas that offer great room for improvement. These recommendations have been made such that we feel would improve the network on a level that even students and faculty of an elementary school would appreciate the differences.

The first area that needs improvement is the structuring of the services employed by the Hartford IT department. While it is true that some services can be left running remotely, such as access to mail, DNS, and DHCP, there are some that should be located locally for each school. A Macintosh server should be made available within the charter school to serve educational software titles for the client Macintosh machines. As the current situation rests, the software is being housed offsite, and using only 1.554 mbps to run software remotely across a network will lead to greater wait times and less productivity among students. Adding a software server to the local 10/100 mbps network would greatly improve the speed and reliability of client software titles, as well as allow for easy upgrading and additions of titles by the charter school staff.

The next area of improvement is the current availability of the Internet through the proxy server, which is located offsite in the Hartford public schools department. The current setup of the proxy server allows HTTP and FTP requests through to the outside world. This should be sufficient for most uses within a classroom environment. However, to allow for greater control over a growing network of the future, server-side content filtering is needed on the proxy server. At the current time, the only thing in place to prevent a student from accessing material that might be inappropriate is the Acceptable Use Policy, provided by the Hartford schools department. While this idea might be nice in theory, it is not practical and certainly is not going to keep small children from finding any amount of inappropriate material on the Internet. In the meantime, we will be making a recommendation on filtering software to be placed on each of the client desktops in the Breakthrough Charter School. Regardless of current actions that can be taken to alleviate this problem, in the future a server-side implementation will need to be set up. This will also make the transition of equipment between schools and new equipment that is included when adding schools to the school network much easier.

The final area of improvement that we recommend for this network is a centralized messaging system outside the confines of email, with which teachers can communicate with students and parents alike. The school currently uses a discussion board system called Copernicus [7] to allow certain classes to set up message boards on their web page. Copernicus is not fully utilized by the faculty, and many do not even know about it. One option for improvement, though it might be difficult to maintain, would be to set up an NNTP news server for the school system to access internally. This would allow anyone in the school system to post to any number of discussion groups with

or without moderation. Another more plausible option would be to find a new message system, or use an updated version of Copernicus, and encourage its use in a more widespread environment on the Hartford schools web site. This would allow access from both the local network at the Breakthrough Charter School and the Internet at large.

5. Software

5.1 Educational Software

Through our research, we discovered that educational software falls into a variety of categories. First, there are the traditional, pure educational titles that attempt to teach any of a variety of subjects. There are also the *edutainment* titles that attempt to teach through entertainment. Both types typically fall under one of the basic educational categories: Math, Science, Reading, Writing, and Reference. There are a number of educational software review sites on the web, several of which were consulted when creating this list, including The SuperKids Educational site [8] and the School House Software Reviews [9] site.

The first category of titles we researched is math software. There are many math education software titles out there for the elementary school level. Mind Twister Math [10] is geared towards elementary school aged kids, and received an excellent review from SuperKids. JumpStart Math for Kindergartners [11] is for younger children, aged four to six. This program includes many activities, songs and toys to provide kids with opportunities to learn basic math facts. Mathville VIP [12] is intended for ages 11 and up, and allows middle school and high school students to practice everyday math skills in real-life activities.

The next category of software is science software. This covers a wide range of software, covering all of the sciences. Nature Virtual Serengeti [13] is based on the Nature public television series, and is filled with information on the animals and lands of the Serengeti Plain in Africa. Surf Into Science 3 [14] covers energy, environment, earth, and weather in a narrated science book style. It is not recommended for those with short

attention spans. I Love Science [15] is set three locales and features virtual hosts who enthusiastically share their favorite science facts and concepts with their audience. Kids can participate in 'hands-on' learning through experimentation, and view in-depth text and interesting factoids for each subject.

Reading software is a great way to help younger kids get interested in reading and improving their skills. Reading Blaster [16] is geared towards ages 7-8, and combines arcade-like fun with a variety of reading drills. It is not wildly unique, nor is it enormously appealing, but is an enjoyable way to help kids solidify their skills. Reader Rabbit's Complete Learn to Read System [17] is for ages 3 to 7. This software package actually teaches reading skills from letter recognition and letter sounds to phonics, words, sentences, and eventually reading comprehension. It features excellent graphics, animation, and child-capturing storyline. The system requires parent/caregiver involvement, and is not recommended as a virtual babysitter.

Writing software to help children improve their writing skills as well as familiarize them with word processing on a computer is an excellent tool. Inspiration Version 6 [18] helps kids organize their thoughts using visual aids and diagrams, create their outlines, and then write their papers.

Reference software is another must have for school computers – students are going to need to access encyclopedias, dictionaries, and other references for their schoolwork. The Ultimate Children's Encyclopedia [19] is an excellent resource, and provides all kinds of information useful to elementary school aged children. Geared specifically towards ages 7-12, it includes an encyclopedia, dictionary, atlas, and thesaurus.

In conclusion, the primary considerations when selecting educational software are educational value, price, and the primary uses of the computer in the classroom. Most school systems do not have the funds necessary to purchase all the excellent titles that are available, especially when they are required to buy a license for each of the computers in the school. However, we feel that when funds are available, especially when they are required to buy a license for each of the computers in the school. However, we feel that when funds are available, reference software is essential, and the Ultimate Children's Encyclopedia is a great choice to fill this need. Also, word processing, and writing assistance program are needed as writing is an essential tool for the children's future.

5.2 Content Filtering Software

Providing an Internet connection to children of various ages in a school environment brings with it many concerns. Will the children be "protected" from the variety of material on the Internet? The truth of the matter is that while the Internet provides a huge amount of material for research, collaboration, and other useful functions for education, there is plenty of material unsuitable for children. Providing a filtering mechanism that denies access to these materials while allowing access to vital, educational material is a difficult task.

Current methods of filtering come in two primary forms. The client-based filter runs on the local machine, filtering material, often by URL (based on a database of 'unsuitable' web sites), or possibly targeting certain words, including profanity, and other keywords. Server-based proxy filtering resides on a gateway, or proxy server, between the client machines and the Internet. This provides a centralized point to filter all material passing in and out of the internal network.

Content filtering is a very controversial issue among school administrators, librarians, and other institutions that want to provide widely available Internet access to students and patrons while ensuring that children are not allowed to gain access to inappropriate material. The definition of what constitutes inappropriate material is just as controversial a question as to how to go about filtering that content. Most software available relies, at least as a base method, on a database of websites and other resources, which can be considered inappropriate. Often these sites are categorized, to allow the administrator to select which material should be denied (i.e., sexual material, adult material, pornographic images/text, violent material, etc.). This can be supplemented by some form of scanning software to scan web pages for suspect material which then can be used to deny access to the file, or perhaps simply display the file with those words removed, or marked out, but none of these methods are completely reliable.

There are many different software packages available for both methods. Client-based filtering suffers due to the poor support of alternate platforms (i.e., clients besides Windows 9x/NT). While the Mac platform is supported by many of the larger filtering packages, the list is restricted. However, server-based solutions usually requires a firewall to ensure proper use of the filtering proxy, which could present a problem if the firewall was not local to the network.

5.2.1 Client-based Solutions for Macs

Client based filtering relies on software installed on each client machine to provide Internet content filtering. This, of course, requires the system administrator to install the software on every machine in use. CyberPatrol [20], a very popular filtering

program, is available on a variety of platforms, and is now part of the SurfControl [21] suite of filtering products, available both as a client-based and server-based solution.

5.2.2 Server-based Solutions

Server-based filtering is less common than client based. This filtering is most often implemented by an Internet Service Provider as an optional service for the end user. However, in LAN environments, this is usually implemented at the gateway. The primary advantage to this method is ease of administration. The system administrator only has to install the software on the gateway, and all of the machines on the network are instantly using the filtering software. Server side solutions can also rely on proxy servers if a firewall is in use. Remote-proxies are now popular where the client is configured to use some remote provider.

Server side solutions can be relatively easy to defeat however on the client side. This method also requires that each client be configured to use the remote proxy. The main disadvantage of server side filtering is the additional requirements of the gateway, or the addition of a separate proxy server. In addition, while the larger filtering software companies offer server-side solutions, less selection is available than client based solutions. A very popular package is Bess, from N2H2 [22]. While their primary package is client based, they do offer a proxy server for NT and Novell. NetFilter Technologies offers the Library Safe Internet System, a proxy server for Unix and NT. SurfWatch, another large and popular package, is available in client or server form. X-Stop [23] is now available as a proxy server for NT servers only.

One of the most popular packages available, N2H2's Bess, provides very complete proxy package, which utilizes N2H2's extensive database, human review, and

automated filtering software based on artificial intelligence. They offer packages for Microsoft ISA Server 2000, Novell Internet Caching System (ICS), a proprietary network appliance, a redirect internet filtering service, and a complete school package, customized for schools (including N2H2's school resource website). There are 40 categories available to filter by (Adult, Alcohol, Drugs, Illegal, etc.), and Bess can filter by keywords, in the URL and in the website itself, and block search engine results.

The other large, popular tool for Internet filtering comes from CyberPatrol (now merged with SurfWatch). They offer proxy packages for Microsoft Proxy Server, and Novell Border Manager, as well as a LAN server package for Macs and Windows. CyberPatrol can block 12 categories (Violence/Profanity, Partial/Full Nudity, Satanic/Cult, Intolerance, etc.), which can be modified by hand by administrators, in the event that a site is being inappropriately blocked

In conclusion, to ease administration, and to ensure students cannot bypass the filtering tools, a server-based solution is preferable in a school environment. N2H2's Bess program is especially geared for schools, and offers plenty of customizations for the various categories Bess can filter for (Violence, Profanity, Nudity, etc.), and makes an excellent total solution.

6. Web Page Implementation

This chapter covers the web site implementation process we used to accomplish our goal of the analysis, design, and implementation of the Breakthrough Charter School website. The steps of this process were the creation, the initial framework developed from our meetings with the charter school, and the changes, improvements, and trade-offs for the actual implementation. We will also document and discuss any 3rd party html or code used to implement our design.

6.1 Framework

Our implementation method was a top-down process. We started with the very basics, top-level index file with title, picture, etc. From there, we organized different aspects that were to be incorporated into this web page using a demo html page, it's hierarchy is shown in Figure 6.1. This provides a web page to begin the Charter Schools web presence, and leaves plenty of room for additional information to be added in the right places.

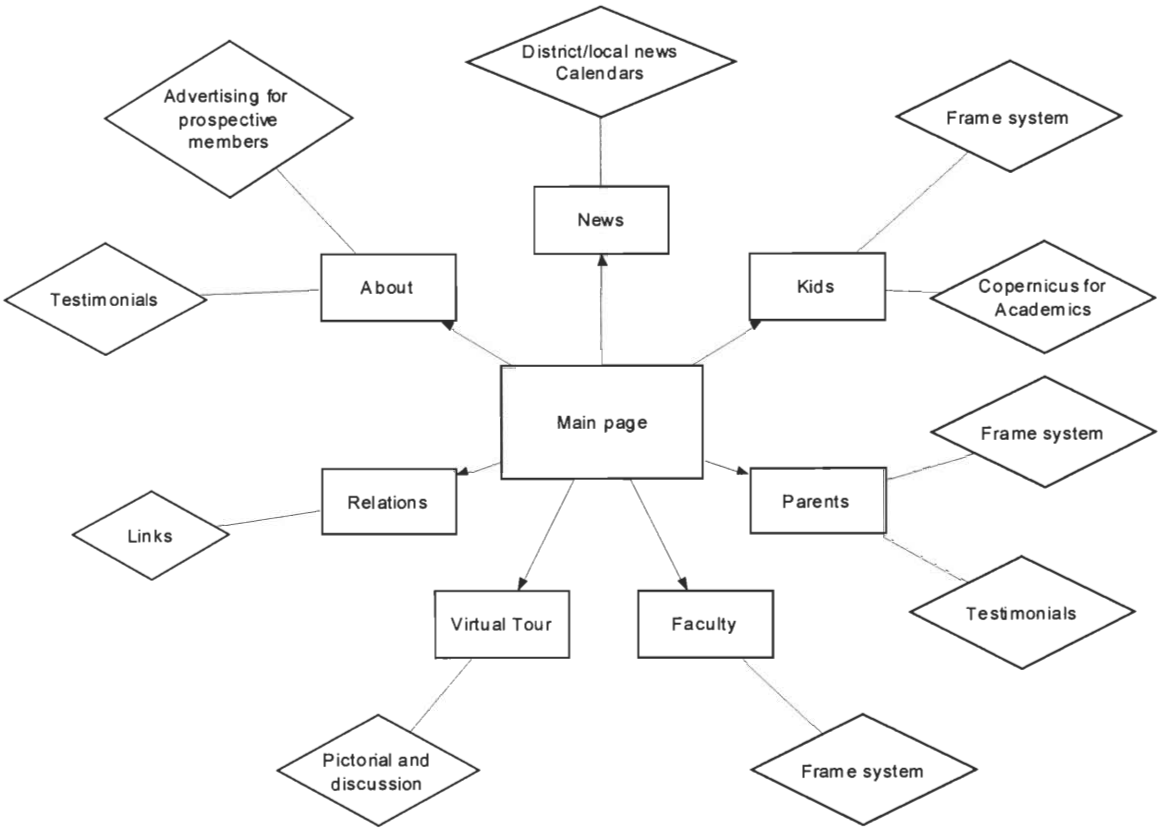

Figure 6.1: Basic site hierarchy

The Charter School's first goal was to have an advertisement for the school, and allow potential parents/students/faculty look at their web page. This involves setting up all the information that sets this school aside from other schools in an organized and easy to navigate manner. Second, they wanted a place for general news, calendars, and announcements. This can be accomplished by setting up an html template, which the school can easily edit when needed. Third, they wanted a place where parents, teachers, and students could look at homework assignments, progress reports and have discussions. This is more complicated because dynamic data in involved. Important sections from their first preferred portal system were placed so that they load in frame, retaining the

easy navigation gained from the frame system used. Also, ample space was reserved for further additions in each subsection.

The index page was designed to allow easy navigation to any other page. This means all links are positioned around the center collage in a specific order. Also the whole ensemble does not require scrolling on modern displays (1024x768). This allows visitors to get an unobstructed view of the content in the whole site, while at the same time emphasizing the selling points of the school.

6.2 Justifications

This section describes the reasons for the specific items presented, and the significance of placement in the web site. This is needed both to verify the design of the web page, and to provide the Charter School webmaster with the details they need to keep a good top-level design while they are editing the content of the site.

6.2.1 Homepage

The homepage was designed with the fact in mind that the first thing the user sees when he or she experiences the site, should be the most relevant thing. Latin-family language speakers generally observe from top to bottom, and left to right, since this is the way that text is layed out. Thus, by utilizing this knowledge we can design object placement to better suit the needs the objects serve.

Foremost, a "Text-only" link is the first link, so text-only browsers can easily find this link (Figure 6.2). This is not currently implemented since the current page can be

handled on the text-only browser using 'alt' tags, but this will most likely be needed in the future when additional content is added to either the homepage or to child pages.

A collage of pictures from student life is placed in center view. These pictures include children learning, playing, and getting along. The "about" link is placed first in the upper left corner because it contains information which is pertinent to first time visitors which are potential students and/or parents. This is in order to meet our first goal of advertising the school. This link also allows visitors who are not familiar with what the Charter School does to get informed about its unique characteristics.

Second is the "News" link, which contains school calendars and up-to-the-minute info for anyone with an interest in the school. This link should get the most hits out of all groups who access this page, since this is the first thing that even regular users would want to check when accessing the web page.

The "relations" page is in the lower left. This is because new visitors interested in this elementary school will most likely be interested in activities, organizations, and secondary schools in the same district. This was named relations and not links at the request of the Charter School representatives. They felt it was proper since they wanted not only links but some content about related organizations in the future.

On the right there are links for three portals: parents, kids, and teachers. Kids portal is linked first because per web hits the students will be using it the most, and with the same justification, parents, and then last teachers is linked. It is placed on the right because regular users will know where these are located after the first time they visit the page, and this was one of the secondary goals of this web design.

The virtual tour is linked to from the about page, however since it is a primary information item, it is also placed on the main page. The main collage is linked to the virtual tour, as it seems most appropriate the pictorial information would link to more pictorial information. ALT Tags are used to indicate this so the visitor will know about this link when the mouse cursor overlaps the collage.

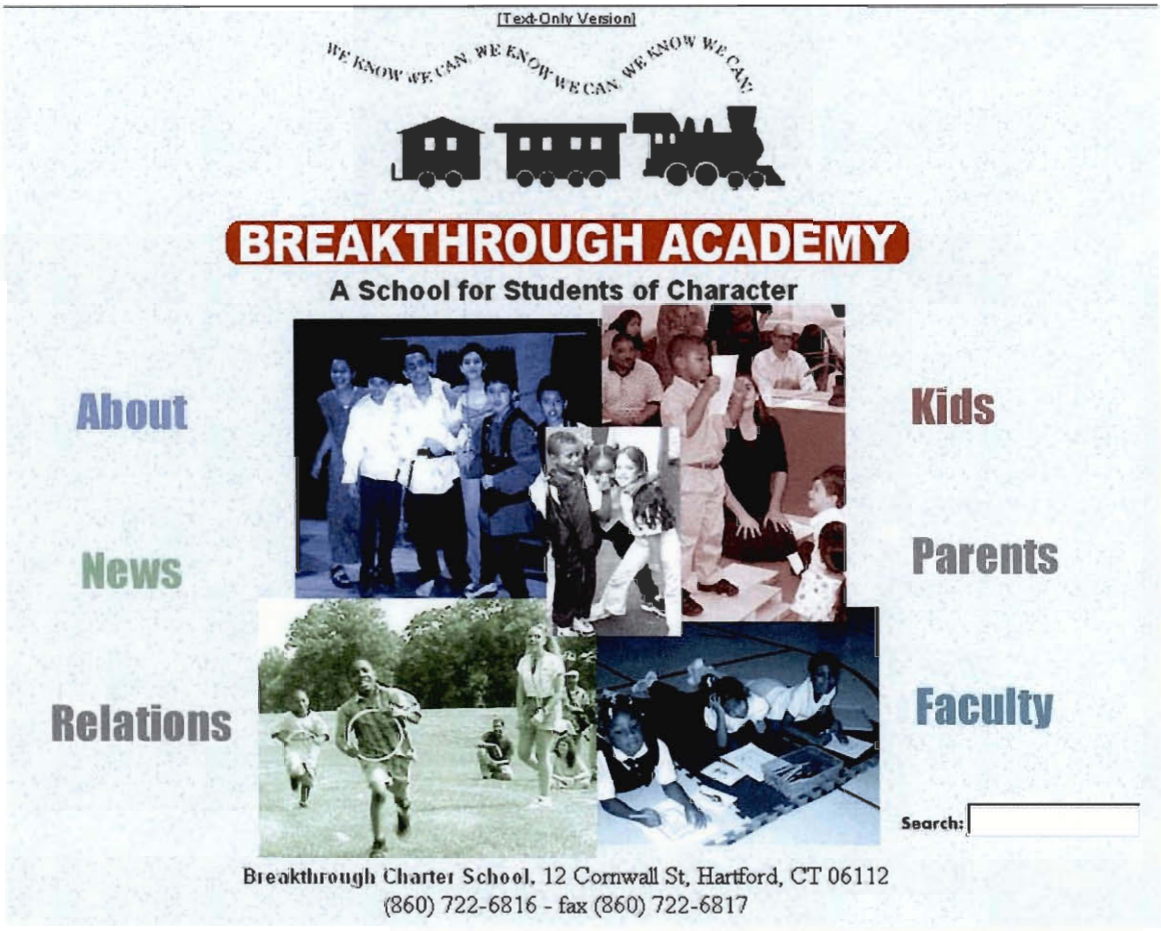

Figure 6.2: Top-level page

6.2.2 Frame-bar Organized Pages

Pages that have large amounts of data are organized with frames. Figure 6.3 is an example of the framed pages. The frames enable a static content bar to be added to the left side as a menu bar, which facilitates easier on-screen data layout and organization. This also enables potential parents or children to find what they are most interested about the school easily, without having to read through a long file. The format shown also includes a standard header that is used for all pages using frames. In total this also allows easier navigation when going off-site, for example to the Copernicus portal system. The parents, kids, and faculty pages follow the same format (see CD)

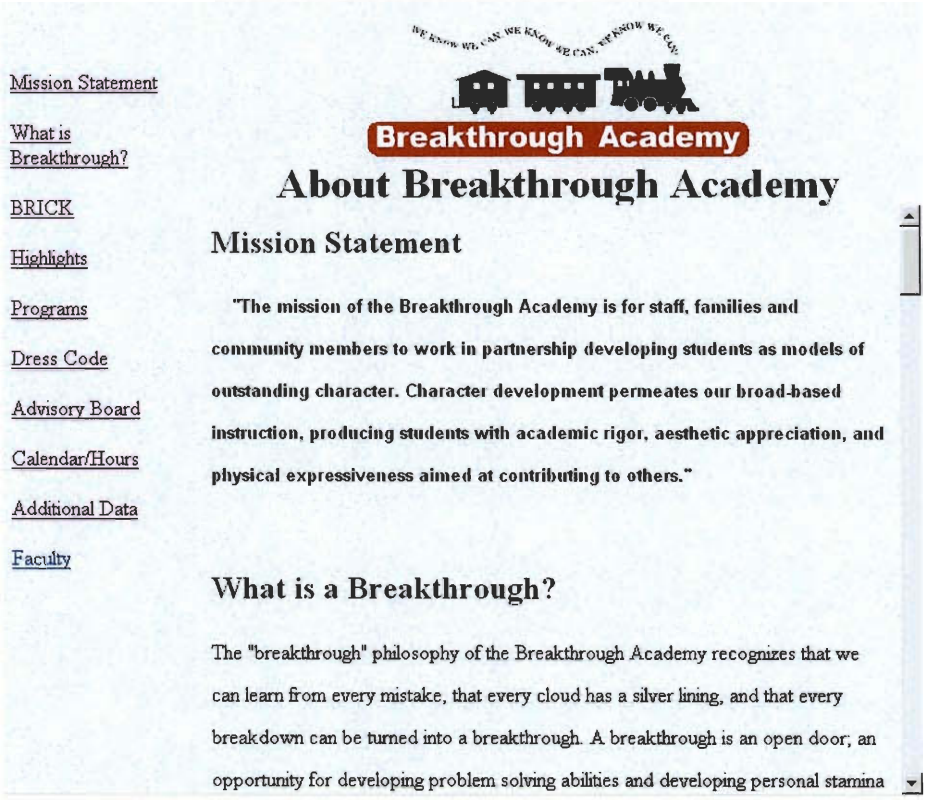

Figure 6.3: About page with frames

6.2.3 Graphical/Color Design

Colors and graphics were chosen that were simple and legible. Black is used for any text with important information. This contrasts well against our almost white background. The background was chosen because it is near-color neutral since it only has a slight tint from white, but it gives some texture to the page. The Breakthrough academy logo shown in Figure 6.4, shows the standard academy logo, but the name of the academy was contrasted with the school colors, red and white. This was done to represent the school colors and to differentiate the name from the rest of the picture. The red is not pure primary, since this would be a distraction, thus the saturation ratio was tweaked down until there was a good balance with the rest of the logo.

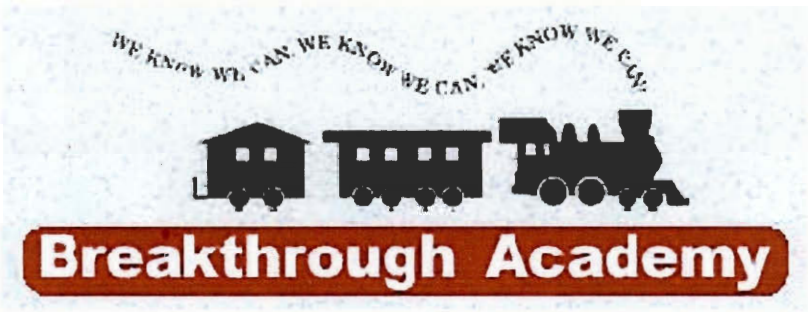

Figure 6.4: The Breakthrough Academy logo and header

The homepage was also designed using this methodology. Although primary colors may seem appropriate for an elementary school design, they would only be a distraction. Thus the colors were slight de-saturated. This also allows the use of more shades of colors in order to bring out the difference between links, but at the same time keep them as far apart as possible to keep the "elementary school" theme.

Graphic design was kept to a minimum until the Breakthrough school approved our design. This was needed also because the school would probably prefer different color/graphic schemes than what we might have done.

6.3 Portal

For the solution to our third objective we chose to find a portal system that would cover the needs of the Charter school. Through long searching, we found a perfect fit, A.N.G.E.L. [24], or "A New Global Environment for Learning". This portal was perfect for our needs as it was designed with educational collaboration in mind. A.N.G.E.L. provides a completely customizable component based learning portal. As an added bonus, A.N.G.E.L. licenses for non-profit K-12 educational institutions are free. Angel runs on a minimum NT4 with IIS4 and MS SQL. Portal setup is done through an executable setup file, which allows easy configuration of the system.

Unfortunately, we did not have the resources to test this portal, and the web-server will need to be configured by the Charter School. Thus we can only recommend this software for and let them and decide. In the meantime, the Hartford school system has endorsed a portal system called Copernicus. This portal has the advantage of being used by many other school systems concurrently, and thus research and learning information is included and regularly updated within the portal system. Grading and assignments are setup up on this system, however the discussion board as of this report is not implemented. Since this was a requested feature, we suggest the A.N.G.E.L. system be implemented for the discussion board and related systems, while the Copernicus system can be used for research, grades, and assignments for kids and parents.

7. Conclusion

This project consisted of consulting with the Breakthrough Charter Elementary School located West Hartford, Connecticut. We discovered, documented, and produced the process necessary to bring an elementary school onto the Internet in the 21st century. This endeavor included producing a design for a network infrastructure for the school, providing a recommendation on software, both educational and content filtering, creation of a maintainable web site for the school, and recommendations on future project plans to enhance the students' Internet experience.

To accomplish this, we investigated several options for filtering and monitoring student access to certain areas of the web that may be unsuitable for children. Blocking software, filtering proxies, and filtering at the Internet gateway are three options that we explored as a part of this project. In addition, we researched the actual impact of computers in the classroom, how computer networks are used, and if they are actually useful. There are many studies available now as to how computers affect the classroom, including federal studies by the Department of Education. We investigated what the best uses of the computer and the Internet are in grades K-12 classrooms, and how the students will benefit most by constructively using their resources. Finally, to accomplish our goals, we provided a set of recommendations based on our findings for the best way that these resources could be implemented in a classroom environment to most benefit an elementary school.

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