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MERIDIAN
A MIDDLE SCHOOL COMPUTER TECHNOLOGIES JOURNAL

Volume 1 • Issue 2 • June 1998

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MERIDIAN

The EyeCue System: A Prototype for The Next Generation of Educational Technology

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Abstract

As designers of interfaces for multimedia learning technologies of the future, we are charged with the immense task of building systems that most effectively leverage emerging interface paradigms in education and game design, diverse approaches to how the brain learns, and the rapid developments in digital technology. These future systems will have tremendous power, featuring new forms of input/output devices, artificial intelligence, interactive 3-D real-time immersive environments, animated intelligent agents, and continuously updating contextually customized libraries of text, images and animations that present themselves in a "just in time" manner (Fitzgerald & Lester, 1997). What ***will*** this educational software of the future look like? How will it function? This paper introduces a vision for how one of these systems might work and the design parameters involved in developing the **EyeCue System**, a interdisciplinary project under development at at North Carolina State University.

Overview

The overarching goal of any interface is elegance. Great interfaces are understated and well crafted (Tufte, 1983). Well conceived interfaces don't call attention to themselves. They are transparent. Interface is not put on as window dressing after the software has been built. Rather, it grows from the initial vision of the project, concurrently and innertwined with the software development of the application. Flexing and stretching, the design bends between the constraints of the software and computer (not to mention more pragmatic issues of time and money) and the promise of amplifying the innate learning propensities of the user. The design refines itself as the development process continues.

In the past, effective computer use relied on the specialized ability of some humans to memorize and recall sequences of highly abstract syntax in a very specific order in order to interact with the computer (the command line interface). It was not until the emergence of a more intuitive

interface, the windows metaphor, that a much greater number of people were able to incorporate computers into their lives as helpful and time-saving devices (Laurel, 1990). What advances, technical or metaphor-based, will constitute the next leap forward in intuitive interface design? Does the grammar of visual storytelling presented in film offer a standard that we can borrow? Would it be possible to have some form of conversational communication integrated with advances in graphics to increase the efficiency of learning and make information collection more manageable? What if your digital library could build specific multimedia presentations to answer your specific questions?

Let's have a look at some of the technologies that are very likely to be an integral part of learning technologies of the future. One picture of current research in educational technology resides in our labs at Intellimedia. Cutting edge research in numerous areas, these projects represent the beginning of a concentrated effort to integrate powerful new technologies, namely animated agents, 3-D real-time environments, and an area of artificial intelligence called natural language processing towards the creation of the next generation of learning tools. The following is a descriptive list of the research group itself and the projects currently underway.

IntelliMedia Initiative is a large-scale multi-disciplinary R&D effort being conducted at the School of Design and the College of Engineering at North Carolina State University. It has been established to create state-of-the-art intelligent multimedia educational technologies. Focusing on animated pedagogical agents, 3-D real-time environments, and interface design for education, this group undertakes a broad range of issues in basic research that examines the computer science, design, cognitive science, and educational problems in designing, developing, and empirically evaluating pedagogical environments and intelligent animated agents.

Animated intelligent agents represent a new generation of human computer interface design. Utilizing state-of-the-art technology, designers of agent technology integrate artificial intelligence with believable animated personas to produce a new level of interactivity and customized response. 3-D environments with "smart" camera planning and natural language narration offer new educational opportunities for vivid, customized multimedia explanations.

Intellimedia has five projects currently underway. **Design-A-Plant** is a design centered learning environment teaching plant physiology. **Design-A-Plant** features a bug-like creature called Herman. This animated agent offers customized advice and support to students as they construct plants in various environments. The **Internet Advisor** is the second project currently under construction. Featuring the intelligent agent Cosmo, the **Internet Advisor** helps explain the fundamentals of internet (TCP/IP) protocol through an interactive packet-matching game. Cosmo offers customized advice as the user guides his packet across the internet. This agent can be interacted with through an interface which allows the user to ask the agent to repeat, skip-over or reexplain what has just been presented. The third project underway at Intellimedia is **3-D SEE**. The 3-D Self-Explaining Environment project promises to be a significant leap forward in learning technology. A combination of an animated intelligent agent technology and 3-D real-time environments (complete with a updating roving camera), this system is linked to a customized explanation generator to produce a highly interactive learning situation. The fourth project is the **EyeCue System**. A design prototype, the EyeCue System is a vision for the next

generation of educational technology, integrating Intellimedia's latest technology through new interface concepts to produce highly interactive, easy to use desktop educational software. The most recent project underway at Intellimedia is **PhysViz**. A project conducted in collaboration with the North Carolina School of Science and Math, **PhysViz** will be an intelligent, real-time, 3-D application in the domain of physics.

Please visit our web site at http://multimedia.ncsu.edu/imedia for more detailed descriptions.

Design Strategy

The EyeCue System is a conceptual educational software prototype that leverages Intellimedia's latest technical advances. The technology presented in this interface is either currently part of one of our projects or is technically possible with a large team of artificial intelligence specialists. We need to take a long look towards the horizon, (not really so far away) and design systems that are technically feasible but not constrained by current (and temporary) limitations such as polygon count and today's computer processor speeds. These powerful systems will arrive in the very short term. Instead, we take for granted that technical progress will continue at current rates and focus our designs explicitly for the top priority, the end user.

The design strategy, at it's highest level, is clear; to build a system that makes learning easy and is very simple to use. Much like the experience of viewing successful film, the viewer should not be aware of the parts that make up the whole of the software experience (Boorstin, 1995). The experience, be it information presentation or information gathering, should be integrated. The media and the way it is presented should not call attention to themselves. Effective media is in service of the information it carries (Laurel, 1990; Tufte, 1990, Wurman, 1990).

But what about the media's ***relationship*** to the information? How can we take the best features of each media and combine them to make a more effective system? What information works best with what media? What are the digital environments' strengths and weaknesses?

Media Overview

Various kinds of information are most effectively carried by specific media (Wurman, 1990; Schacter, 1996; Boorstin, 1995). It might be much more efficient, for example, to show someone the text of a telephone number than to show them the visual sequence of the number being dialed. Likewise, the emotion of a certain character would be more accurately displayed by seeing a film of the emotion on the individual's face than to merely *say* that he was disappointed. Still, most information can be more vividly remembered if it is presented through multiple media, either simultaneously or sequentially (Schacter, 1996).

Text is a powerful medium for carrying abstract information. The ability of the viewer to review what is currently being read (reading at one's own pace) and the ability of the viewer to stop reading altogether (to digest information or problem solve) are powerful features of text. People can read much more than they can hear in the same amount time (Schacter, 1996). Text is not, however, effective at explaining complex spatial relationships.

Besides the obvious power it has in carrying information about 3-D space, video offers nuance of emotion. No other media can carry this sort of overlapping communication information so vividly. Subtleties of gesture, expression, intonation, and timing are unequaled by other media in this respect (Boorstin, 1995; Katz, 1991). Although video can carry the details of real world information, it has a significant drawback when used to explain information. It does not ***highlight*** information (Thomas & Johnston, 1981). It's noisy. Video shows us more than we need to see.

In addition, video doesn't offer us the ability to change the rate at which information is being delivered. It is linear and can only be crudely controlled with scrolling devices. According to Boorstin (1995) at top retention we can only cover about 10 pages of information in a 25 minute film. A more pragmatic assessment would be less than that.

Linear video, like text, offers little chance for adjusted detail on a specific topic. One must sit through the video, hoping for a more detailed description of the topic of interest. In the case of text, one must search out and find (in physical space) related material. Used in isolation, either approach is less than satisfactory as preeminent learning tools and this situation is avoidable in digital environments.

Animation offers many promises for clear communication with a diminishing downside (Lasseter, 1987; Jones, 1989; Thomas & Johnston, 1981). Digital animation software (both 2 and 3-D) offers clear advantages in scene and character animation. Time, effort, and the ability to revise serve as powerful pragmatic reasons to adopt digital animation over the traditional approaches to explaining information. These are not the primary reasons to use animation as the

main visual carrier of information, however. The primary reason is simple: animation has the ability to exaggerate and sublimate information, enabling the designer to emphasize the salient features through exaggeration, while sublimating the unimportant information by not presenting it at all. Furthermore, animation can compress or expand time and space in a more believable manner than film or video (Thomas & Johnston, 1981). It can even change in appearance (show more, less, or even different detail) over time to aid the user in the attempt to recognize relationships and capture knowledge about a particular subject matter.

Another particularly important feature of animation is anticipation. The same is true for all efficient time sensitive information delivery systems (think highway signage). The user must have a good idea of ***what*** happens next (getting bearings on the situation) in order to appreciate the ***how*** of that particular action (Lasseter, 1987; Jones, 1989; Boorstin, 1995; Thomas & Johnston, 1981). In other words, if the user can easily guess what is about to happen, he can more readily concentrate on other aspects of the situation at hand. Good design is transparent.

Character animation (agents and avatars) is a great place to see some of these principles in action (Lasseter, 1987; Thomas & Johnston, 1981). Gesture, intonation, voice, expression, even posture aid in mutually supportive and clear communication. Notice how the eyes lead all action, even the head turn, telegraphing the movements and making the overall action smooth and understandable. Cosmo's visual appearance was designed with communication in mind; big hands, thin and less emphasized arms, large eyes and eye brows (for expression), and little emphasis given to less important parts of the body such as the midsection and legs. Character animation is the top of the animation, but it is worth climbing ladder (Thomas & Johnston, 1981). Clear communication with low noise awaits the diligent animator/designer.

Agents must also have a personality and appearance that will help the user infer what information should and ***shouldn't*** expect from these digital guides (Laurel, 1990). It is a poor idea to create a character that looks omnipotent but delivers much less. Furthermore, creating audience empathy with the agent through manifestations of personality can create motivation in the student learner that would not otherwise exist.

The Multimedia Approach

The drawbacks to using the computer as the main instrument of learning have traditionally been lack of access (a critical issue but statistically diminishing with cheaper computing and internet access), the ever present interface learning curve, and less than robust educational applications. Software (including the system software) needs to be designed better.

Of course, advantages of using interactive systems for learning are many. In the EyeCue project, our attempts to explain how a computer works are significantly aided by our ability to explode space and time in the computer. We are able to build a model of the micro-electronics of the motherboard on a more human scale so it is easier to relate to spacially. Likewise, time can be slowed to more readily understand the complex sequences of processes that occur. These are extremely useful forms of exaggeration that can make learning easier.

The technologies of 3-D real-time worlds are becoming commonplace. Software in which users can navigate avatars to solve problems (or kill anything that moves) have emerged to dominate

the gaming market. Current speech synthesis technology allows us to hear verbal articulation (admittedly less that perfect) based on a text file. Interactivity allows the user to ask questions or proceed in a direction of their choice in a time-based manner. All this is potentially very powerful technology if integrated effectively. The real punch, however, comes from using artificial intelligence to build customized text-based explanations in a "just in time" manner. These natural language systems produce highly customized English language explanations based on the question you ask, the situation you are in, and what the system itself knows about the subject matter. (Please see Intellimedia technical papers to get more detailed explanations on natural language generation and knowledge-base learning environments). These articulated, customized explanations can be tied to camera planning and animations to provide vivid, information rich, real-time explanations.

Imagine a system that could re-explain 3-D information from other ***angles***. Interpreted literally, the camera could re-present the information from another sequence of choreographed camera angles to give the viewer a redundant (this is not bad!) assessment of the information (Katz, 1991). A more powerful approach would include having the system revise the textual description (based on the users request), causing the associated camera views to change in angle, sequence, and focus. Additionally, the environment itself could reconfigure, highlighting certain features to isolate the particular points of emphasis. This approach would offer both repetition ***and*** novelty in the learning experience--a powerful combination for long-term retention (Schacter, 1996).

An Interface for Learning

The goal of an educational system is to help the student construct an accurate and rich mental model, there by establishing deep, elaborate encoding of the subject at hand. How is this done? How can our interface support this task? We set forth the following guidelines to help direct us in the iterative development of the EyeCue System:

1. Encourage curiosity-driven learning (Wurman, 1990). Users must be afforded the chance to explore the relationship of information components. The brain is constantly looking to establish pattern. Exploration (curiosity) is the mind's attempt to discover this pattern through a serious of experiments (Schacter, 1996). When the user is finished exploring, redirect the user back to the pre-selected pedagogical path (a guided tour).
2. Utilize Gestalt organizational principles to design information so no visual tension exists (Kosslyn, 1994) . That is, one piece of information being pulled in two or more ways at once. This creates less interface confusion.
3. Offer multiple cues (elaborate encoding) when describing information. The quality of the memory depends on strength of encoding (vivid or frequent) (Schacter, 1996). The same event replayed from another perspective or level of detail insures repetition while retaining novelty. The depth of this encoding affects long-term memory of information. Our goal is to construct a strong bridge from short-term, working memory (small amounts of information for a short time) to long-term memory (Schacter, 1996).
4. Present information so it is easy to retrieve and make connections (Laurel, 1990; Schacter, 1996; Tufte, 1997). User centered hypertext (an example of task and user centered tools) and the ability to cross reference information should be consistently embedded in the interface. Afford users the ability to jump in focus (detail of a textual, verbal, or animation presentation) as well as scale in the 3-D environment.

5. Let the user control the pace of the explanation (Laurel, 1990; Schacter, 1996).
6. Consider the use of priming (small hints to help students strengthen connections of cues to engrams) in the interface (Schacter, 1996). Avoid true/false questions. It is better to offer diminishing hints or cues (method of vanishing cues that triggers recall) to help strengthen weak connections. 3-D environments which offer changing degrees of hints could become more realistic (or symbolic) as learner becomes more sophisticated.
7. User should anticipate what is about to happen. Environment and interface should support this (Lasseter, 1987; Boorstin, 1995; Thomas & Johnston, 1981).
8. Incoming information must relate to what we already know. Redundant overviews or guided tours could establish a common set of facts (even if it is merely the location of parts).
9. Create 3-D immersive environments in order to promote a more personalized relationship to the information. Retrieved information must be recollected in context of setting and time, with some connection to the user as a participant in situation (Schacter, 1996). A 3-D environment can be a useful component to a constructivist learning approach (Lester, Fitzgerald, & Stone, in press).
10. We remember tools by the movements we do when we use them (Schacter, 1996). Consider the use of dynamic function icons (animated icons symbolizing a discrete part of a process). Problem solving mode could offer the user the opportunity to match these event icons to specific locations in the environment to demonstrate understanding of complex processes. These animated icons could have levels of hints (vividness of explanation) that the user might utilize in the problem-solving process.
11. Make the exploration of information have a goal. This will help the user be selective in remembering information.
12. The use of visual mnemonics as cues can serve as a powerful visual memory tool. Software should help user remember mental images and place them in well-known settings to help the memorization of complex or detailed information (Schacter, 1996).
13. Give users control of the system.

A Powerful Classroom Tool

How might middle school teachers use this new technology? As we will see in the following description, the systems of tomorrow will offer immense amounts of information in a multimedia interactive format. It might well be that a student's ability to collect information in a highly selective manner will emerge as the most important skill-set students could acquire at this age.

Imagine students collecting and organizing bits and pieces of animation, sound and text in digital notebooks which could later be evaluated by their instructor for quality of perspective and presentation. Students might prepare for testing by exploring an environment and building a selective portfolio of information from which they could refer during teacher designed tests. In these tests, students would be lead through environments by agents who ask questions, offer advice and encourage students on toward a successful completion of their learning tour. Teachers preparing for a lecture could travel through this information landscape to select pertinent information for a very specific learning module that the software would then create into a vivid, interactive animation.

As with the radio and the television, guesses of the ultimate uses of these new technologies will

probably seem humorous in retrospect. In the end, classroom use, evaluation, teaching innovation and technological evolution will bend and flex these learning tools toward their most effective use.

System Description

The following is a walkthough of the EyeCue System. This system has numerous major overlapping functionalities: the teacher or lesson plan mode, the problem solving mode, and the information gathering mode. This description will center primarily on the information gathering mode of the system.

Information Gathering

There are five key components to the information gathering mode of the system: a modifiable index of the lesson sits to the upper left, a user-centered hypertext system is located on the right hand side, a "go to" map sits at the bottom right, and finally, two animated agents, EyeCue and Whizlo, reside in the lower left and center (respectively) of the interface.

Whizlo is an energetic, uniwheeled, digital helper who has the double function of serving as both an agent and avatar. The user may guide Whizlo (the avatar) to complete tasks or explore aspects of the computer, but, when control is returned to the system, Whizlo (the agent) explores and asks questions of EyeCue by himself. This second type of interaction creates a sort of information movie that the audience can choose to watch (passively) or interact with (actively). The instructor can easily preprogram (literally show) the system what areas to cover (or pass over).

EyeCue is the character that represents the natural language generated explanations of the system. As the customized text is produced, voice synthesis software articulates it, creating a narration of the unfolding animation that is synched with the accompanying gestures and expressions of EyeCue. The visual appearance of this animated intelligent agent is designed to rhyme with the less than natural sound of current text to voice technology. Imagine the same system with a cute animal character but with the unemotional voice of a computer!

A modifiable index of the lesson

As the lesson begins, the index offers the user a syllabus-like functionality. Users can see that they are currently at lesson 3: the CD ROM. By holding down on the 3, the user may go to any of the other chapters listed here. Check marks indicate what lessons have been completed. The purple dot indicates the current lesson. Furthermore, a user or teacher may amend the lesson by clicking on and off major subjects or minor areas of focus. This information is then saved into the lesson planner for future use. Likewise, a preprogrammed lesson can be loaded into the current lesson plan. Teachers could purchase, create, or customize lessons for student use. These lessons could serve as auto-building linear presentations if the teacher so desired.

Customizable Intelligence

EyeCue is customizable. The user can customize his personality to be more talkative and

friendly, or more to the point with less humorous interjection. Certainly, agent appearance itself could be customized by the user to switch out characters altogether. This functionality has minor effect to the underlying AI structure itself.

The AI software has a component called the user (or student) modeler. It is constantly updating itself to infer what it believes the student knows about the subject matter. To make the system more efficient immediately, the user can see and amend the student modeler. The experience button enables the user to update and modify any assumptions that the user modeler has incorrectly made. The user modeler could have (for example) incorrectly inferred that the user knows more about binary numbers than is actually the case. As the user detects this incorrect assumption through receiving overly complex descriptions and animations concerning binary numbers, the user (student) profile can be open and adjusted. The AI software will now take this new information into account when new presentations are constructed and presented.

Likewise, detail and pace can be adjusted on a global level. If the user is generally interested in a more cursory overview of information or a more relational perspective, this can be adjusted. The general pace (rate) of explanations can be customized. More detailed animations for specific types of information can also be requested.

The GO TO Map

The "go to" map serves numerous functions. It's primary job is to orient the viewer. In a complex micro world, understanding your position and ***scale*** help minimize confusion while exploring new areas and relationships [3]. As user rolls over the second level, the first level becomes smaller and less significant. Rolling over the bottom area results in similar functionality. By clicking on the arrows at the bottom of the map, the user can snap to the next most significant location. Rolling over any location with the cursor will call up text labels. The user may click on a location or use the scrolling titles to go to the next area of interest.

Learning-Centered Hypertext

The upper right section of the interface holds the text-based delivery system. It is designed to be cross-referential with convenient "just in time" functionality. The top part of this information bar has cross referencing terms (object and action) that produce customized summaries in the text box below. If a user is interested in how the ***action*** (DATA) affects the ***object*** (HARDDRIVE), he would simply hold down on the object label (currently the CD ROM) and scroll to the term harddrive. A new description would be produced and displayed in the text box below. The user-centered hypertext bar sits below the objects action. It offers a universal system to conveniently access various types of information tools for the term or topic you are currently interested in.

A task-centered interface, this system offers an ***overview*** functionality that displays customized textual information. A detail scroller enables the user to get more (or less) information on demand. Page numbers let the viewer know how much information exists and limited bookmarking offers the chance to review your steps. The user may click on any hypertext word to receive the same functionality. To eliminate the current text box and return to the original underlying text, click on the red dot in the corner.

To ask a question about the topic at hand, the user pull his cursor over the closest ***FAQ*** button. The frequently asked question functionality offers the user two main choices. One can pick from a list of software customized questions based on the user's profile and current situation, or a question can be built from the template questions located in the QUERY section. To ask a question, press the question mark to receive a textual and animated response. When the animation is complete, the system returns to the textual overview section.

The ***notes*** function is a storage mechanism which allows users to store selected concepts, terms, and animations for later use. Notes can be used by a teacher to build a customized lesson. These notes would then be loaded into the lesson planner and used as the pedagogical guide for the next day's lesson.

The most exciting functionality in notes is the ***summary*** function. By clicking on summary, the student asks the AI to rewire all collected notes into a coherent, pedagogically sound animation. The user may watch this animation for review or perhaps submit it as a thoughtfully constructed overview of the subject matter as a means of evaluation.

Finally, the ***animation*** function allows the user to see an animation of the term or topic he is currently interested in. Perhaps the most powerful feature of the system, the animation function allows for a ***customized*** animation to be played. This animation would be dictated by the natural language description produced. Tags for camera movement and animation sequences would be tied to this description. Finally, this description would be narrated by EyeCue. The user would see a dedicated animation of the topic at hand. For a more detailed animation/explanation, the user can pull down on the detail bar. The system takes this new information into account and builds a more in depth description with associated tags, ready for presentation.

Conclusion

The combination of artificial intelligence and 3-D environment technologies with innovative interface design offers great opportunities for efficient, customized learning. These integrated technologies will produce new learning tools which will make understanding and retaining many types of complex information much easier. As we know from the evolution of desktop computing, these new technological innovations need to be coupled with innovative design concepts to fully leverage their impressive potential. The next generation of educational technologies will promote curiosity driven learning. These systems will blur the line between exploring and learning, entertainment and scholarship.

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* Support for Intellimedia was provided by the Office of the Provost at North Carolina State University, the National Science Foundation, and donations from Apple, IBM, and Novell.

MERIDIAN

The North Star Approach to Technology Planning

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INTRODUCTION

Many schools today are providing some excellent learning experiences using technology. Ever resourceful, teachers have found ways to turn even a single, aging, Apple IIe into a catalyst for discussion, inquiry, and cooperation. Some schools have more technology available -- from videodiscs to scanners and digital camera to ISDN connection to the Internet.

Even in technology-rich schools, resourcefulness is still a prized instinct, where there never seems to be enough to go around especially when "the next new thing" seems to pop up every month.

No matter what the situation, schools that spend time doing technology planning reap the rewards. Whether planning is done by a school as a large team or a single teacher rallying around a singular vision, giving shape to the technology experiences can benefit learner, mentor and community.

Regardless of which tools, and how plentiful the tools, educators are being offered staggering amounts of technology activities to "weave" into the existing curriculum. These are multiplying daily -- truckloads of software which provide the learner with interactive experiences on everything from algebra to zoology. Add to that the Internet with it's hundreds of thousands of homepages. Teachers are now preparing for new broadband technology which will dish up software, the web, old and new television -as well as a new breed of interactive programming at 50-100 times the current speed. It's coming at us fast and furiously.

The mountain of choices dumped in front of us has turned into a galaxy of choices which at times can overwhelm us. What if there was a way to help educators sift out some powerful experiences from the nearly 10,000 titles software publishers have poured onto school shelves?

So what should guide us as we sort out this avalanche of material?

What is the organizing principle?

THE NORTH STAR APPROACH

The North Star Approach to technology takes its cues not from technology manufacturers, software developers or academic committees, but instead from the student. The NS Approach encourages the student to become an active participant in the learning voyage --to help determine the direction -- to help us know how to help guide them. To help us see what knowledge, research, additional skills they will need on their own unique life journey. After all, isn't that what this whole learning endeavor is about? Helping young people navigate productive, fulfilling, rewarding life journeys? The North Star Approach suggests that each learner develop a personal curriculum.

The North Star Approach acknowledges different learning styles and teaching styles. It is a keen observer of new brain research which is helping us tailor learning experiences to decrease stress and increase long-term memory. It acknowledges multiple intelligences. Billions of intelligences. It allows teachers to respond to emotions before test scores, interests before scope and sequence charts, spontaneous ideas before canned curriculum.

The North Star Approach challenges students to master "foundation skills." Often referred to as "basic skills" -- these tools are the cornerstones of a North Star voyage. Describing them as "basic" seems underwhelming for such vital and empowering tools of the journey.

- Reading
- Writing
- Problem solving
- Communication
- Citizenship

These all make a North Star journey more rewarding and fruitful.

Here is why:

On a North Star Learning Voyage...

I need to be able communicate

in order to tell you about my constellation.

I need to be able to write

to share my dreams.

I need to to be able to problem solve

and sharpen my logic

to get me through the tangled brush

that is sure to be a part of my voyage.

I need to to be able to draw upon the wisdom of others,

their stories, their histories and herstories

to help me navigate around

shallow water and over rocky coves.

I need to be able to

be creative and innovative,

to be open to new ideas,

to strive for original thought.

I need to be able to see how I fit into the community

- how I affect it --how I can affect it positively.

I need to appreciate other

people's constellations and North Stars.

I need to be able to create more than I consume.

I need to see that learning is my responsibility.

My privilege. An ongoing gift I can give myself.

I need to be able to see -

and help others see -

that we can move this world

to a better place.

A GLANCE AT THE NORTH STAR TECHNOLOGY CATEGORIES

The North Star Approach could happily survive on a small handful of technology tools. This is especially appealing for resourceful classrooms short on time, money and resources, and yet

equally appealing to techno-rich environments searching for a truly meaningful experience in the lab or classroom. The North Star focuses on six categories of computer tools.

- Creativity/Expression Tools
- Crafting/Building Tools
- Exploration Tools
- Communication Tools
- Problem Solving/Innovation Tools
- Publishing/Sharing Tools

These are constructivist tools that depend on content or guidance coming from the student. It celebrates the blank canvas. The empty sheet of paper. The silent room. The spark of curiosity. The sudden "Aha!" The unplanned answer. The unexpected solution. The original thought!

The North Star Approach draws on a learner's personal curriculum. Relies on personal content. Nurtures personal expertise. The following four categories are cornerstones of a learner's North Star Personal Curriculum.

- Interests (Hobbies/Passions/Point of View)
- History (Family/Personal Experiences)
- Impact (Mission/Service)
- Future Thinking (Career/Life Path)

Each of these is like a deep well upon which to draw. It is a deep well belonging to the learner. Each can provide a wealth of inspiration for student-inspired projects, writing, reading and problem solving. Foundation skills will be provide the framework for expression . . . the learner will provide the message.

The North Star Approach invites students to become philosophers. Deep thinkers. Thoughtful about their journeys. Many students have trouble seeing beyond tomorrow. The North Star Approach helps young people explore more deeply the concept of time. It helps students see that the journey is a long one in need of planning, care and wisdom. It inspires an understanding between cause and effect. Action and consequence. The North Star Approach gives students a better sense of their own personal time lines.

The North Star Approach helps students avoid the wrenches thrown into the journey. Students are faced with more and more temptations and distractions from a thoughtful journey. Each navigator responds differently to the wrenches thrown their way, but for more and more young people (who are only a few years from becoming the adults of our society), external pressures can interrupt their navigation. Violence on television, drugs, family dysfunction, fashion, peer pressure, and sex are just some of the stronger influences on the personal journey than inner-guidance. Inner-guidance systems are often under-nourished and undeveloped, often having never been exercised at all.

These damaged voyages are due in large part to three things...

- Lack of Guidance (parental, societal, mentor, personal, spiritual)

- Lack of Self-Vision (usually referred to as self-esteem, but where self-esteem is about feeling good about ones self in the present moment, self-vision is also about being able to see the betterment of one's self in the future. It is about dreaming big --knowing that a bright future IS possible.)
- Rebellion --While a degree of rebellion is a common part of a teen's growth, there is also a resistance to an educational system that disregards the personal needs and nature of the individual.

The North Star Approach applauds the shifting paradigm, albeit slow, from short term memorization to long term learning. Personal context --meaningful projects --designed by teachers and students.

THE BOOK...

The North Star Approach is a blend of the new thinking about learning. It is a reflection of the best thinking about making learning more rewarding and effective by acknowledging different learning styles, multiple intelligences, and emotional intelligences. It blends student constructed learning and creative assessment. To trigger conversation and thought about these critical issues, I wrote and illustrated a very special book called The North Star. My fourteen years working with children, schools and technology inspired me to write this allegory to help explore the issues of what really is important when you boil down all the thousand pages of educational code, the hard-wired curriculum, the standardized test, etc. (A free on-line version is available at http://www.fablevisionpress.com/northstar)

After years of watching educational technology mushroom into its own industry, I felt we were missing the point. So much effort was spent to correlate the technology plan to curriculum plan, when it seemed to me that we needed to ask some harder questions. What is the best for the learner? The only way to find out is to ASK. A real conversation, to find out what the spark is for THEM. It is a daily conversation.

Technology and the Internet is triggering a paradigm shift so dramatic that we can only guess how schools will operate in the next millennium. The rules are being rewritten. The exciting thing is that we are here to witness the evolution - to see the limitations being lifted. Anything will be possible.

The North Star Approach is not a 12 step plan. It can not be implemented as a ready-made formula. Rather it is a creative approach that can live with current plans. Amazing things can happen without changing much. Keep 90% the same, but allow for 10% North Star thinking in your day. Let your students discover their personal constellations. The stars that guide them. Let them teach YOU about their personal curriculum. Let them see the connection between foundation skills and their constellations. It will be a profound experience.

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MERIDIAN

GIS as a Tool in Interdisciplinary Environmental Studies: Student, Teacher, and Community Perspectives

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> The twentieth century concludes in much the same way as it began--with the redrawing of maps. However the new maps are not so much of geographic territory, but of landscapes depicting new and developing networks of finance, people, and culture . . . The ultimate work of education is to learn to be a human being . . . But as we struggle for new identities we must be able to transcend these notions of territory and engage new concepts of energy and place (Hartoonian, 1996: 6-8).

One of the ways that energy and place are being re-mapped by certain schools and communities is in environmental community service projects. Using Geographic Information System (GIS), students are conducting original research and spatial analysis. Originally developed for international resource and environmental analysis, and later for military use, GIS is now applied to national and global weather reporting, topographic and census mapping, and thousands of municipal, county, state, national and global planning and marketing applications (Foresman, 1998).

This article describes an application of GIS technology as a tool in an environmental community service project in which students and adult community members participated in water quality monitoring and biological assessment. I discuss the function of GIS in community service learning toward the goal of a socially and environmentally healthier community through a balance of actual learning experiences and a virtual technological application. I focus on how students, teachers, and community members made sense of the technology in the context of the environ-mental inquiry. I discuss issues and problems associated with technology in education and recommend a cautious and critical balance of actual ("experiential, " "hands-on," "real-world, "authentic") and virtual learning, urging educators to teach with technologies that are focused on production versus consumption; that empower rather entertain.

What Is GIS?

http://www.usgs.gov/research/gis/title.html

Question Technology?

The economic phenomenon of skyrocketing computer and telecommunications equipment sales toward the end of the 20th century reflects an underlying assumption that ***any*** technology is desirable. What some describe as a belief, others as a religion, and still others as an addiction to "technology" so permeate our *fin-de-millennium* culture, that we do not even consider it critically; it is summarily assumed beneficial. This cultural assumption has led to the reallocation of millions of dollars to implement "educational technology."[1] As American schools race to meet

perceived demands of technology education, many critical questions remains unanswered: What are impacts of technology on learning? How do students make sense of technology?

In their critiques of *technique*,[2] the social mystique and "buy-in" to technological approaches across social institutions, Raymond Callahan (1962), Ivan Illich (1970), Jaques Ellul (1980), Neil Postman (1993), Henry C. Johnson, Jr. (1994), Robert Yager (1993; 1996) and others (STS, 1995) have pointedly illustrated how the values of industry and science have transformed those institutions; particularly education. So embedded are our cultural institutions in our technology-dependence that we in the post-industrial world cannot conceive of life or giving validity or value to life outside of the technological paradigm. This is how we have systematically devalued the human contributions of societies that are not as technology-dependent as we are. From our ethnocentric perspective, we discount proven practices until validated by "scientific" means, even when those practices may represent thousands of years of collective human wisdom, and require less dependence on technological "solutions."

Thus, the types of knowledge, or what I prefer to call *knowing* (Alibrandi, 1997) that have in effect led to environmental and social sustainability are those that the technology-dependent society may in fact be losing. *Knowing* in the gerundive form focuses on ongoing, ontological knowing; one that is internal and developmental. This knowing is devalued by over-exposure to media. It is what Schon describes as "reflection-in-action" (Schon, 1983) and what Belenky et al describe as an "inner" way of knowing (Belenky et al, 1986). Because of an emphasis on efficiency, post-industrial societies discount differing types of knowing in the much same way that religious dogma invalidated scientific knowledge during the Medieval era (Brewer & Chinn, 1993).

While alternative views have begun to influence this ethnocentrism, and as the 'science, technology, and society' movement provides locations of dialogue about the process, an ability to remain both critical and facile in diverse 'ways of knowing' must be balanced. If the *hominidae* are identified by the fact that we alone among the great apes developed stone technologies, then this is part of our phylogenetic development. The key distinction here is "part;" for there are other domains of human cognition yet to be recognized and developed.

We have used technologies to understand physical space as distant as "outer space." As we now approach the "inner space" of the brain, and its interacting organic systems, we must neither ignore the wisdoms of ancient societies, nor the new learning provided by imaging technologies. Will the ancient wisdom of acupuncture practice lead medical-technological research? If we are to retain healthy social and environmental systems, how will we use technology toward sustainable goals? The combining of *diverse* practices should guide us into the next millennium. In this, the wisdom of culturally diverse technologies, biologies, and medical practices is included.

Finally, before leaving this discussion of questioning technology, let us focus briefly on the power of this questioning. John Penick in Yager's (1996) STS volume discusses the role of questions in science education in a complementary yet different fashion than I have (Alibrandi, 1997). My focus is more neurobiological; in other words, what kind of brain function is engaged in asking and considering questions? It is asking students to raise questions both *with* and *about* technology that will lead to a better understanding and integration using diverse ways of knowing. This represents not just a cognition of technology, but a metacognition about it. This internal reflective process is one that must also be experienced in order to balance teaching and learning with computer technology.

How is computer technology part of learning to be human?

I share Illich's impressionistic metaphor (1997) of education and technology as substituting one addiction for another. If we continue to view education as a technological system, rather than as an organic component of our communities, we will have so "bought-in" to a partial view of human, cognitive, and social development that certain of our human capabilities may become atrophied (if they haven't already).

In so saying, I share a perspective of refusing to limit education to the formulaic approaches promoted by developers and marketers of standards, standardized tests, test manuals, and other test products. These "replicable" or "expert" approaches are those Ellul calls *technique* (1980). To view valid "knowledge" as only that which is taught and learned "systematically" is to deny the creativity of innovation, which by definition lies in *what is not yet*. To teach human beings with so unwholisitic a view is to limit both the scope of human capacity and the functions of education within the community.

Janice Koch, in Yager's (1996) Science, Technology and Society volume concurs: "Science education has not made space for the truly creative, inventive child who believes that there may be another way." (Koch, in Yager, 1996: 307). She describes ways of learning and knowing that are undervalued by standards and assessments.

> Once, while doing science with middle school children on a small rural island off the coast of Maine, I learned how to spot a clam in the wet sand off this island coast. The middle schoolers who taught me how to spot a clam were adept at observing the slightest differences in the surface of the sand. The clues to their clams' whereabouts involved an almost intuitive ability to perceive minor changes in their coastal environment. Their skill in this arena is a valuable attribute for scientific study. Nobody ever told them that (1996: 308).

Beyond the known and formulaic, it is the innovative and intuitive that allow us to "learn to be a human being" as Hartoonian reminds us. It is the processes of learning and creating, not just the consumption of books, boxes or bytes of information that constitute this learning. Therefore, teaching for this learning would mean acknowledging multiple ways of knowing, and providing experiences in which those ways might develop.

Balancing the Actual with the Virtual

My research focuses on a particular research application of GIS that balances the actual with the virtual. Some teachers have directly introduced GIS into original research projects, and teach the GIS application itself to students. These students have conducted original field studies and are learning, beyond entering information into a database, to conduct spatial analyses. Because GIS is generally a municipally-owned tool used for planning and development, teachers using GIS have integrated education with community problem-solving. Here, I believe, lies a powerful tool not just for integrating education and community through environmental studies and technologies, but for reconnecting youth with their communities in environmental inquiry. In the process, students learn high-demand career skills, work in collaborative teams in the environment, and make real contributions to their communities. This type of project fulfills the promise and premise of STS as it engages students in implementing Hartoonian's call to "engage new concepts of energy and place."

To put this discussion in a temporal context, certain phenomena specific to our point in time are relevant. First is the *fin-de-millennium* concept of "diversity," a value whose source derives from E.O. Wilson's description of ecological relationships as dynamic and interconnected systems of biodiversity (Wilson, 1989). There has been a call from institutional leaders in economics, ecology, and education for models of institutions based on living systems rather than mechanical systems. This concept of diversity must also apply to our value on ways of knowing and meaning.

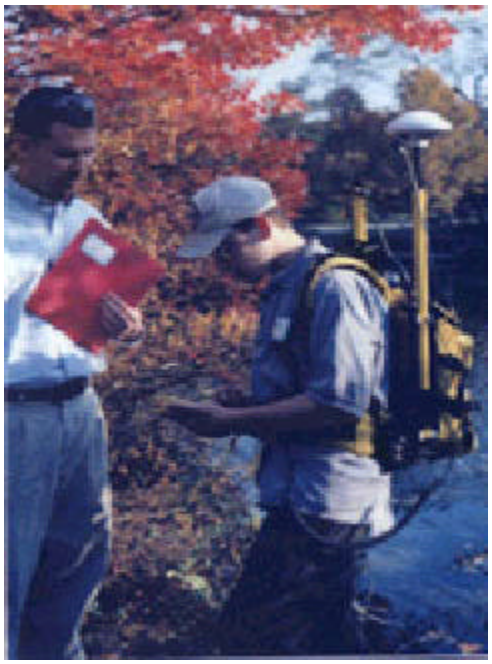
The second phenomenon is that uncanny characteristic facility with computers by a segment of the generation that has "grown up digital." While this is a generational phenomenon, it is not a whole generational phenomenon; it is a class-bound generational phenomenon (Tapscott, 1998). And while many in this generation may view technology as humanity's salvation, they are still youth that require wholisitc actual experiences in order to develop fully and to use their skills wisely. Wisdom is not inherent within computer skills. In fact, we may more easily identify wisdom from skill by balancing the actual with the virtual in education.

An Environmental Community Service Project

This case study describes an ongoing environmental community service project involving volunteers from middle school, high school, community college, and the community at large. In the partnership project, a non-profit land trust, a community college, public schools, and municipal agencies collaborated in water quality monitoring and Geographic Information Systems (GIS) training and sampling. Textual documentation from the project, interviews of student volunteers, trainers, and collaborators, and photographic and computer-generated products were used as data sources. The study focused upon community relations and the combination of environmental and technological applications across a year-long project, and addresses the merits and problems of GIS education and implementation.

In the project, the students sampled water from a local river weekly throughout the fall. The locations of their sampling connected upstream and downstream sampling efforts by adult citizen volunteers. The students assisted in locating the exact points where the sampling was conducted using a GPS (Global Positioning System) unit under the guidance of a town GIS Specialist. During the winter months, the students participated in ten weeks of database and GIS training, compiling and analyzing the data they had gathered. Their results led them to further refine their questions for spring field work, adding habitat assessments to their water sampling regime.

What is GPS?



Student wearing a GPS unit "gathers points" from orbiting satellites.

http://www.utexas.edu/depts/grg/gcraft/notes/gps/gps.html

How did the students view their work?

The activities described here took place in the context of a community service project; students were not required to participate, but came, week after week to work in a natural setting on a small river. It wasn't glorious work; there were no fans or cheerleaders urging these adolescents on, but they described the project as "fun." The participating volunteers placed a higher value on environmental field work than on the computer technology. GIS technology, in the participants' view, was secondary to the primary function of the actual environmental field work. From their perspective, GIS technology was viewed as a tool for analysis and public education. In this way, the computer technology was seen to provide a virtual public education function within the context of their environmental community service.

Further, when asked to describe the types of technology used across the project, students lumped together the computer technologies (GPS and GIS) with pH meters, water testing kits, clipboards, nets, slide and overhead projectors, and VCRs. Student responses are shown in Fig. 1., below. The responses are represented from left to right by chronological age; the youngest, an eighth grade female to the left; the oldest, an eleventh grade female to the far right. The three central comments are those of the male students from the "Class of 2000."

Figure 1.

What types of technology did you use in your participation?				
GIS, GPS, Water Quality test kits, software	GIS, GPS, stream test kits, pH meters, flow meters.	Water test kits, computers, flow meters, nets, clipboards and field data-gathering equipment.	Water Quality test methods, pH meters, flow meters, GIS, GPS	GIS, GPS, slide projector, overhead projector, video, VCR

Perhaps due to their generational perspective, the students took a more wholistic view of computer use as just another tool. Chronologically, most of these students are from the "Class of 2000," ranging in birth years from 1980-1983. Students saw the use of GIS applications as secondary to what they considered their primary investigative learning; in this case, the "hands-on" water quality and biological assessments performed in the field.

Secondary students learned the GIS application more quickly and with less resistance than their college student or adult colleagues. Project participants from the community college, only a few years older, but not of the "growing up digital" generation, demonstrated greater resistance and slower comprehension and mastery of the computer applications. This tendency was even further marked in the adult participants, only one of whom "took to" the GIS instruction.

Gender differences have been studied for decades (Liben in TERC, 1995; 1982), but the introduction of a new technology in geographic education opens additional research terrain for investigations of gender and geography. About using GIS, an eighth grade female student explained:

It gave us a place to put our information and organize it. It helped us to actually see what we were doing in the field from a different perspective. It was easier to find the information after we put it into the GIS. (Alibrandi, 1997).

Only the female respondents described this attribute of the GIS as a "place to put" information for its display. Figure 2., below indicates possible gender differences in perspective on GIS utility.

Male students described the GIS and GPS (Global Positioning System) as "connecting" their field data to existing land use maps. Thus, the sense of having provided real and useful data as part of their field study was enhanced by the computer application. Many volunteer water quality studies exist in isolation from other local data; it was through joining the databases using a GIS that the spatial analysis was facilitated. Without GIS, the data would have been hand-drawn onto a map to display the situated effects. With the GIS, successive years worth of data can be analyzed and compared, both in spatial and/or in graphed formats.

Figure 2.

How did using the GPS benefit the project?				
It told us actually where we were and gave us a place to put our information. It gave us a "downstream" perspective for measurement and comparison.	It hooked into the GIS and the data tables and maps and the program overall.	It helped us pinpoint the sites with true latitude & longitude, and to piece the maps together to connect the river with the GIS.	It helped us get a better sense of the maps and to pinpoint the sites on the map, and to connect to the interactive maps and tables in the GIS.	It made things more visual for us and for our presentations. It connected our data and made our case more professionally.
How was GIS used?				
It gave us a place to put our information and organize it. It helped us to actually see what we were doing in the field from a different perspective. It was easier to find the information after we put it into the GIS.	It used the information from the GPS. The data we gathered, we entered into GIS to connect it with existing map information [layers].	To show "what our results were" to compare sites & comparative effects to determine cause & effects.	We used GIS to map the sites and to plot where high concentrations were nearby, and to analyze from the plot maps what the industrial uses were that might have impacts [or be point sources].	We were able to lay out maps and put all our information in one spot. It made it easier for us to look at all of our data and analyze it. And to make it clearer in presentations and to review it ourselves.
Do you expect that you will work with GIS in some future capacity?				
I hope so! Probably in college depending on my choices. (female, gr.8)	We'll use it this year, I know that. It'll depend on whether I go into science or geography.	Probably--in Marine Biology or mapping the seafloor--in navigation or other marine	Yes, I think it'll help me in the future--I used it this summer! I mapped the shellfish we	Yes--I used it this summer! Probably doing field work in college.

	(male, gr. 9)	science work (male, gr. 9)	planted this year. We also took the GPS out to the areas of high concentration and low densities [of shellfish] and coordinated them with aerial photos. We mapped some commercial and private shellfish grants. (male, gr. 9)	(female, gr. 11)

In view of these facets of GIS application, the need to sequence certain prerequisite skills emerged as a focus for study. Preparation for GIS instruction might include basic keyboarding skills, database and/or spreadsheet skills, basic geography, cartography and orienteering skills. As teachers develop familiarity with the uses of GIS, these curricular issues may become more apparent. Fundamentally, this assumes a virtual application of actual research findings.

Middle school teachers Ann Thompson and Rita Hagevik have found that middle school students needed to apply the GIS to a problem; that simply learning the GIS software was unacceptably "boring." http://www2.ncsu.edu/unity/lockers/project/midlinknc/gis/gis_intro.htm
Thus a hands-on application or manipulation of data within a GIS format appears to be the most effective practice. This lends itself to the metacognitive level of thinking and learning both with and about the new technological application.

Teacher Perspectives

Teachers that have introduced GIS have commented on the ways in which collaborative use of the application has expanded the classroom to both the environment and the community.

> This is a wonderful collaboration with the Town. The Town has shared its GPS/GIS resources, so we have expanded computer and GIS resources in the school. Students are now our liaisons to the town and the town has gained the energy of its youth as active and productive citizens. . . .There is a new GIS course in the curriculum this year. Our work is spurring other courses to use GIS in Business courses and CAD courses. There have been lots of requests by Social Studies teachers for maps from the Town--the teachers are learning about the technology and its products. . . . The project developed student leadership and career development--several of the students have been hired by the town already.

While this coastal biology teacher's comments focus not on the biology that drove the project, there is a strong relationship to the characteristics of the National Association for Science, Technology, and Society (Yager, 1993) approach. The omission of comment on the science contrasts with the students' views that they were learning aquatic and marine biology.

Since GIS is often municipally-owned, it was viewed by parents and community members as an economically and environmentally beneficial use of technology for the community. A local non-profit land trust initiated the collaboration between the town and the school. Prior to the project's first year, an intense debate over school budgeting had divided the two entities. The land trust and the school's Community Service coordinator saw an opportunity for more positive relations, and worked together to secure state funding for the project. Local agents from the GIS department, the Conservation department, and the Coastal Health Resources office collaborated in the design and training of students and adult volunteers in the project.

> **Community Perspectives:**
> Public awareness was raised by putting out information and communicating it using GIS. Before, we had arguments. Now we have "hard data." When children are involved, and they're doing research in the community, there is greater consensus. The "trickle-up" theory really works! As a community member, whatever is done to raise students' consciousness, raises the consciousness of adults. . . . The school has gained some tangible resources and a real-world multi-disciplinary project. The skills students are learning transcend the traditional boundaries of the school and have inspired new innovations. . . . The community service is valued in multiple settings across the community. Through this project, the environmental organizations and agencies have made connections with the business community.

> **Parent perspectives:**
> Students are a very valuable resource--they're full of energy, they want to work in the environment, and it's good economics. My son has shown me commitment to this program. School recruiters were most impressed by participation in [the project]. [The project] makes practical applications of skills students are learning in school, and enhance their interest and effort at school. Finally the concept of "slope" in Math class had some practical application! . . . The intergenerational aspect eases the transition from Middle to High to college level. Presenting at a university conference added significantly to [our daughter's] self-confidence. This experience has helped our daughter to make better decisions about her future.

Problems implementing GIS

It would be a misrepresentation of gross omission not to mention the many problems associated with initiating GIS use in a school-community project. While the outcomes have eclipsed the relative importance of those problems, it is important to acknowledge for those interested in instituting this technology that "start-up" is more complex than loading a software program.

The problems encountered in the GIS education implementation included hardware, software, and general public school computer lab issues (viruses, time constraints, etc.). GIS training in an intergenerational group presented unique problems and implications. While middle and high school students, more "technology-ready" than adults, learned GIS applications quickly, adults progressed more slowly and became frustrated more easily, causing disturbances. Out of this intergenerational training experience comes the recommendation that trained students become team leaders or instructors' assistants to aid adults and new learners in subsequent GIS training sessions.

Conclusions

Acknowledging the associated problems with implementing GIS and the problems with reinforcing a technology-related learning approach, there seem to be some community benefits to its inclusion in a balanced program of actual and virtual research. Whether the community in question will, in fact benefit from the environmental assessments conducted will only be borne out over the long term.

The characteristics of the project seem to align with those of the STS "megatrend" (Yager, 1996) and the students apparently focused on the science versus technology. Also reinforced were some of Tapscott's (1998) findings among those of the generation currently "growing up digital" regarding facility with technology and a sense of social responsibility. In their own words, students described a "connection" between their field work and the mapping of local officials. This connection represents the difference between technologies that entertain versus those that educate and empower. In the act of producing information that constructs "new concepts of energy and place," students involved in actual research participated in a wholistic and balanced experience that included a virtual application. This distinction, I caution, is critical as we approach integrating computer technologies and as we construct educational communities.

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[1]See Shaw et al (1997)

[2]Callahan in Education and the Cult of Efficiency documents the history of industrial efficiency models as systematizing education. Illich (1973) observes that the technological system is built upon "radical monopolies, a monopoly of consumption by advertising, of circulation by transports, of health by the existence of official medicine, of knowledge by schools, etc." Ellul in The Technological Society (1980) summarizes, "It is essential to realize that the man always spoken of is now a technicized man. . . . And here is the final proposition. Man in our society has no intellectual, moral, or spiritual reference point for judging and criticizing technology." Ellul's "technicized man" is one that he describes as dependent upon technology to define his choices and his freedom; that freedom and choice are at once defined, limited, and prescribed by a self-perpetuating technological system. Postman in Technopoly (1993) classifies cultures into "three types: tool-using cultures, technocracies, and technopolies. At the present time, each types may be found somewhere on the planet. . . . Technopoly eliminates alternatives to itself in precisely the same way that Aldous Huxley outlined in Brave New World. It does not make them illegal. It does not make them immoral. It does not even make them unpopular. It makes them invisible and therefore irrelevant. And it does so by redefining what we mean by religion, by art, by family, by politics, by history, by privacy, by truth, by intelligence, so that our definitions fit its new requirements." Johnson (1994) in the Bulletin of Science, Technology and Society reflects, "my concern today is with technicized education . . . What can, what should, what must a technologically mediated education accept as its moral responsibility in all this? What will be the ethic at he heart of its resistance? Such an ethic of resistance will have its origin in a moral critique, and a practical plan of action, that consciously resists the dehumanization of persons through their captivity to Technique. If education is our conscious effort to realize our humanity, education will be a central locus in this struggle." In The Science Teacher (1993), Yager outlines the characteristics of a Science, Technology and Society (STS) approach. Too numerous to list here, the foci are on local issues, problem-solving, citizenship and responsibility, authentic research, applying skepticism, and considering the political, economic, moral, and ethical aspects of science and technology. In his preface to Science/Technology/Society As Reform in Science Education (1996), Yager reminds us, "Interestingly, technology (how the human-made world operates) is seen as more important today than science (how the natural world operates). And yet, it is rarely taught to all students across the elementary and middle school years."

MERIDIAN

Applying the Unlimited Potential of the Internet in Teaching Middle School Science

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It was the opinion of Mark Twain that the person who did not read good books had no advantage over the person who was illiterate. If Twain were alive today, what would he have to say about our use of the Internet as an educational tool? What manner of "computer literacy" are we providing? Unquestionably, the Internet can be a valuable resource and powerful tool. Through the Internet, students can be involved in rich classroom learning experiences in ways that were not merely possible but scarcely imaginable without the use of a computer. It is now possible from the classroom to find weather reports and forecasts for any city in the world; students can be directly involved in environmental projects with other schools across the nation; and without ever leaving the classroom, you can take students on field trips to various museums, the Galapagos Islands, and even the virtual edges of the known Universe. How could any of these things been done prior to the computer age that gives us ready access to the World Wide Web? These are just a few of the incredible opportunities that the Internet has to offer if it is used to its greatest potential. Yet, in most classrooms where the Internet is being used, the applications and strategies that might really allow students to begin tapping such potential are conspicuous by their absence.

The majority of teachers who are using the Internet use it primarily to find information. Essentially, the Internet is being used as a high-tech (and expensive) encyclopedia. Thus, students learn how to use the Internet to "look up" factual information on the Internet, just as they would in books. And after the students master such competencies, just what advantages do they have over the "Internet illiterate" peer who only knows how to use conventional paper reference ? Our intent with this article is not to justify, nor to condemn using the Internet as a glorified encyclopedia, but to suggest better ways to implement the World Wide Web as a powerful teaching tool.

Valid concerns have been raised over the inappropriateness of some of the material to be found on the World Wide Web (Jackson, Bourdeau, Sampson, and Hagen, 1997). We feel there is little need for the students to be involved in an open-ended search for information. This could be a

waste of time and also very risky due to the amount of adult sites that could appear. Ideally, if the teacher is setting up a lesson plan on a subject, they would be responsible for finding the most appropriate Websites ahead of time. Our solution to the argument proposed by Jackson and others, appears in the identification of specific sites that can be used for detailed educational purposes.

We consider three general educational strategies, each of which taps into different strengths of the Internet as an information delivery system. First, through daily activities, students learn how the Internet can help them be informed citizens in an age of information explosion. Knowledge bases are changing and growing rapidly; students need to learn how to stay up-to-date if they are to be "informed citizens." The daily exercises described here address this need through activities that tap into the Internet's strengths of (1) providing up-to-date information and (2) providing easy access to a broad base of information. Second, through weekly project activities, students learn how the Internet can help them be contributing members of society in the age of the "global village." These activities tap into the Internet's strengths of allowing interactive informative exchanges. Finally, through Cyber field trips students learn how the Internet can help them explore the wonders of the universe in exciting ways that could barely have been imagined only a few years ago. These activities tap into the richness of the information base available on the World Wide Web.

Daily Exercise

We propose that the Internet can be effectively used through daily exercises that approach the Internet less like an electronic reference book and more as an electronic newspaper. These exercises are scheduled as daily activities for the same reasons that newspapers are read daily--the focus is on information that is constantly changing, such as current events and weather reports. In addition to exploiting the Internet's strength of provider of up-to-date information, these exercises should utilize the Internet's strengths for easy access to promote integration of the curriculum. For example, in the absence of a resource such as the Internet, you might turn to the daily paper for current weather reports (of limited depth) and information texts for more in-depth "science content" information. Why not use the Internet to check out current conditions and forecasts and then "browse" into content areas in more depth while you are at it? Math lessons naturally fall out of this application as well (e.g., graphing and measurement exercises), not to mention opportunities to delve into meaningful geography (and other social studies) content. A good Internet resource for this activity is the Weather Channel homepage (http://www.weather.com/twc/homepage.twc).

At this weather channel homepage sight, you can actually call up the five day weather forecast for your own state and city, or many other parts of the world for that matter. You could take your students to this sight every day and have them observe satellite pictures or Doppler radar for your region. There is even a section called the weather classroom where you can guide them in learning about all things involving the weather: from hurricanes, tornadoes, and winter storms; to how to measure precipitation and temperature; to how to actually become a meteorologist. Graphing techniques can easily be incorporated into these lessons. For example, students might

graph temperature against other parameters. Student's can build a weather station and compare their data with the data provided on the net. Storm tracking provides an effective and meaningful means of teaching about longitude and latitude and X-Y coordinate systems. By visiting this sight every day, students will gain appreciation of the importance of being able to predict the weather and come to better understand how the entire world depends on this knowledge for not only travel, but for agriculture and human safety.

You could take them to find out Today's Earthquake Activity Around the World (http://inspire.ospi.wednet.edu:8001/curric/land/todayqk.html). At this sight you can find the date, time, location and magnitude of the most recent global earthquake activity. Let the students discover if there has been any seismic activity anywhere near their city or state. They can also use the instructional student activity that is provided to learn how to predict the location of an earthquake.

Jean K. Martin makes the observation that "when students browse through the Web, they look for striking pictures; such pictures make students want to learn more about a topic." (1997). If you are studying the stars and our universe, why not take them to Amazing Space: Education Online from the Hubble Space Telescope which is affiliated with the Space Telescope Science Institute (http://oposite.stsci.edu/pubinfo/amazing-space.html). Martin and her associates have created educational lessons that all grade levels can participate in. This site also highlights the thousands of pictures the Hubble Space Telescope has taken that the students can view. There are mind-numbingly beautiful pictures of the wonders of space added to this archive almost daily. Any one of these images could spark a topic of conversation that can be used to interest your students in astronomy and/or the physics involved in these galactic processes. This sight could also be used in the Cyber Field Trip category that will be discussed later in this article.

Project Involvement

Through the Internet, you can access tremendous resources that have been specifically designed (and are maintained) for classroom science (and other) instruction using the Internet. That is, the projects are designed to teach about a traditional content area and about using the Internet and telecommunications. The Project Involvement activities focus on using the Internet to interact with students in other settings on relatively large scale projects. Through these resources, students can conduct research and compare their findings with the findings of others (both students from distant classrooms and in some case with real scientists)--a central component of real-world science that was once too impractical to incorporate into classroom activities. Many of these resources lend themselves nicely to a schedule of (about) once-per-week lessons.

As examples of resources suitable for a weekly Project Involvement activity, consider the Students-as-Scientists Website (http://smec.uncwil.edu/glaxo/sas/index.htm). and the Globe Project (http://www.globe.gov/) webpage. Both of these projects involve middle and high school students from schools located throughout the country who are gathering environmental data to be

used by other students as well as scientists for information gathering. The Student-as-Scientists project allows students to not only compare their findings with those of other student researchers, but those of professional scientists conducting similar research. You and your school can become a part of either of these studies or you can use the data presented on these pages to help supplement your environmental studies in the classroom.

The Students-as-Scientists project is a growing North Carolina based program that will allow your students to go out into the field, take water samples, and test the samples for numerous parameters such as dissolved oxygen levels, pH, carbon dioxide content, temperature, nitrate levels and others. This information will then be posted on the web to be compared to scientist's data from nearby locations. It will also allow local scientists access to data from locations that may not be within their gathering area. So, not only will this give scientists information that they may not have, but it will allow students to have a feeling of importance in that their data will be looked at by not only their peers, but also by the scientific community.

J.F. de La Beaujardiere describes the Globe Project as "a World Wide Web-based, user-friendly... interface providing access to visualizations created [specifically] for GLOBE." (1997). This project is similar to the Students-as-Scientists project, but along with water data, it also includes atmospheric observations, soil investigation, and biology investigation. Both of these projects have or are developing an Ask-a-Scientist component where questions about the various aspects of these projects can be sent to be answered. These are just two examples of ongoing projects that were developed specifically with educational use in mind and would be ideal for use in the classroom setting.

Cyber Field Trips

Our third recommendation for using the Internet in the classroom capitalizes on both the quantitative and qualitative richness of the World Wide Web information base in what we call a Cyber Field Trip. After a unit on rocks, why not take the students on a Cyber Field Trip by way of the Internet to The Mineral Gallery (http://mineral.galleries.com/)? On this trip, students can call up any mineral, such as their birthstones, and see what the actual stone looks like, as well as call up written documentation about its properties and uses. From that site, you can use the Geology Link (http://www.geologylink.com/) and extend the outing to a virtual field trip to any region of the world. Students can see pictures of volcanoes in Africa or find out how coral reefs form at the Great Barrier Reef in Australia.

Students can experience the Exploratorium (http://www.exploratorium.edu/). The Exploratorium is a museum of science, art, and human perception with over 500 interactive "hands on" exhibits. With such topics as Sports Science, Searching for Radio Emissions from Alien Civilizations, and a virtual Cow's Eye Dissection, this site covers a broad range of science educational themes that could easily be implemented into your classroom.You could go to the Terraguest homepage (http://www.terraquest.com/) where they offer a virtual field trip of the "living laboratory of evolution", the Galapagos Islands or even a trip to Antarctica. Both of these explorations delve

into the history, ecology and wildlife of that particular site. The Field Museum of Natural History in Chicago (http://www.fmnh.org/default.htm) offers an on-line tour of our Earth before dinosaurs, during the dinosaurs, and after the dinosaurs. Basically, a field trip through geologic time!

Never before in the history of civilization have educators had so many places to go and so many project opportunities available to them. In this time of budget cuts for supplies and field trips, the computer is a tool that can be utilized to fill that void. It is up to us to use the Internet to its greatest potential. The Internet's greatest potential is not as an expensive encyclopedia, but as a resource that will allow teachers to use and manipulate the world's knowledge in such a way that students can explore our planet without having to leave the classroom.

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MERIDIAN

Touching the Future-The SWAT Team Movement

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Imagine young children walking around the school with cool SWAT Team T-shirts and proud that they are the technology leaders for teachers and students. ***Imagine*** seeing children assisting teachers with Internet research, and helping young students find their way with technology. ***Imagine*** a student approaching you at a local library and asking you if you need help using the Internet. ***Imagine*** taking advice from a student about cool web sites or how to discriminate between good research on and off the Internet.

Imagine no more... The SWAT Team, Students Working to Advance Technology is not only impacting the elementary school where it all began, but pilot sites are springing up all over the United States with the same mission, students helping others. The SWAT Team is all about empowering children to be the leaders of tomorrow, they so happen to enjoy technology, too!

Why is the SWAT Team sweeping the nation?

What began as a simple idea to develop a school web site a year ago has exploded into a revolutionary program to put the simple task of technology integration in the hands of children where it belongs!

The original SWAT Team, at Davis Drive Elementary school in Apex, NC consisted of 35 students the first year and grew to 78 students and six task force teams this year. The task force teams consist of Web Page Designers, Internet Researchers, Computer Buddies, TV/Weather Internet Crew, SWAT Team Central and SWAT Team Mobile Unit. Each task force team has a specific job to do. The web page designers maintain the school's web site:



(http://www.geocities.com/Athens/Forum/6607/index.htm). The Internet Researchers save teachers time by conducting Internet research for their lessons. The Computer Buddies assist

younger students with word processing and other computer related tasks. The TV/Weather Internet crew broadcasts morning weather information acquired from the Internet. The SWAT Team Central Unit assists with computer maintenance and the SWAT Team Mobile Unit teaches technology to the community.

After submitting a proposal to Technology and Learning Magazine (http://www.techlearning.com) and Microsoft's annual Teacher of the Year contest, I was chosen the National winner, and received the award by Bill Gates himself at the National Educational Education Computing Conference in Seattle, Washington.

Since then, I was hired by the North Carolina State Department of Public Instruction as an Educator on Loan to continue my work at Davis Drive Elementary School, to promote the SWAT Team program, and to present my program at local, state and national conferences to help other teachers learn more about how to integrate technology through the Teachers Connect project, (http://www.ofps.dpi.state.nc.us/OFPS/tc/)

The SWAT Team Web site, developed by Chris Cobitz and hosted by North Carolina A&T State University, offers information about the SWAT Team inclusive of replication materials available for downloading. Schools interested in having a SWAT Team at their school can sign up on the SWAT web site and become a part of the national network of SWAT Team pilot sites. (http://www.ncat.edu/~schofed/swat)

SWAT teams are growing everywhere, from elementary to high school levels. Currently there are several hundred children who are a part of the SWAT Team movement and an undetermined amount of individuals who will ultimately benefit from the children's expertise and assistance! The beauty of the concept is that it costs no extra money to have a SWAT team, all you need are willing students, and a person to coordinate the program. Having a SWAT Team saves teachers valuable time, what we all could use!

How to Start a SWAT Team

- Assess the technology needs of your school and community
- Communicate concerns with administration, teachers and the community
- Develop your mission, goals, priorities, plan of action, and methods of evaluation
- Announce the plan to the students via school announcements and classroom visits
- Distribute applications, gain parent permission
- Conduct interviews
- Select the team

- Train the students
- Monitor and evaluate the program

Nitty Gritty Logistics for Running Your Own SWAT Team:

- Keep everyone informed, every step of the way, about your plans, wishes and dreams. It will save a lot of confusion when you begin to storm ahead with your troops!
- Inform your administrators and teachers of expectations of the mission of your SWAT Team.
- Go beyond what is typical, take some risks and run with your program.
- Look at the needs of your school, and then design the jobs the kids can do.
- Try to find all the ways you can meet your local or state technology competency goals through this program.
- Invite parents to your meetings, you never know who will rise to the occasion and take over a Task Force Team to save you even more time.
- Lean on the businesses in your community for support, hand them a brief proposal and ask them how they could help your efforts.
- Remember when you are searching for money try writing some grants, use mine to get a jump-start. Go to the Internet and search out possible grant opportunities. Ask a parent to help with searches, too. Better yet, ask your "Internet Researchers".
- Remember to constantly check the school calendar to avoid conflicts with SWAT meetings.
- Put your SWAT kids on a mail list and communicate with them via email, saves time and paper!
- Have a parent do all the T-shirt orders.
- Train your SWAT students to do your PowerPoint Presentations, they will love to do this for you.
- Get that Web site up; the Web Page Designers can do it for you! Show off to your community and they will support you even more.
- Call a local Tech corporation, and ask them to allow the SWAT Team to go on a tour of their facility, show them the real world of technology!
- Take the kids with you when you do staff development or presentations, you are helping them develop skills that will be vital for them in the future!
- Always try to include special needs students, they can benefit from leadership activities, too!
- Try not to exclude any child who is interested in becoming a SWAT member; remember you never know if this will make a difference in their self-esteem and personal growth as a human being!
- Remember this is for the kids, let them take charge when ever you can, you'll be surprised how much they do know and how well they can teach us all!

The Student's Voices

If you ask any SWAT Team student why they like being on the SWAT Team you'll hear, "because I like helping others" and "I want to tell the world how good technology is and how

technology can help the teachers. I want to go to different schools to help them make SWAT teams and I want to talk about how important it is to have all schools on line." I also know that by their involvement on the SWAT Team the students will gain necessary technology competencies, job skill training and learn valuable social and communication skills. Students are learning about technology in a fun and natural way. I emphasize in my workshops that it is not about how much technology your school has, but how you use what you have, how you empower the children and how you involve the community. In a recent luncheon keynote speech at the South East Regional Technology and Teaching Conference in Greenville, North Carolina two of my students accompanied me as part of their SWAT Team involvement. This is what Rachel Simes and Graham Sheldon had to say about being on the SWAT Team.

"On the SWAT Team I feel like a leader. My teachers always rely on me to figure out the computers when something goes wrong. When I help it makes me feel proud knowing I could do something that my teacher did not know how to do. I also help my friends learn about computers. I show them how to get on the World Wide Web" another student said, "What I do on the SWAT team gives me confidence to do other things. I have learned how to speak in front of large numbers of people without getting stage fright. I have learned how to answer questions when people ask me for help. I am now learning how to play the piano. I didn't do it before because I was afraid to go to recitals, but now that I have had the opportunity to speak in front of large numbers of people. I now have confidence in myself. I'm not afraid anymore!"

The Community Extension-The SWAT Team Mobile Unit

I often say I just can't stop at the school level when thinking about the future of technology. I ask where are the natural learning environments that can help us all to learn about technology?

The SWAT Team Mobile unit began as a risk. As a true visionary and team player I met with administration, parents and community members and asked them all to think about the ways we could help children and their community learn about technology. The local library is a logical location, so I walked through the doors of Eva Perry library, and shared my proposal at a library staff meeting. A few weeks later, Teresa Young, Youth Services Department Manager and Kathryn Yensen, Librarian, accepted our 12 SWAT Mobile Unit Team with open arms. The SWAT Team Mobile Unit is serving their community in a special way! Fourth and fifth grade students are helping other children, who visit the library, with Internet research, helping the

library staff with finding cool sites for the library web site (http://wakecounty.state.nc.us/), and also learning to access and discriminate what makes a good source for information. The SWAT Team students were trained by the library staff to help the public discriminate between text reference and Internet research and how to integrate what is relevant into a research project. It is a vital skill that we all need to learn in order to face the overflow of the Information age!

For more information about the Mobile Unit and Eva Perry Connection visit http://www.microsoft.com/education/k12/articles/intnov97.asp

A Middle School Pilot

The pilot sites are now offering information as to how one can adapt the SWAT Team program to meet the needs of their school and grade levels. Jeanne McBrayer, Curriculum Integration Coordinator at Wake Forest- Rolesville Middle School in Wake County Public Schools shares an excerpt of her experiences with her Middle School SWAT Team Pilot Project. Her adapted forms are also posted on the SWAT web site for replication.

"My school entered the world of SWAT through the "back door". I was trying to obtain a free Internet account for our school, and find that an Internet service provider would give us account credit if we created a school webpage and used their logo somewhere on the page. They would even provide us with a print tutorial and software with school webpage templates. I decided to attempt the challenge of creating a webpage, but thought it should be a student project. I needed a team of students to write and contribute to our homepage. I was mulling over ideas about how to form a technology club, and was writing grant proposals for a digital camera and scanner, when I met Lucy Miller at a grant meeting in our county. Being a busy person, I decided not to reinvent the wheel, but to become a pilot site for SWAT and use some of Lucy's wonderful ideas and even her forms. Soon after the meeting, I attended Lucy's presentation at the Coastal Carolina Technology Conference in Wilmington. After that, it was a matter of recruiting and selecting students for my team.

I like the idea of students applying and interviewing for SWAT positions, especially since I am in Vocational Education and always looking for tie-ins to career skills. I basically used Lucy's application and interview forms, but added another requirement. Each student had to get three staff members to sign their application forms as a reference. I sent a note to the faculty asking them to sign only for students who would be an asset to the team. I did not know whether I would have nine or ninety candidates. As it turned out, I have fourteen members on our team. I accepted everyone, who applied.

With such a small SWAT team, there was no need to break down the job assignments into squads. Everyone is on each task group. We focused on the need at our school for Web Masters, Computer Helpers and Internet Researchers. Our biggest project so far has been getting our web page up and running. I knew nothing about it, but the tutorial and template from our local Internet service provider were just what we needed. We looked at pages from other schools, studied the source documents of their pages and figured out how to add the tags to code our text. I found that what the students wanted to include was not necessarily what I thought was

appropriate! They liked the bells and whistles and things, which appealed to their age group. I have comprised, negotiated, and flat out vetoed some of their contributions. I have allowed them to have a SWAT Team opinion link off of our home page where they can put their opinion surveys and commentaries. Some of the girls are starting an advice column, and a couple of boys have SWAT Team Favorite Links to pages about movies, skateboarding and video games. We are lucky in that we can ftp from our own site as often as we like, so we are constantly updating and changing our information. Now that the basic pages are out there, we are getting the rest of the school more involved in submitting information for the webpage.

At the middle school level, being Computer Buddies or Helpers is not too feasible on a regular basis. Middle school teachers do not like students to miss class very often. Therefore, I suggested that SWAT Team members only work with their core team at school. We have not done much training yet on trouble shooting, but are planning a session in the near future.

As far as the Internet, we have had a few requests from teachers for research, which I assign to the SWAT Team students. They use their home computers to look up websites and summarize information. Next year we hope to have the whole school networked with Internet access, so I anticipate that the Internet Researchers will be more in demand.

Future plans include a guest speaker for our town who will describe his career as a commercial web designer; troubleshooting and software training, and possibly an after school outing to some technology-related site in our area. I think there is a virtual reality lab at UNC-Chapel Hill that might let us come and experiment. I have really enjoyed the chance to work with the middle school students on our SWAT Team."

Another Special Pilot Story To Tell!

At William C. Friday Middle School and Web Street School in Gaston County, North Carolina, Gail Brannon and Renee Beale, Special Education teachers, are working together training their special needs students as SWAT Team members. Regular Education age peers at Friday Middle School, will work with their students as Internet Researchers, Computer Buddies and Weather Reporters. The more challenged students from Web Street School will travel to Friday Middle school to work with these teams of students. Everyone, in spite of their own personal challenges, will work together to help one another with technology. I can't think of a more heart-warming story to share!

(For additional information about middle school SWAT Team Pilot sites remember to visit the SWAT Web site at http://www.ncat.edu/~schofed/swat.)

So now *imagine* having a SWAT Team *help you* serve the technological needs of your school -*Imagine* giving children the opportunity to become leaders and promoters of technology. Like Jeanne, Renee and Gail and their missions. There are SWAT Team pilot sites at the middle, and high school and elementary level that are doing what is best for children. Technology Leaders are now stepping in and supporting the SWAT Team concept. The University of Rhode Island in cooperation with the Rhode Island Foundation are offering incentive grants to teachers who develop SWAT Teams at their schools. The money will cover release time for teachers to plan and organize the teams.

Empowering students, meeting the needs of the school, meeting technology competencies and consequently saving teachers some time is how we should be looking at technology, and how we should promote and integrate learning. It is not about the school who has the most expensive equipment, but about our natural resources, our children, their talents and their natural desire to help others!

MERIDIAN

Evaluating Internet-based Information: A Goals-based Approach

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Introduction

A high school junior is asked to write a report about the Holocaust, a topic that her class has not yet discussed. At home our student uses her computer with access to the Internet to research the topic and word processing software to construct the report. She spends an hour searching the Internet and examining a variety of web pages about the subject and selects three web sites that are particularly compelling because of the graphics and layout of the pages, indicating authority.

Our young woman copies text from the pages, carefully paraphrases some, quotes others, downloads images and pastes them into the appropriate spots on her file, prints a professional looking report, and proudly turns it into the teacher two days later. She has used the Internet to explore, discover and report information about this historic event and her word processing software to craft a rather impressive looking information product.

As can easily happen today, each of the web sites that our student used were published by neo-nazi and white-supremacist organizations portraying a biased point of view -- and our youngster's report becomes a reflection of this divisive perspective without the student even knowing it.

This kind of scenario has many educators concerned about using of the Internet as a reliable resource for academic information. The fact is that almost anyone can now publish on the Internet, while only a few years ago, nearly everything that you read was filtered by editors and presented based at least on its economic value if not for its scholarly worth. Today, anyone with an axe to grind can do so over the Internet and with a look of authority. At the same time the Internet is increasingly becoming the first and preferred source of information for many of us.

In response to this concern and the scenario above, I believe that the presence of inaccurate and biased information on the Internet is not our primary problem. The information and points of view have not really changed, it is the tools that have changed. Today, our students use professional and sophisticated information tools and global electronic networks to complete their assignments while most of us used pencil and

paper and the information resources that existed in our school library. While we did our work with what could be compared to a $12 box of Lincoln Logs, students today have at their disposal professional tools and virtually limitless materials, as if they have an entire *Builder's Supply* warehouse to work from. While we assembled our reports with children's building blocks, today's students can craft their information products with word processors, enrich them with multimedia mined from the Internet, and empower them with hypertext. Their work can be compelling and it can be published to a global community.

The real problem with the scenario above is the assignment. The problem is that we are still, by and large, giving Lincoln Log assignments -- "Write a report about the Holocaust." These advanced and powerful capabilities that are increasingly available to our students beg for a different kind of assignment. Writing a report **about** something has as its goal the demonstration of gained knowledge. Yet gaining knowledge becomes only a small part of what students should be learning to prepare them for a world where knowledge changes and information grows at dizzying speeds. In fact, in the information world, their jobs will be to help in growing knowledge by becoming information builders.

From the perspective of the builder, our students have aisles of information processing tools to choose from and an Internet warehouse from which to choose building materials. The difference is that the builder, in the middle of Builder's Supply, has a task or project in mind, something that he or she plans to build for the enjoyment and convenience of others. Our builder has a goal behind his or her selections of tools, lumber, and nails.

Likewise, as students browse through the Internet, looking for information raw materials, they too should have goals for their work. The difference between "Lincoln Log" assignments and what students should be doing today, is that our young high school junior should have had a goal for her report beyond that of just earning a grade. Because she can produce such impressive work and it can potentially be published for others to see and use, her goal should be behavioral. **Students should be building their information products to affect impressions, decisions, beliefs, support**

or defeat positions, or create new knowledge.

Goals-based projects have a variety of benefits:

- Goals-based projects provide a context for the student's work that is authentic. They are collecting, synthesizing, processing, assembling and expressing information for a reason that is real and beyond the pursuit of just a grade.
- Students are less likely to simply copy and paste large chunks of text as they would if they were writing **about** something. They will find and copy smaller chunks of information and then carefully assemble them to produce information products that are designed to accomplish something. They will also provide mortar between these building blocks to hold them together and lend them relevance to the expressed goal.
- Goals-based assignments also lend themselves especially well to the use of rubrics. The student's goals can become part of the rubric's goals, with teacher or student defined benchmarks.

Goals-Based Evaluation

What do goals-based assignments have to do with evaluating Internet resources? Let's return to the builder's analogy. One of the many things that my father taught me is that when you are building something in the workshop, the number one key to success is using the appropriate tools and materials. Walk into any "Builder's Supply," and you have a virtual Internet of tools and building materials available to you. As you examine them individually, they are not judged as good or bad, but simply appropriate or inappropriate for specific building projects. Our task, as the shopper, is to select the tools and materials that are appropriate to our goals.

Traditionally, Internet resources have been evaluated from the perspective of the information itself and it's source. This usually involves some type of checklist that puts all Internet information through the same sieve, evaluating each based on the same criteria. Here is part of a checklist that I developed several months ago after reviewing some of the many evaluation forms available on the Internet.

Does the author have the authority to present this information?	Yes [ ] No [ ]
Does the author have anything to gain by presenting this information?	Yes [ ] No [ ]
Does the publishing organization have anything to gain by making this information available?	Yes [ ] No [ ]
Is the information consistent with other published material on the topic?	Yes [ ] No [ ]

It is implied that if you end up with a sufficient number of "Yes" checks, then the information is good and you use it. If not, then the information is bad and you never use it. Some of these evaluation forms can be quite long and picky, asking researchers to check spelling and grammar. But the result is the same. The resource is either stamped "Good" or "Bad," and this approval has little to do with the work that the student is doing.

As students' information products should be based on teacher or student established goals, evaluating the material that they consider using in their products should also be goals-oriented. Rather than judging the material based solely on itself via an examination instrument that has nothing to do with the students work, it should be judged from the perspective of what the student wants to accomplish.

From this standpoint, we would not ask, "Is the author qualified?", but, "What aspects of the author's background help me accomplish my goal?" Under certain circumstances, a web page published by a neo-nazi organization might actually be appropriate for an assignment, while other resources, produced by people with credential would not. It depends on what the student wants to accomplish.

This approach actually serves three interesting purposes.

- The student is focused on drawing supporting or appropriate information into the project rather than just filtering "bad" information out.
- The student gathers information about the information.
- As students approach information with their goals to accomplish, they are less likely to be influenced by the goals of those who generated and published the information, which has interesting implications for ***media literacy***.

Information about the Information

The second benefit is of particular interest as Internet-based information meets with increasing suspicion. In the print-based world, it is only necessary to mention the author's name and a vague reference to the source. "John Robinson said in his book, Acres of Sound, that…". This plus a standard citation placed at the bottom of the page or in the bibliography alone is sufficient to render the information fact.

This will not be enough justification for information gathered from the wild Internet. Other rationale will be needed which might read like this:

> John Robinson, in his twelve month research at the University of Hawaii on the influences of motor sounds on the navigation of sea mammals, states that…

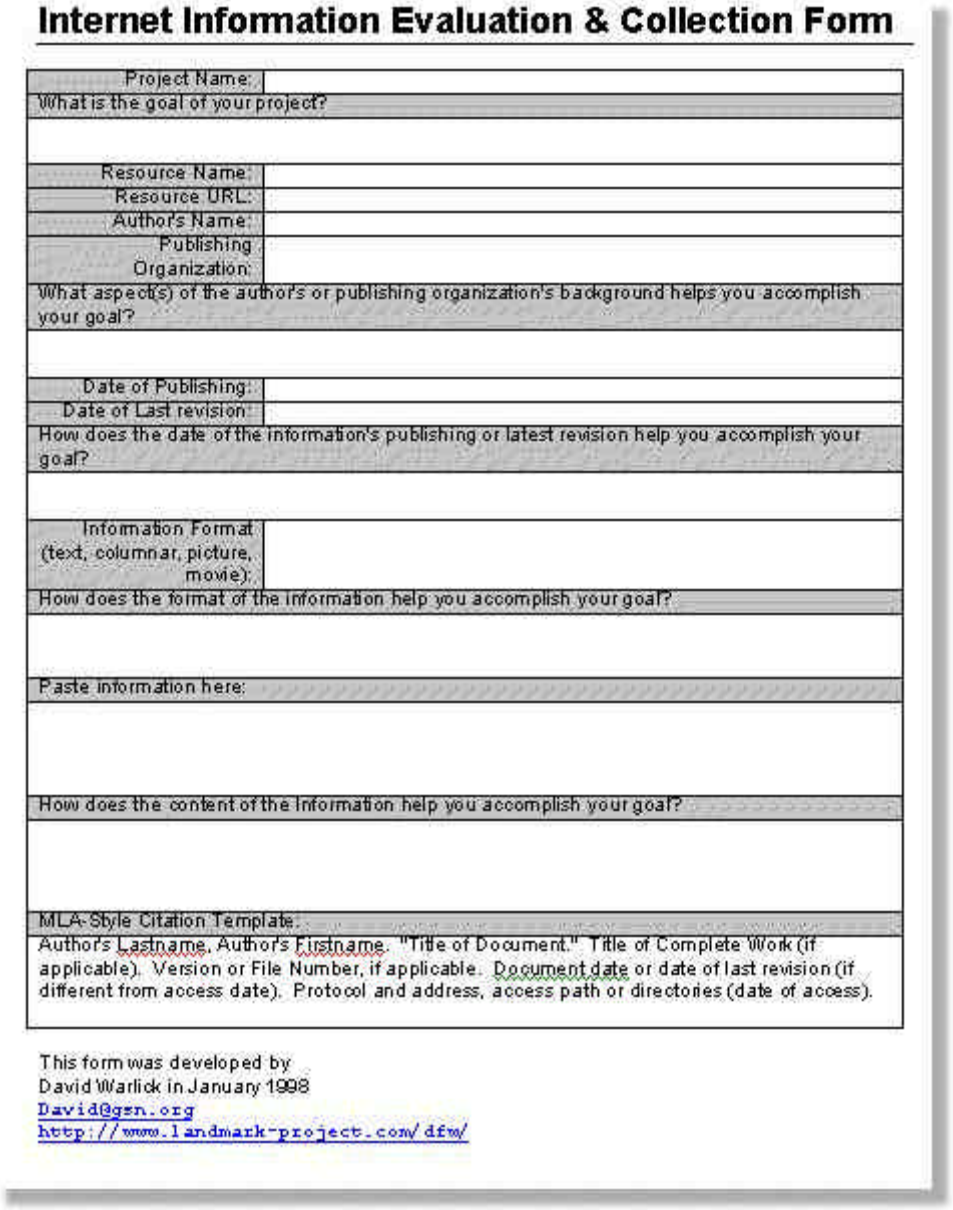
This more elaborate explanation of the information's source lends it credibility when a mere URL would not. Therefore, part of the evaluation process should be to identify and collect this sort of supporting information about the information, as justification.

Internet Evaluation Form

The form below has been created to help students evaluate Internet resources based on the goal(s) of their work. It begins with a statement of the student's goals, and then follows through with the collection of specific information with explanations of how the information supports the resource in terms of the student's goals.

Another assumption provides an additional basis for this form. As students are researching the Internet, we might safely assume that they are using a computer. Therefore, they should also be using a computer-based form for their evaluation and collection of information. This form is designed to be used as a computer file. The student will come to the computer with a disk, and will complete the form by typing their information into the appropriate spaces or by copying and pasting the information with the **Edit** menu.

The form that follows is available in three formats, Microsoft Word97 for Windows, Rich Text Format (RTF) for importing into other word processors and operating systems, and text for computers will limited memory where only NotePad or SimpleText can be run along with the browser.



Internet Information Evaluation & Collection Form

Project Name:	
What is the goal of your project?	
Resource Name:	
Resource URL:	
Author's Name:	
Publishing Organization:	
What aspect(s) of the author's or publishing organization's background helps you accomplish your goal?	
Date of Publishing:	
Date of Last revision:	
How does the date of the information's publishing or latest revision help you accomplish your goal?	
Information Format (text, columnar, picture, movie):	
How does the format of the information help you accomplish your goal?	
Paste information here:	
How does the content of the information help you accomplish your goal?	
MLA-Style Citation Template:	
Author's Lastname, Author's Firstname. "Title of Document." Title of Complete Work (if applicable). Version or File Number, if applicable. Document date or date of last revision (if different from access date). Protocol and address, access path or directories (date of access).	

This form was developed by
David Warlick in January 1998
David@gsn.org
http://www.landmark-project.com/dfw/

This form is available for download as a zip archive (.zip) file with this evaluation form. It can be decompressed with WinZip for windows computers and the latest version of Stuffit Expander for Mac OS. The file decompresses into three version of the above form. The Microsoft Word version (.doc) is for Word97 on Windows 95. The rich text format (.rtf) version can be opened into most other word processors, either Windows or Mac OS. The text (.txt) version is for computers with limited memory. This file can be opened into NotePad, WordPad, or SimpleText.

Description of the Form Sections

Project Name:

The project name labels the evaluated resource assigning it to a specific project. Asking students to assign a project name can also help them to think through their goals and to apply an identity to the project based on those goals.

What is the goal of your project?

Here the students will enter the goal(s) of their project in words that make it easy to associate other information resources to the goal(s) at hand. Again, the goals should be behavioral. For instance, how do you want to effect:

- what the readers believe,
- their impressions,
- how they makes decisions,
- their knowledge, etc.

Resource Name:

This is the name of the web site, ftp file, picture, graph, or map file.

Resource URL:

Enter the URL or electronic address of the Internet resource being evaluated and retrieved so that it can be revisited at a later date.

Author's Name:

Find the name of the person who authored or compiled the information. This is not always the web master of the page, and it may be necessary from time to time to ask for the author's name from the web master via e-mail. Another piece of information that might be valuable here is the author's home page URL. In many instances it is also good to have the name and e-mail address of the site's web master. He or she is usually the first contact point for the information being published.

Publishing Organization:

This is the organization that maintains the web or ftp site, or who sponsored the publishing of the information. In many cases the publishing organization and the author are the same. Again, the URL for the organization's home page might also be included in this space.

What aspect(s) of the author's or publishing organization's background helps you accomplish your goal?

This will be information about the author and the publishing organization that relates to the generation and publishing of the Information and that relates to the student's goals. This might also include special research in which the author is engaged or previous projects. Another example might be the mission statement of the publishing organization. It could also involve the research that lead to the information and other studies being conducted by the author. Students should examine this information and pull out aspects that are relevant to the topic and that lend credence to the information and its relationship to the student's information product goals.

Date of Publishing:

Enter the date that the information was originally published. If it was published separately in print and this information is available on the web site, include this date as well.

Date of Last revision:

This information is not always available. In some cases information web resources are not updated, just published. This information will, however, be important for time sensitive data.

How does the date of the information's publishing or latest revision help you accomplish your goal?

In many cases the most recent the information is, the more valuable it is. However, this is not always the case. Sometimes, depending on the goals of the information product, information generated in 1942 or 1066 may lend it more valuable to the goal(s). In this section fill in any information about the date of generation, publishing, or revision that enhances the information product in relation to its goal(s).

Information Format (text, columnar, picture, movie):

Enter the format of the information here.

How does the format of the information help you accomplish your goal?

Information format is of greater importance than most people believe. In information rich environments, it is essential that information communicate itself as effectively as possible -- and this involves format. Some types of information deliver themselves into the understanding of readers by being displayed in columns and rows of text or numbers. Others communicate better as graphs, and others as paragraphs of text. Another consideration in this section is the transfer of information from the Internet from one format to another. The information may come as tabular data, but you need to convert it to graph to more effectively communicate the information. All of

these notes should be entered in this section of the evaluation form.

One of the advantages of retrieving digital information from the Internet is the fact that it can conceivably be accessed, manipulated, included in the information product, and published without ever being printed to paper. Data can easily be copied from a web page or other Internet tool and then pasted into this section. If you are using MSWord or other more sophisticated word processor (especially if you are using a Macintosh), even pictures can be copied from the web and pasted into the evaluation.

How does the content of the Information help you accomplish your goal?

Why is this information important to accomplishing your goals? This is perhaps the most important part of your evaluation and should apply directly to the goals of the student's information product. Consider that this may be included in the product itself as supporting information about the information.

MLA-Style Citation Template:

You want to get all of the information about your resource that you can at one time, so that you don't have to return to locate specifics for your citation or for other reasons. This section provides a template for a standard MLA-style citation. Simply highlight each element (last name, first name, title of the article, date published, etc) and then replace it with the appropriate information from the web page. When you are assembling your information product, all you have to do is copy this citation from your evaluation form and paste it into your product.

Conclusion

The Industrial Age has resulted in a glut of manufactured products that find their way onto our store shelves, mail order catalogs, and into our homes. We see them and purchase them because they have value to us in some way. When I took shop in 1966, we learned the skill of producing items of wood and steel, but the items that we produced had value to us or to family members. They were built to be used. In the Information Age, information will be the commodity. Our world will be rich with it, and information will compete with other information to be used in ways not dissimilar to the competition among automobiles and washing machines.

Therefore, in the same way that the chess boards, and book shelves that we built in shop had goals of value that created context for the skills we were learning, the information products that students create today should also have goals of value and lend context to their learning.

Assignments should include:

1. A statement that the students' work will be available over the Internet

where it can be used by people.

2. A behavioral goal for the students' work, how the readers of their work will be affected.
3. An understanding among students that the readers of their work are not limited to those people in the classroom, and therefore the readers will not have the benefit of that environment. Therefore, their work should communicate itself clearly, completely, and independently, assuming that the reader knows nothing of the topic.
4. An understanding among students that the resources they select for their information product must support their goals.
5. An understanding that since information products will be available to a broad audience, they will likely receive feedback from that audience.

MERIDIAN

A MIDDLE SCHOOL COMPUTER TECHNOLOGIES JOURNAL

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MERIDIAN
A MIDDLE SCHOOL
COMPUTER TECHNOLOGIES JOURNAL

Editor's Note

Dr. Edwin R. Gerler, Ed.D. • Cheryl L. Mason, Ph.D. candidate

The Electronic Meridian in Middle School Education

On September 15, 1851 some people living near Geneva, Switzerland saw five suns in the sky. They were stricken with fright at this extraordinary spectacle and they believed that the sun was reproducing itself in order to destroy the earth and human existence with fire. What these people actually witnessed was an optical phenomenon created by light striking ice crystals in the atmosphere (Heuer, 1978).

The process of integrating computer and networking technology into K-12 education has often seemed as mysterious and elusive as "light striking ice crystals in the atmosphere." The goal of this new on-line publication, Meridian: A Middle School Computer Technologies Journal, is to introduce educators to the reality and possibilities of applying the latest technology to teaching and learning in the middle school classroom.

A perspective on the multimodal base of middle school education

Middle school education is, above all, a process of promoting growth and development in young adolescents, preparing them for the intellectual, emotional and social challenges of late adolescence and early adulthood. Middle schools incorporate interdisciplinary, broad spectrum educational processes that are enriched by the application of computer and networking technologies.

Many researchers have argued persuasively that educational interventions intended to foster both rapid and enduring development in students need to be broad spectrum in nature, what Lazarus (1981) has termed multimodal interventions. In other words, success in middle school education depends on deliberately influencing a variety of domains that are essential aspects of human functioning. Lazarus has identified these domains as behavior, affect, sensation, imagery, cognition, interpersonal relations, and diet and physiology; he used the convenient acronym "BASIC I.D." to identify the domains.

Case studies as well as numerous research projects during the last two decades have shown the multimodal approach to influence variables important to students' learning. Case studies, for instance, demonstrated the positive effects of multimodal interventions on social and emotional development (Keat, 1985), on self-concept (Durbin, 1982), and on performance of various school related tasks (Starr & Raykovityz, 1982). Another case study (Keat, Metzgar, Raykovitz, & McDonald, 1985) showed that multimodal group activities improved school attendance. Controlled studies involving multimodal programs in the classroom yielded positive results in such areas as school attendance (Gerler, 1980),

classroom behavior (Anderson, Kinney, & Gerler, 1984), achievement in mathematics and language arts (Gerler, Kinney, & Anderson, 1985), and reducing procrastination (Morse, 1987).

Beginning in the 1980's and continuing into the 1990's, research with the multimodal program "Succeeding in School" (Gerler & Anderson, 1986) demonstrated positive effects on student achievement and on variables related to achievement. Gerler and Anderson's (1986) study of the program with 900 students across North Carolina showed the program to have positive effects on attitude toward school, classroom behavior, and language arts grades. A California study (Lee, 1993) involving more than 200 students yielded significant effects in mathematics achievement. Other research (Gerler, Drew, & Mohr, 1990) showed the program to have positive effects on middle school students' attitudes toward school.

Computer and networking technology assists educators as they develop broad spectrum or multimodal strategies to promote student growth and development in the middle school classroom. Meridian: A Middle School Computer Technologies Journal will lead the way as teachers, administrators, and other school personnel work to advance middle school education through the integration of technology. This journal will provide practitioners and researchers alike with new perspectives on the application of computer technology.

The interdisciplinary and multimodal base for Meridian

The debut edition of Meridian ushers in a new era of middle school publications. Meridian is unique not only in its intent, but also in the its administrative structure. As such, it contributes to the field in a most significant and critical way.

Meridian's structure is modeled after the interdisciplinary, multimodal structure of the middle school, and not the discipline specific structure of the university. The review board is comprised of a highly talented team of graduate students who represent an array of disciplines. Members of the review board come from a variety of departments across the NC State University campus: Curriculum and Instruction, Mathematics, Science, and Technology Education, Psychology, Computer Science, Graphic Design, and English.

Each member of the team brings with them a voice of expertise and experience. Electronic exchanges and monthly meetings link the members together and provide opportunities to teach one another and learn from one another. These experiences, much like the broad spectrum educational processes in middle schools, have steered Meridian into uncharted territory . Dewey refers to the individual who comes to an unmarked fork in the road experiencing disequilibrium which leads to growth. Meridian's board members have faced the unmarked fork in the road, yet their collaborative efforts have helped them to successfully chart their way. One is reminded of Dewey's classic truism, "Growth depends upon the presence of difficulty to be overcome by the exercise of intelligence."

Despite the rich and diverse backgrounds, there were complex issues that were new for all involved. Issues such as electronic copyright, review procedures, electronic archives, and electronic dissemination placed us all in a state of disequilibrium. These were questions few had asked before. Expertise from individuals across the University. The University's Attorney's Office, the University Library, and major professors all provided unparalleled assistance.

This inaugural edition of Meridian has emerged from the collaborative efforts of graduate students at NC State University and numerous university resources. The success of Meridian, however, is also greatly attributed from the contributing authors who have each written significant pieces that will begin to fill the void in the current literature devoted to middle schools and computer technologies. Moreover, the articles are significant not only in their message, but also in their use of the medium.

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MERIDIAN

A MIDDLE SCHOOL COMPUTER TECHNOLOGIES JOURNAL

Author Guidelines & Submissions Policies

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Meridian is an electronic journal dedicated to research and practice of computer technology in the middle school.

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Manuscripts should be approximately, but are not limited to, 20 pages, double spaced.

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