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ABSTRACT

This report was produced by the 18 participants enrolled in a week-long summer institute conducted at the Center for Excellence in Education at Indiana University and sponsored by the Indiana Department of Education. The purpose of this institute was to give school people the time and resources to identify and apply technological solutions to restructuring issues. Working in small groups, the participants investigated how technology might support the following areas of restructuring: authentic assessment; learning styles and multiple intelligences; life-long learning; outcome-based education; student-as-worker; and thematic instruction. Participants formulated inquiry questions; reviewed professional journal articles; read books; conducted ERIC searches; interviewed local, state, and national experts; and explored software and hardware. Each group submitted a finished report. This document is a compilation of those six reports. Each group report contains the following components: a brief description of the group members; a definition and description of the inquiry topic; issues, concerns, and problems in implementing the topic; inquiry questions; resources and references; reviews of articles and software; scenarios or outlines of implementation strategies; and final comments. (JLB)

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REPORT

Technology for Restructuring Institute
June 20-25, 1993

Edited by Toni M. Maddox

Facilitated by
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INTRODUCTION

This report was produced by the eighteen participants enrolled in a week-long summer institute conducted at the Center for Excellence in Education and sponsored by the Indiana Department of Education. The opening paragraphs in the brochure advertising the institute set the stage.

> THE PROBLEM:
>
> School people who take leadership roles with technology often also serve as restructuring agents. They seldom have the time and resources, however, to take a holistic approach to applying technology to restructuring issues in ways that may accelerate and sustain restructuring efforts.
>
> PROPOSED SOLUTION:
>
> The Technology for Restructuring Institute will provide time and resources. The process of identifying and applying technological solutions to restructuring issues will begin. More importantly, however, the institute will provide a framework which participants can take back to their schools to help their own restructuring teams.

The institute participants included classroom teachers, administrators, technology coordinators, curriculum directors, and a school board member. They represented elementary schools, middle schools, high schools and whole school corporations. Working in small groups, they investigated ways that technology might support one of several areas of restructuring: thematic instruction, student as worker, outcomes-based education, learning styles/multiple intelligences life-long learning and authentic assessment. Prior to the institute these areas were identified by the participants as restructuring issues that could be positively impacted by the appropriate use of technology.

Using Carolyn Burke's Inquiry Cycle as a model, participants formulated inquiry questions, reviewed professional journal articles, read books, conducted ERIC searches, interviewed local, state and national experts, and explored software and hardware. Each small group shared their investigation, progress and findings with the other institute participants and got feedback on their work as well as suggestions for additional study. At the end of the week, each inquiry group submitted a "finished" document. This report is a compilation of those six documents.

Each of the six inquiry group documents contain these components:

- Brief descriptions of the people in the group, including contact information
- Definition/description of inquiry topic
- Issues/concerns/problems in implementing topic
- List of questions to try to answer
- Citations of resources & references
- Critical reviews of articles, software, etc.
- Scenarios or outlines of implementation strategies
- Final comments

Within this structure, each group was free to address the issues as they saw fit.

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We are calling this document a "first draft" because none of us feel that it is finished even though the institute is over. Each participant will return to his/her school and work with colleagues to implement as many of the suggestions contained in this document as possible. They plan to stay in touch with each other throughout the year and share their experiences. Perhaps they will make a presentation at the Indiana Computer Educators Conference in January. Perhaps they will get together for a few days next summer to revise parts of this "first draft." At any rate, they all want the reader to know that this document does not contain definitive answers or solutions, but it does represent the best suggestions of a group of people who immersed themselves in the issues for a very long week.

There are at least two ways to use this document. One is to use it as a resource for your own inquiry process. A team of people in your school might use the resources and suggestions from one of the sections as a "stepping-off" place for a year-long effort to further define implementation strategies for your particular situation. Another approach might be to try some of the implementation strategies contained in this report and join the network of people actually evaluating the success of the strategies in different locations and circumstances. Communication can be established through the contact information given in each section.

If you have questions or comments or need further information you may contact one of the institute facilitators:

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Jan Good is a Media Specialist at Mary Castle Elementary School in Lawrence Township, Indianapolis, Indiana. She shares the School Computer Coordinator position and has served on the School Improvement Committee, as well as the School Community Council. Currently she is co-chair of the corporation-wide Library Automation Project.

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Karen Rench, a former second grade teacher from Indian Creek Elementary in Lawrence Township, is now the district's coordinator for technology staff development. She is responsible for K-12 technology training and for helping schools formulate and implement their technology plans. Karen's duties also include the coordination of Lawrence's district-wide Buddy Project.

Howard M. Smith
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Howard M. Smith is a fifth grade teacher and computer resource person for his building at Indian Trail Elementary School in La Porte, Indiana. He is co-chairman of the school's restructuring committee and is responsible for reviewing and guiding the building's grade level plans for restructuring. In addition, Howard has developed a microcomputer-intensive curriculum for the fifth grade classes in his district. He is currently serving on La Porte's technology committee.

DEFINITION AND DESCRIPTION

Authentic assessment should follow authentic instruction. It is the teacher's responsibility to insure that realistic and valued instruction and assessment take place in the classroom. Authentic assessment may help drive authentic instruction. If a teacher or school changes how they assess students, it can encourage or force changes in instruction and curriculum:

> To define authentic achievement more precisely, we rely on three criteria that are consistent with major proposals in the restructuring movement: (1) students construct meaning and produce knowledge (vs. reproducing declarative knowledge and

algorithms); (2) students use disciplined inquiry to construct meaning; and (3) students aim their work toward production of discourse, products, and performances that have value or meaning beyond success in school. (Newmann & Wehlage, 1993)

Authentic assessment takes two common forms: performance/product assessment and portfolio assessment. "An assessment is called 'authentic' when the performances that the student exhibits in the assessment are precisely those that are of interest to the teacher and the larger community" (Hawkins et al., 1993).

A valid assessment system includes a set of tasks or expected outcomes and a set of criteria that addresses process as well as product. The format of the performance/product and the assessment should be appropriate to the desired outcomes. These formats include but are not limited to: file folders, notebooks, albums, photographs, videotape, audio tape, computer disks and other digital storage devices. The medium of the portfolio needs to be reliable and easily accessible to students, teachers, and parents. We must avoid the tendency to ignore legitimate low-tech solutions because we are blinded by high-tech possibilities.

IMPLEMENTATION ISSUES

How do we help parent and community understanding of assessment?

Anytime there is change in schools, there are cultural barriers to overcome. "There's this fundamental fear that if school doesn't look the way it looked when I was sitting in the classroom, then there's something wrong," states Jeannie Harmon from the Central Kitsap School District in Washington State (Bruder, 1990). Communication is essential to letting the community and parents know what is happening in assessment. How this communication is going to happen needs to be considered in the planning stages of any changes. One piece of paper will not do the job; the communication needs to be ongoing. Technology can be used to help this communication.

Well-constructed parent newsletters can explain teaching and assessment methods, prepare parents for conferences, and include pictures of classroom activities and suggestions of activities that the child can do to demonstrate to parents what is happening in the classroom. The newsletters can be produced and saved or templated on a word processing program or publishing software (Ziko, 1993). The newsletter could have a video format and be sent home for parents to view. This same video newsletter could be shown at the mall, at the grocery store or in the public library. Learning styles information suggests that 70% of the population are visual learners; therefore, the visual newsletter may be a better way to communicate. Telecommunications (e.g., electronic bulletin boards, voice mail) may also provide a way of communicating with parents and students (Raval, 1993).

Parents are made a part of the assessment team by being asked to use a simple scoring rubric to evaluate their child's product, presentation or performance (Class, 1993). The student portfolio can demonstrate to parents how students use their skills, are involved in the process of learning, grow over time, and see themselves as learners. A performance-based assessment with tasks, criteria, and a library of examples of all levels of performance gives parents a much better picture of how their child is doing.

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How do we make sure the assessment process doesn't overwhelm the student's product?

1. Standards need to be developed for authentic assessment

In their studies of restructuring schools, Newmann and Wehlage "were cautious not to assume that technical processes or specific sites for learning, however innovative, necessarily produce experiences of high intellectual quality" (1993). Authentic schooling needs to encourage, allow and insist that students use their minds well. The students' work needs to have meaning and value.

Students, parents, and teachers need to know what is expected in students' work. Bank Street College and Education Center researchers suggest that a set of tasks representative of the domain being tested and a small set of criteria capturing both the process and the product as well as knowledge and skills must be developed. Then there needs to be a library of examples accessible to students and teachers showing all levels of accomplishment (Hawkins, 1993). Technology can be of assistance in storing and accessing the set of tasks, the criteria, and the library of examples. These could be stored on a videotape, network database, electronic bulletin board, or rewriteable CD-ROM. Researchers at the Center on Organization and Restructuring of Schools at the University of Wisconsin address the issue of quality with five standards for authentic instruction: (1) higher-order thinking; (2) depth of knowledge; (3) connectedness to the world; (4) substantive conversation; and, (5) social support for student achievement (Newmann, 1993). These were set up as a research tool, but they are certainly useful global standards for student achievement.

2. Product, performance, and portfolio tools

Performance-based student products encourage non-traditional methods of expression. Students and teachers may become so focused on the media that the message gets lost. A hand-written paper insightfully developing a topic of value is of greater merit than a multimedia presentation on drivel. Clear goals and criteria for evaluation need to be formulated and communicated before the student begins a project so that all know what to expect from the assessment.

Clearly stating those criteria in an accessible manner creates a guide for the student during the creation process and a tool for evaluation upon completion. Incorporating the evaluation standards into the finished product clearly communicates the criteria for the assessment to all interested parties. Washington Township schools use technology to facilitate in this manner by requiring their students to add an evaluation card (stored on the network server) to HyperCard stacks assessed in their writing portfolios.

How do we make sure the process doesn't overwhelm the teacher?

1. Product and portfolio management

If there were a panacea for the awesome task of efficiently managing the authentic assessment process, technology would seem to be the logical provider; however, commercial software solutions appear to be woefully lacking. Jefferson County Schools in Louisville are currently working with IBM to develop a management/evaluation system using the Hypermedia software, LinkWay Live!. Its format is being driven by student products and stated educational outcomes (Niguidula, 1993). Currently there is software marketed as portfolio management solutions but most of these appear to be more in the realm of student records management.

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The name Grady Profile Portfolio Assessment would seem to imply its suitability for the task at hand. Its developer, Aurbach & Associates, states that their software "creates individual student portfolios, into which can be stored not only test results, but student writings, home assignments, drawings - even oral presentations if the computer has audio capability." The principal of Belle Rieve Elementary in St. Louis (a beta test site for Grady) states, "We were looking for a flexible, multifaceted assessment tool and that's what the Grady product offered" (McCarthy, 1993). Other educators have not been as enthusiastic. They felt it was more of a student management system than an assessment tool. Furthermore, the assessment measures weren't suitable for their desired student outcomes (Corpus, 1993). Wally Ziko described the package as a gradebook that assumes that evaluations are secret and, therefore, cannot be accessed by the student.

Some schools have found that Knowledge Management Systems Company's Fox database lends itself to some authentic assessment activities. Nargansett Elementary in Gorham, Maine, has this software on their network server. Students can input their work, make comments, and add speech. The teacher can also leave a recorded commentary (Ziko, 1993). Educators at Saturn School of Tomorrow have set ten process skill outcomes for their students (e.g. interpersonal skills). These are entered in the Fox database where students can access them. Students can also enter personal goals related to these skills: the software asks them if the goal is public or private (private goals can be accessed only by the student, their advisor, or their parents); then the system searches the student's stated goal for keywords and suggests learning activities/opportunites that may help students achieve their goal.

Two programs designed as administrative packages to help manage information about students are SASI Classroom by Macro Educational Systems for the Macintosh environment and SAA Image Plus by IBM for the DOS computers. The SASI classroom is not designed to be a portfolio management system; instead, it assists the teacher in maintaining a grade book, seating chart, personal data, and achievement test scores. The program also allows input from scanned images. The SAA Image Plus may be used as a limited portfolio system if you are not concerned with going back into the system to make changes to a document. Allowing you to write the information once through scanning and then saving it in that form, it does not give you the flexibility to later add comments about the work. This same program may be used to hold other records more commonly found in cumulative folders; in many ways, this is a more valid use of this product.

Teachers have been making observations for many years and for many purposes to assess student progress; however, it has been difficult to quantify and report those observations in a meaningful and convenient way. A new software and hardware package, Learner Profile from Sunburst/Wing for Learning, attempts to solve this problem. This package allows teachers to scan barcode information as they observe student activities. The barcode reader is portable so that the teacher is not limited to remaining in one place. At the end of the day, the barcode reader is downloaded into a Macintosh. The software allows the information to be analyzed graphically to assess the student's activities both individually and as a whole group. In summary, this technology quantifies the types of information that a teacher previously would not have been able to easily share with others in a meaningful way.

On the low-tech hardware end, Mead Products is working to help the student store the various media formats that may comprise her portfolio. Their Five Star-1st Gear-Zipper Binder was developed in partnership with the Saturn School. This binder has an expandable nylon case with a removeable 1.5" ring fixture. It will include mesh pockets on the inside for storing audio tapes and floppy disks. The binder is expected to be available this fall for approximately $15 (Moore, 1993).

2. Digital storage space

Transferring portfolios across grade levels raises the question of adequate storage and management capabilities. Documenting the course of her K-12 education, a student could quickly amass an unwieldy amount of information. Student and teacher must consider the audience or lack of audience for such information. Assuming an audience, how does one manage the information so that a potential user can efficiently access it? Although technology with its scanned images and data storage would seem to provide an answer, as David Niguidula of the Coalition of Essential Schools notes: "Multimedia documents - particularly video clips - occupy a great deal of disk space. . . . With hundreds or thousands of students developing portfolios within a school, issues of storing bits of information are just as real as issues of storing paper copies of everything."

The Washington Township Schools in Indianapolis have attempted to manage the sheer volume of information contained in a portfolio by purging the portfolios as a child moves from elementary to middle school, and from middle school to high school. At each transition, the child and teacher jointly choose the one product that will go on to the next level to begin the next portfolio. The information removed from the portfolio then goes home to be enjoyed by the students and parents.

Current and emerging technologies are also addressing this issue. Larger hard disk drives, auxiliary tape cartridge drives, laser discs, and rewritable CDs allow for ever increasing amounts of data storage. However, as Washington Township found, with student enthusiasm for elaborate multi-media projects (one student product occupied 80 MB), that space may be inadequate. The increasing sophistication of data and video compression techniques should eventually solve this problem.

3. Available technology to support student assessment

Student performance/products can be produced, shared, and evaluated using a wide sophistication of technology. Realistically, however, this technology must be reliable and accessible to the student, teacher, and community. Furthermore, issues of equity demand that the required production medium be available to all students. "In fact, equity was one of the primary goals of setting up standardized tests in the first place. . . . It allowed students from different places to compete in the same way. . . . Designers of alternative assessment strategies and products should use technologies that are readily available to schools, like slide projectors and VCRs." By requiring high-end productions with technology like lasers discs and CD-ROM, Dennie Palmer Wolf argues that "we'll end up hitting only the privileged kids" (Bruder, 1993).

Audio and video tapes are a reliable and accessible technology for both student production and performance documentation. The tapes are inexpensive and share the benefit of easy transportation to the home for review by parents, especially if they did not have the opportunity to see the original performance. Most families in Indiana have access to technology to play either type of tape. These are also useful tools to communicate with parents who may have difficulty reading the traditional notes from the teacher. Tape media can be shared or duplicated easily when evaluating and archiving products produced by cooperative groups. Teachers and students can also document the creation or cooperative process on tape. Ultimately, the video or audio record of a student play or production can be digitized with current technology and saved on disk (keeping in mind data storage limitations).

Teachers that have their students doing major writings on a word processing program or other types of electronic publishing, already have the tools to add electronic elements to student portfolios. Rather than storing the chosen written products and accompanying evaluations in a file folder, they may be stored on diskette. A template can be constructed showing evaluation criteria and allowing for comments from the teacher, the student, his peers, and other outside evaluators. This template could be stored on a hard drive or network server. As part of the production/assessment process the student imports the necessary template(s) to be used and stored with his work. At the end of the year, a child can have a printout of those items that were chosen to be placed in the portfolio and the teacher can transfer them to a permanent file for the next teacher or, assuming consistency in platforms, the diskette can be dropped in the file for future access and additions.

Scanning hardware and software is available that makes it possible to store other student paper products electronically. At this time this technology, while increasingly common, is not widely available to students and teachers. When schools do have this and other limited high-end resources, they sometimes address the equity issue by putting this technology at a student production station that is accessible to students outside of the classroom.

4. Time constraints and expense of equipment

Naturally the platform needed to do an adequate job of portfolio assessment and storage will be more sophisticated and, therefore, more expensive than the typical student/teacher workstation. More time should be allocated for users to master this platform.

5. Teacher training in evaluation and scoring

Researchers from the Rand Corporation in Vermont reported that teachers need continuing support and training in implementing portfolio assessment in math and writing. Another area of concern that the researchers found is "low agreement between scorers of the portfolios about the quality of the work." Teachers need training in the development and scoring of authentic assessment tasks. With this training the issues of quality tasks (balancing the breadth with the depth of the task, scoring reliability, and balancing validity with authenticity) need to be addressed. Two other dilemmas the teacher as assessor faces are the complusion to teach when a student's assessment task is not going well, and the basic understanding that standards are not expectations (Standards, 1993). Researchers at Bank Street College feel that not only teachers, but administrators of the testing system and the students need to be trained in scoring (Hawkins, 1993).

A video tape and print curriculum "Standards, Not Standardization" (1993) has been developed by the Center on Learning, Assessment and School Structure in Genesco, New York, to help teachers deal with developing and scoring authentic tasks. It gives design principles for assessment, sample scoring sheets, tips on assessment of discussions and a design tool kit. It is a rich resource for teachers who are rethinking and retraining themselves in assessing student work.

Additional ways in which teachers might get training (taking advantage of materials to suit a variety of learning styles) include:

- Reading "An NCME Instructional Module on Using the Portfolios of Student Work in Instruction and Assessment" or other articles in current journals
- Participating in an inqiry group on assessment with other interested teachers

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- Viewing the videotape series "Standards, Not Standardization"
- Attending workshops
- Getting in touch with the Indiana Department of Education
- Requesting training from the local school system

INQUIRY QUESTIONS

1. How can we use technology to support assessment of student progress?

2. What can available technology realistically do to support student assessment?

3. What form should future technologies take to meet the challenge of authentic assessment?

4. How do you communicate the result of the assessment to parents, students, next year's teacher, the education community, and the community at large?

5. How do we manage the assessment process?

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What is a learner profile? Promotional video tape by Wings For Learning, 101 Castleton Street, Pleasantville. NY 10570. 800/321-7511.

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FINAL COMMENTS

No amount of technology improvement can help a teacher do authentic assessment if they have not yet started that process. Before the improved technology can be effective, the teacher must have a good grasp of what is needed in the assessment process. As the technology matures a software and hardware environment that allows the integration of the authentic assessment strategies into a student production is desired.

Ideally, students and teachers would have at their disposal an "assessment laboratory." It would include a hypermedia authoring tool and database that contains portfolio shells that could be used or tailored by the teacher or student. This production/assessment station would accept still images, full-motion video, postscript files, animation files, and sound files; furthermore, it would have analog in and analog out. It would also include a reflective portion that would accept audio as well as textual comments for self and outside evaluations, and have the capability of generating a report. This would all be seamlessly linked and could be compressed for storage.

Until then, however, our efforts must focus on using existing technologies to create an atmosphere conducive to authentic teaching, learning, and assessment. Everything we do should focus on guiding the student in the creation of products that all value.

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LEARNING STYLES AND MULTIPLE INTELLIGENCES

INQUIRY GROUP MEMBERS

Jolinda Bove
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This is my sixth year as principal of Templeton. During the past two years the entire faculty has been heavily involved in improving teaching and learning. We were granted "Indiana 2000" designation as well as an "Exploring Grant" by the DOE to support our efforts. Staff development in the areas of Cooperative Learning, Thematic Instruction, Math Their Way, Authentic Assessment, Conflict Resolution, and Inclusion have dominated our meetings. The 1993-94 school year will bring us to a new facility that will be technologically equipped, giving us our focus for staff development.

Kathy Mack
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Decatur Township schools provide educational leadership for the State of Indiana and for the nation. As an outcome-based school district we have made the commitment that all children in our schools will learn well. Many visitors come each year to observe our outcome-based education, our nationally recognized staff development program, and our utilization of interdisciplinary teaching. The Curriculum and Instruction department is responsible for developing a sequential K-12 outcome-based curriculum, providing professional development opportunities, and providing technological assistance. Our staff has been trained in Teacher Expectations (TESA), Student Achievement, Critical Elements of Instruction, Style-Differentiated Instruction, Cooperative Learning, Classroom Management and basic computer operations, such as word processing and electronic mail.

Carol Montgomery
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Over the past three years the Community Schools of Frankfort has been actively incorporating technology into our K-12 curriculum. Apart from our local financial commitment, we have received both 4 R's and 3 R's funding at the elementary level, have piloted an Industrial Mentorship program at the high school, and have received state funding to assist our staff development programs. Through technology we have seen teaching methods change and attitudes toward learning take on a new direction. As computer coordinator for the school corporation, I am directly involved with adding new technology and with the implementation of technological resources into the classrooms.

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DEFINITION AND DESCRIPTION

Over the last decade the rhetoric of school improvement has changed from a language of school reform to a language of school restructuring. School restructuring efforts reflect changes in traditional roles and relationships, curriculum, pedagogy, and the working/learning environments. A number of restructuring programs are identified by the individuals who formulated theories which have influenced educational practices. In addition, technology has been recognized as having the potential to change the way teachers teach and the way students learn. Our inquiry group focused on the impact of technology in the implementation of two theories as restructuring efforts.

The first of these is Howard Gardner's Theory of Multiple Intelligences. This theory asserts that human beings are capable of knowing the world in seven different ways. Known as the seven intelligences, humans are able to know the world through language, logical-mathematical analysis, spatial representation, musical thinking, the use of the body to solve problems or to make things, an understanding of individuals, and an understanding of ourselves. The Multiple Intelligence theory acknowledges that people learn, represent and utilize knowledge in many different ways and that individuals possess these intelligences in varying strengths, giving everyone a unique profile of intelligence. Schools that have implemented this theory provide children the opportunity every day to use and develop all of their intelligences.

The second model we examined was The Energic Model of Style authored by Anthony Gregorc. This is a model of mind style which examines mediation channels by which people perceive and order their world. The four mind styles--concrete random, concrete sequential, abstract random, and abstract sequential--have different combinations of abilities, making each individual unique. This means that in the learning process students respond differently in the ways that they as individuals perceive and process information. Consequently, students of different learning styles respond differently to instructional strategies. In order to achieve the highest level of learning it is imperative that teachers find the appropriate mode of instruction to address the varied learning styles within their classroom. Kathleen Butler's application of mind styles to teachers and learners creates a practical way of teaching students through their own mediation channel. Style-differentiated instruction, by her definition, is a process that promotes the intentional match or mismatch of learner style to instructional methods--strategies, technologies, techniques, and activities. Style-differentiated instruction allows teachers to examine learner outcomes at the highest levels of cognition and devise an efficient, sequential, style-fluid plan to achieve that learning. This means that during the course of a unit of study, instructional activities are divided into fourths by mind styles so that each child's mind style is respected and honored.

IMPLEMENTATION ISSUES

As our inquiry group discussed Style Differentiated Instruction (SDI) and Multiple Intelligences (MI) as restructuring efforts, several issues, concerns, and problems arose for consideration. The major ones were:

- providing staff development
- changing mindsets and paradigms concerning learning and intelligence
- addressing technology's role in implementing SDI and/or MI
- acquiring financial resources for staff development and material resources
- connecting style and/or intelligences to a current instructional model
- providing community and parent education to assure support of implementation efforts
- connecting with teacher education programs to influence pre-teaching curricula

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INQUIRY QUESTIONS

1. How can technology address the need to reach each learning style and/or develop each intelligence?

2. How do learning styles and/or multiple intelligences fit into the instructional model?

3. What do teachers need in order to implement these instructional strategies, ie. staff development, finances, community/parent support?

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Changing schools and classrooms (1992). Teacher Magazine, 8(3).

This article contains brief overviews of several programs, techniques, and approaches related to improving schools and student learning. Overviews on restructuring, effective schools, multiple intelligences and technology are included.

Larson, R. E. (1992). Relationship of learning style to the effectiveness and acceptance of interactive video instruction. Journal of Computer-Based Instruction, 19(1), 17-21.

This article presented research involving the significance between learning styles and the use of Interactive Video in instruction.

Davis, R. B. (1991, May). Learning how to learn: Technology, the seven multiple intelligences and learning. Paper presented at Spring CUE conference, Palm Springs.

A discussion of Howard Gardner's Theory of Multiple Intelligences is combined with practical ways of incorporating technology (namely, computers) into the curriculum. Gives specific examples of existing software being applied to each intelligence.

IMPLEMENTATION STRATEGIES

In our investigation of technology supporting learning styles and multiple intelligences we found that: (1) research indicates that Interactive Video Instruction (IVI) addresses all learning styles; and, (2) technology can be utilized to intentionally address the learning styles of students and the development of multiple intelligences.

In research conducted by Ronald E. Larson, NCR Corporation, the issue of examining the interaction between learning styles and Interactive Video Instruction is presented. He shares that even though the research found no significant relationships between various learning styles and effectiveness of IVI it was concluded that the flexibility of IVI in adapting to individual student needs produced positive results with all learning styles. "It would appear that IVI is equally effective for all learning styles, that students of any learning style find it to their liking, and that IVI can and should be used precisely because instruction is individualized to every student's need" (p. 20).

Believing that interactive technology in the form of CD-ROM, laser disc, and video are effective with all learning styles, we, as educators, need to look at this form of technology as a means of satisfying our curriculum while meeting the varied needs of students. Products such as Optical Data's Windows on Science, a videodisc-based science program for K-8, uses visuals, hands-on activities, and reading and writing activities that allow students to absorb information in a manner that is the most productive to their learning style. Windows on Science is one of many programs that supports the various learning styles of students through seeing, hearing, discussing, doing, reading and writing.

Mammals: A Multimedia Encyclopedia, produced by the National Geographic Society, provides information on approximately 200 animals through motion, sound and incredible color. The New Grolier Electronic Encyclopedia, by Grolier, transforms the written page of the printed volumes onto the screen with graphic support for many of the articles. Students will stand in line to use the automated encyclopedia while the set remains available on the shelves. Electronic atlases such as Picture Atlas of the World from National Geographic Society portrays the world in incredible digitized images with sound as well as printed tutorial data. Students can literally "travel the world" in front of the computer screen; thanks to technology the world has truly become a smaller place. These are but a few of the interactive programs which are designed to stimulate the varied learning styles of students. By allowing students to become their own guide in the learning process we are eliminating many fears of teacher-directed instruction. By using interactive products, students can pace themselves and find a learning environment with which they are comfortable and that is directed to their senses.

In an effort to find teaching methods and instructional programs that are geared toward the restructuring of our educational programs we should also take a serious look at multimedia development in the classroom. Student-created multimedia programs are an innovative way of allowing students to learn through doing. Developing multimedia programs requires the use of computers and software programs that retrieve information from existing data bases, video discs, CD-ROM, digitizer cameras, and still pictures, as well as keying in data. Instead of having students write a research paper, many teachers and students are finding that students, whether individually or in small groups, accomplish the same objectives in an entirely different format through the development of multimedia projects. Creating a multimedia program requires some very basic steps that enhance the learning process. The initial step of research requires the use of process thinking. The second step of working with peers exposes students to cooperative learning skills that can generate peer tutoring and the final creation of the program demands planning, organization, sequential thinking, and creativity. The end results are most generally a product that all students are proud to display.

The implementation of learning styles into instruction requires teachers to intentionally align activities with student style. Typically, when a teacher plans a unit, a learning center, or instructional activities for students, she begins with learner outcomes and then develops teaching and learning activities that align to those outcomes. If a teacher includes style and levels of thinking in her planning, she must intentionally plan instructional strategies to reflect the learning styles and the levels of thinking. Kathleen Butler has developed the SDI (Style Differentiated Instruction) Strategy Chart to assist teachers with this task. This chart reflects the characteristics of activities that use and/or develop each style as well as instructional examples that cause students to work at each level of thinking. To facilitate the integration of technology into instruction, examples of software categories and specific software have been listed that match each level of thinking and each style. This list is not intended to be all inclusive, but instead is merely a beginning list that teachers can add to as they connect technology and learning styles in their classroom.

Level I - Basic Thinking

Concrete Sequential

- Use database to gather information in categories

Abstract Random

- Use a draw program to create a web to reflect key ideas/concepts
- Use Geometric Supposer to investigate geometric relationships
- Retell stories heard on CD-ROM

Abstract Sequential

- Use outline and notes feature of a presentation program
- Use word processor to create report and/or list of facts
- Record information from on-line databases and CD-ROM encyclopedia

Concrete Random

- Use word processor to record brainstorming ideas
- Use draw program to develop web, mind map, and/or cluster
- Use discovery software to explore mathematical concepts, i.e. Hands-On Math

Level II - Engaged Thinking

Concrete Sequential

- Use graphing or charting software to organize and analyze collected data
- Use sorting capabilities of database to group and/or categorize data

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- Use SnapDragon to classify objects

Abstract Random
- Capture video to create personalized multimedia projects using presentation software
- Use draw and/or paint programs to create original cartoons or illustration
- Use sound input features to record an interview or sounds related to an investigation

Abstract Sequential
- Use word processor to create term papers or essays
- Use on-line databases to develop resource bibliography
- Use on-line services to conference with experts

Concrete Random
- Use multimedia encyclopedias and on-line resources for independent study
- Use simulation software such as Interactive Physics to develop conceptual understanding
- Explore mathematical concepts utilizing discovery software--i.e. Mathematica, MacNumerics, Geometry Sketchpad
- Use problem-solving software to challenge students to solve real world problems

Level Three: Dynamic Thinking

Concrete Sequential
- Use mapping software to create maps, reflecting geographical features
- Use draw and word processing to create timelines, flowcharts, and diagrams
- Use spreadsheet to create graphs

Abstract Random
- Use a musical composition program to write an original composition
- Use paint program to create an original piece of art
- Use word processor to write collections of poems or journals
- Create an original videotape, digitize it, and utilize a video-editing program to polish the final product

Abstract Sequential
- Use statistical software for analysis of survey data
- Use database sorting features to arrive at a hypothesis
- Use grammar analysis program to critique writing selection

Concrete Random
- Use CAD/CAM program to design a structure or tool
- Use video editing software to create an original movie
- Use word-processing software to write editorials and speeches
- Use spreadsheet to simulate mathematical iterations

Technology can also be a most powerful and vital tool when incorporating multiple intelligences into classroom teaching and learning. Howard Gardner's research (Frames of Mind) suggests that presently only three intelligences are being tapped into in the classroom--namely, Linguistic, Logical-Mathematical, and Intrapersonal. Students who are dominant in the other four--Spatial, Musical, Bodily-Kinesthetic, and Interpersonal--are being short-changed, so to speak. Though the research is limited, it supports our belief that technology can provide some necessary avenues which can be successfully traveled by students of all intelligences. A rich environment in which students of any of the seven intelligences can thrive is created by using computers, combined with multimedia equipment.

The following are suggestions taken from Davis' article:

Linguistic

Any word processing program will aid children in language, organizing, writing, editing and rewriting skills, regardless of the subject area. Three particularly good programs that offer graphics along with the word processing are The Children's Writing and Publishing Center, KID PIX (and Companion), and Monsters and Make Believe.

Logical-Mathematical

Programs dealing with logic skills such as King's Rule and Safari Search will encourage this area of intelligence. Math Blaster, The Factory, and Super Factory provide practice in critical thinking skills as well as drill and practice. A four-step problem solving guide is introduced in the Solutions Unlimited series. Spreadsheets and databases are also an excellent means for students to explore and organize most types of information.

Intrapersonal

Use of the computer can further develop individual skills by allowing for differences in learning styles and abilities. Use of drill and practice can provide those students who need it with extra help in such areas as science, reading and even in critical thinking skills. Simulation experiences are excellent for developing this intelligence. Research and library skills are taught in programs such as: Oregon Trail, Decisions, Decisions, and the Carmen SanDiego series. While allowing students to work at their own pace, analytical skills are developed in programs such as The Science Tool Kit and Voyage of the Mimi.

Spatial

Visualization of math concepts is aided in Geometric and King's Rule. Graphics programs serve two purposes in that they help develop spatial perceptions, as well as increase creativity. Tetris and Welrus are excellent in reinforcing skills in many of the Multiple Intelligences since they combine different types of activities at once. Spatial intelligences will thrive on the use of laser disk technology and much of the multimedia available.

Musical

Look for software that incorporates music into the program. For example, Oregon Trail deals with estimating the supplies needed for heading West in the 1800's while incorporating music from that time period as an introduction to each segment. In addition, programs are available which help in music composition.

Bodily-Kinesthetic

This almost seems self-explanatory in that children are constantly "touching" computers in using the keyboard, a mouse, and/or a joystick. Two excellent "hands-on" reading programs for lower grades are Grandma and Me and Arthur's Teacher. Both have bright, colorful pictures which children can click on to see motion and hear sounds (e.g., a squirrel exiting a tree, a bird tweeting, a letter coming

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out of a mailbox). For more advanced work, one could use Lego Logo, which combines using children's Lego bricks with computer skills to create an object that is then operated via the computer.

Interpersonal

Cooperative learning has proven to be an effective device for having children work with others. Experience has shown that working in small groups with one computer is actually more effective than students working on computers alone! This is an excellent method for all students, but especially those who have a strength in this intelligence.

The following scenarios are offered as our way of sharing what we have gathered from reading the few articles available that deal with learning styles and multiple intelligences in regard to technology. We started on the premise that anyone reading this would, in fact, be familiar with the research on learning styles (Martha McCarthy, Kathleen A. Butler, Anthony Gregorc, Howard Gardner). Although there is a great deal of information on both learning styles and multiple intelligences, we found very little information that tied either of these into our question: How can technology be used to address the need to reach each learning style and/or multiple intelligence? As is often the case, and especially in restructuring, we have gleaned information from the few sources available and added our own instructional materials to suggest ways one might support learners and their special needs.

Scenario I

A first grade classroom with 20 students. Most are able to recognize letters and are beginning to read easy books. Some are having more difficulty with the printed word. Of these, some (especially Jane), tend to be more motivated when seeing videos, pictures or other visual aids, while a few respond to sounds in a positive way. The teacher, being aware of different learning styles as well as multiple intelligences, has requested her principal purchase a program called Grandma and Me. The principal, trusting in her teacher's ability to select appropriate materials, even though wondering what in the world this expensive piece of software could offer, orders it immediately.

Two weeks after the program has arrived and been put to use, the principal visits the classroom. Upon entering she sees Jane, who was having difficulty reading the easiest of books, or even attempting to read one, totally involved in reading the words under the bright animated pictures being projected on the computer screen, complete with sound effects. In addition, Larry, who has difficulty staying in his seat long enough to remain on task for any length of time, is engrossed in the story that Jane is reading. While he listens to Jane and watches the pictures, he is able to use his kinesthetic sense in manipulating the mouse to click on various parts of the pictures and discover such things as a bird in a tree, a letter in a mailbox, a doorbell that rings, and much more.

Programs such as these aid teachers in providing sources for children to tap into their different learning styles as well as their intelligences. It is a "win-win" situation where the teacher has facilitated learning for the non-reader, as well as provided reinforcement of learning for the child with the kinesthetic strength.

Scenario II

A multi-age grouped 4th-6th is working on a thematic unit of study dealing with World War II and its effects on Americans. In addition to bringing in information from various resources in the school and local library, the teacher has arranged for the cooperative groups of children to interview people in the community who have memories of that time period. In addition to providing them with a XAP Shot camera, she has given them a video camera in order to record interviews (if they so choose). When they return to school, they have a multimedia station available where they can incorporate motion pictures, still pictures and sound into their text report. The children excitedly gather around the computer to share information they have gathered and begin to put it into a coherent form. This type of learning provides the means for each intelligence to flourish.

Scenario III

Students of United States history have long been accustomed to hearing about the civil rights movement and the strong prejudices that have existed throughout history. They have seen the riots of Kent State, Watts and most recently Los Angeles via television or on film. It would be natural to assume that these students have an in-depth understanding of prejudice--but do they? Testing over the subject matter discussed or viewed may give indication of short term retention, but how would they respond in the future to questions regarding their feelings of prejudice? A typical classroom of students would probably have little reflective thoughts about their emotions during the classroom activities. Why? In most cases being a listener or passive viewer allows students short term retention. From our studies on technology integration and various research conducted in the area of learning styles, learning increases proportionately to the number of senses we address. Decisions, Decisions: Prejudice, a Tom Snyder product, provides a realistic simulation that allows the students to place themselves in the position of actively making decisions and judgments in situations involving prejudice. The program allows students a different perspective than they would receive via traditional lecture. By assuming an active role in the simulation students are forced to make decisions and often react in an emotional manner. By including projects and activities that are related to the software, the teacher reinforces the learning. Using debate as a follow-up to the small group discussion actively involves students. Researching racial issues that have had a direct influence upon history and obtaining bibliographic information of individuals who were influential in civil rights supports the students learning in all styles.

Decisions, Decisions: Prejudice, is but one of the programs produced by Tom Snyder Products which are designed primarily for use in groups, whether small groups or total class involvement. In situations where computers are limited, this approach to teaching in the "one computer classroom" has proven quite successful.

Scenario IV

A 9th grade English teacher had difficulty getting her non-academic student to demonstrate any interest in writing "short" stories. The stories lacked imagination, demonstrated no comprehension of grammar, and were the shortest stories ever written. Soliciting the assistance of the media specialist, it was decided to have the class work in pairs to develop an illustrated story based upon a subject being studied by a 2nd grade elementary class. The stories were composed at the computer and illustrated using Children's Writing and Publishing Center. The stories not only showed creativity, but many of the groups had to be stopped because their stories were becoming too long.

Once the stories were printed, they were duplicated and bound. A copy of the book was presented to each of the 2nd graders at the elementary school. The stories were read in class and the students then colored the illustrations in their book. As a follow-up activity, each one of the 2nd grade students wrote a thank you note to one of the 9th grade students using Children's Writing and Publishing Center. The 2nd grade students were thrilled to have the "big kids" share their stories with them and the 9th grade "authors" produced much more effectively by having an identifiable audience. Knowing that someone outside of the classroom was going to read their papers had a

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positive influence on their interest in the end product. Implementing co-operative learning with the writing process supported by technology proved to have a very positive effect upon the development of linguistic intelligence. The books deserved a spot on the media center shelves and many of the authors still come in to see if their work is represented in the collection.

FINAL COMMENTS

Restructuring with technology requires financial resources to support staff development and the purchase of materials and supplies. Communities, school boards, and parents need to be made aware of the impact that technology must have on students and their learning.

As teachers begin to look at ways of implementing technology into their instructional programs caution needs to be exercised that appropriate software, which addresses not only the subject matter, but the various learning styles and intelligences of the student, is selected. In addition to software selection, the manner in which materials are presented is paramount. Teachers who use technology as a stand-alone teaching tool will see little success in its effectiveness.

Although technology is a tremendous source of support for restructuring efforts, educators must not assume that technology alone will change teaching and learning. It is the educator's ability to recognize the importance of using technology to support changes in traditional roles and relationships, curriculum, pedagogy, and the learning environment that will make a difference.

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LIFE-LONG LEARNING

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DEFINITION AND DESCRIPTION

Restructuring schools often include the term "lifelong learning" in their vision statements, as do educational researchers and business leaders when setting goals for the future; in fact, this is one of the National Education Goals. The need for creating a community of lifelong learners is apparent when one considers the lessons of the past and of the present. Today only a small percentage of farmers are needed to provide food for the world because of advances in agricultural technology. These advances have led to the displacement of a whole generation of workers who have needed to find training and jobs in other areas. Many people are finding that the nature of their jobs is changing while they are still employed in those positions; as a result, retraining and relearning are essential to keeping the job. As our society continues to evolve from an industry-based to a knowledge- and information-based one, the need for lifelong learners becomes more important than ever.

Lifelong learning should be a desired outcome of schools. Learning is essential to the preservation of the principles of a democratic society. In addition to providing the tools for lifelong learning, schools have a responsibility to create an atmosphere that nurtures and supports a community of lifelong learners capable of making informed decisions and solving life problems.

IMPLEMENTATION ISSUES

A number of issues may hinder a school's ability to create lifelong learners. Among them:

- State requirements such as I.S.T.E.P. and a required number of minutes encourage teachers and administrators to maintain teaching of lower level discreet skills.
- Accountability needs of the public also encourage teachers and administrators to maintain teaching of lower level discreet skills.
- Parents and other members of the community may not feel a need for such changes.
- Teachers may be reluctant to give up the security of teaching methods that they were trained in years ago.
- Typically, schools have not been used as centers for community education.
- There may be inequalities among socio-economic groups in their ability to access opportunities for lifelong learning.

INQUIRY QUESTIONS

1. How do we change the current educational paradigm?
2. How do schools create lifelong learners?
3. How can schools be used as centers for community learning?
4. How can technology be utilized to support a community of lifelong learners?
5. How can we insure equity of access to technology?

RESOURCES AND REFERENCES

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REVIEWS

George, Y. S., Malcolm, S. M., & Jeffers, L. (1993). Computer equity for the future. Communications of the ACM, 36(5), 78-81.

Schools, community organizations, and businesses are increasingly concerned about the number of Americans who can use computers and who understand the use of computers in our society. Because the number of those who use computers in their work is increasing and because many of the new entrants into the work force come from minority groups who often do not have access to computers, the gap between the "haves" and the "have-nots" is widening. Some schools are initiating programs to place comprehensive computer programs into schools in low income areas and to provide training for those teachers. Many community-based computer centers have been established since 1985 to provide access and training for people in economically disadvantaged areas. Moveover, businesses are joining with community organizations and schools to provide access to computer training.

Edwards, C. (1993). Life-long learning. Technology in Education, 36(5), 76-8.

Technology can make life-long learning a reality. People can learn virtually anywhere, anytime, without the obstacles of distance or expert teachers. Using technology to expand opportunities for learning is especially critical because we live in a time when learning is a necessity, not a luxury. Since women have entered the workforce en masse, the resulting need for child-care and high quality learning experiences for young children is a reality; therefore, a greater emphasis on parental involvement with early childhood education is necessary. Technology can play heavily in this endeavor. Edwards also offers these suggestions for life-long learning:

- life-long technology based workplace education program
- hardware/software lending library at work
- volunteer programming design to community-based adult literacy programs

The National Center for Family Literacy and Senior-Net are two examples of organizations in which people and technologies work together to facilitate life-long learning.

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D'Ignazio, F. (1990, September). Integrating the work environment of the 1990s into today's classrooms. T. H. E. Journal, pp. 95-96.

In this article, D'Ignazio describes the 21st century as a time when a new kind of worker will be needed. He states that workers will not be expected to know everything, but will need to be good learners. They will have skills in the basics of communicating, computing, coping with technology, taking responsibility for learning, helping peers learn, working cooperatively, and dealing with problem solving where situations are fluid. D'Ignazio states that these workers will not suddenly appear, but will emerge from classrooms where they have practiced such skills.

To create such workers, the role of teachers must change. Each teacher must control this change, and become a leader for change. D'Ignazio feels that technology offers teachers this opportunity in two ways: (1) technology will improve the transmission of curricular knowledge as current knowledge carriers overlap; and, (2) multimedia technology can transform the traditional classroom environment into a studio-like arena where the curriculum comes alive as students translate and create. He concludes that technology will be only one of the ingredients needed to create an environment resembling the workplace and that there must also be opportunities for students to become responsible for their own learning, to become producers of knowledge, and to work collaboratively. Finally, D'Ignazio states that a teacher's role will be that of both a leader and a collaborator.

IMPLEMENTATION STRATEGIES

How do we begin to create a community of lifelong learners? We believe there must be pervasive change in schools in order to create a community of lifelong learners. This paradigm must include elements that address the followings areas: organizational structure, governance, instructional roles of teachers and students, integration of technology, assessment, expanded learning environments, and staff development. Restructuring schools need to work towards becoming flexible in the ways that the resources of people, knowledge, time, and space are allocated (Schlechty, 1991). What would this scenario look like?

Scenario I

The organizational structure of schools will need to change so that teachers and students assume new roles and responsibilities. Students will be arranged in developmentally appropriate ways so that they can learn from one another. Rather than being placed in age-grouped, lock-stepped classes, students will be placed in ungraded sections or communities of learning that allow for collaboration and interactive learning opportunities. All staff members will be regrouped to allow frequent collaborative planning time. Teachers will work as teams within their "learning communities." In schools that are undergoing change, staff development will play a major role in the success of the change efforts. Staff must become lifelong learners.

Leadership will change from a top-down model to a model that employs shared decision making by all stake-holders. One strategy that would reflect this change would be the development of a school community council composed of teachers, students, parents, principals, industry leaders, school board members, representatives of higher education, and central office administrators. Many of the players in education will become more actively involved in creating a clear sense of purpose for their school. Team teaching and the integration of curriculum through thematic units will give teachers flexibility, breaking away from the constraints of mandated time requirements.

In a school that is restructuring, the nature of teacher and student roles will need to change. The teacher will no longer be a disseminator of knowledge, but rather will become a facilitator of authentic learning experiences in which the students have ownership (Duffy et al., in publication). The students will be active participants in the creation and design of their learning.

Schools have a responsibility to integrate the use of technology with instruction. Our world is becoming much more dependent on the availability and use of information. Students must know how to seek and access information in order to provide solutions to the unique problems of their investigations. Technology will be used in authentic assessment portfolios to monitor a student's progress.

The classroom will no longer be constrained by the boundaries of four walls. Authentic learning projects will involve the study of real life problems. Real life problems will be studied on site or through the use of technological tools such as multimedia and networks. The school will become the "base camp" of learning.

This scenario contains strategies that could be adopted immediately by almost any school at little cost.

1. The school will form a Community Advisory Council. The Council members will spend "real" time in the school and will investigate real issues concerning the school.

2. The building will be open for greater use by community groups, not just for basketball games.

3. Senior citizens will be invited into the school to become learning partners and role models as lifelong learners.

4. Investigate and apply for grants from various state agencies and local businesses, such as the Annenburg Foundation, Lilly Foundation, Cummins Engine Foundation, Ball Foundation, and grants from the Department of Education. Subscribe to the Supermail Conference on Ideanet to gain advance notice on grant opportunities.

5. Students will publish a weekly newsletter within their own classroom using whatever level of technology is presently available.

6. Put technology in the existing day care situation at school for children to use and share with parents. Motivating software for this situation could include Kid Pix, Nigel's World, Bouncy Bee, and the Carmen Sandiego series. This will not only engage the children, but will also encourage parents to begin relearning.

7. Begin a parent/child shadowing program, where children can shadow parents in the real world.

8. Teachers will work toward project-based (authentic) learning.

9. Teachers will collect portfolios of work that illustrate how a child is progressing toward desired outcomes. These can be paper/pencil folders, or media-based, depending on the technology available.

10. Allow students-parents-teachers to begin charting their own opportunities for learning. Students will work toward their self-selected goals achieving passages (Gregory, 1991).

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11. There will be a year-end celebration for the school community to celebrate the achievements in learning.

Scenario II

Another scenario is a set of strategies that requires long-range planning as they involve more money and a greater degree of commitment from the school staff, parents, and community. Consensus for these items will have emerged following exposure to earlier conversations and planning with all members of the learning community. Technology will play an increasing role in the creation of lifelong learners.

1. Phones will be provided for each classroom to allow greater communication between teachers and parents. Students will also use the phones as a tool for accessing information.

2. A voice mail system will be created to facilitate two-way communication between teachers and parents.

3. A homework help-line will be established.

4. An electronic bulletin board system should be started with access for all members of the school community.

5. The school should become part of the Buddy Project which provides computers, printers, modems and network access to participants.

6. Video presentations about the school and about student projects can be created for broadcast through local television or cable stations.

7. The school's media/technology centers should be available for use after school hours and during the summer. One use may include producing workshops for parents or other members of the school community (e.g., a child development seminar which would be exportable for use by families in their homes).

8. Schools will sponsor Learning Fairs where students will use multimedia to demonstrate their learning processes and products to the community.

9. An on-line catalog of total school corporation media holdings for public access will be developed.

10. Teachers will use complex software programs to further enhance authentic learning such as Hypercard and Linkway.

Scenario III

The future holds unlimited and even unimaginable opportunities for technology to impact lifelong learning. As schools become a more comfortable center of the community, learning will become a social activity which will involve the exchange of information as a routine life activity. Schools with vision may work toward implementing these strategies:

1. Kiosks or other multimedia equipment will be installed in the school foyer, the mall, the bowling alley, etc. Parents and community members can have immediate access to the projects and presentations their children have created. In addition, information can be

transmitted using this medium.

2. The school will become the community technology center which will house telecommunications, studios, and up-to-date hardware and software. These centers will also be long distance learning hubs for continuing education. Students will have the opportunity to be teachers in this setting. Everyone in the community will have the opportunity to use this workspace as a place to continue learning and solving problems.

FINAL COMMENTS

The vision includes the socialization of learning as the school becomes the center for a community of learners. An informed populus that practices the skills of communication will increase the possibility of improving the quality of life for all people. Technology has the possibility to bring schools into the 21st century. In order to prevent further polarization of society between the "haves" and "have-nots," schools will need to play an active role in their community as a learning resource.

All stake-holders will need to be involved in the change process in order to promote the ownership that will be necessary for success. Learning communities need to become proactive rather than reactive and need to develop a vision for the future. **Finally, freeing teachers from traditional roles and allowing them to share responsibility for learning with students is the key to the creation of lifelong learners.**

OUTCOME BASED EDUCATION

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Jim Mellon is an eight-year member of the Hobart School Board and has been involved in budgeting, bargaining and legislative issues affecting schools. As president of Mellon Software Inc. he is involved daily with business applications of technology. Jim views technology as a driving force in restructuring all aspects of schools, from governance to homework.

DEFINITION AND DESCRIPTION

Outcome Based Education, sometimes referred to as Results or Results Based Education, is an educational philosophy and process which promotes success for all students by integrating outcomes, assessment, and curriculum & instruction. Crucial to this process is the collaborative effort of all school stakeholders to determine the desired outcomes

The principal tenets of OBE include:

- All students can learn.
- Success breeds success.
- Schools can create learning environments which promote success.

OBE is based on four principles:

- Clarity of curricular and instructional focus guided by the established outcomes

- Sequential design of curriculum and instruction from pre-established outcomes
- High achievement expectations
- Extended and expanded learning opportunities (Mack, 1993)

IMPLEMENTATION ISSUES

OBE has the potential to serve as the framework through which curriculum, instruction, and assessment can be restructured. However, there are issues involved in the transition process of implementation:

- **Effective staff development/inservice**
  How can time, resources, and incentives be restructured to promote continuous staff development? How can consistent and sustained support for staff development be ensured? How can school development activities for all school stakeholders be coordinated?

- **Development of instructional strategies to support OBE**
  What instructional strategies are appropriate for OBE? What instructional strategies are necessary for enrichment and corrective learning activities? What assessment methodologies are appropriate for OBE? What consequences, if any, should result from assessments?

- **Development and revision of meaningful, relevant curriculum**
  How can the relevancy of curriculum and instruction keeps pace with the rapid changes in information, knowledge and technology?

- **Inclusion of provisions for student choices and teachers' academic freedoms which build on personal and student interests**
  How can instructional flexibility for teachers and learning flexibility for students be optimized within the framework of local, state and national standards?

- **Development of ownership/commitment to OBE**
  How can local school constituents develop a sense of ownership in local school outcomes?

- **Barriers to OBE**
  What are the organizational, personal, emotional, and fiscal barriers to OBE?

- **The public mindset**
  How can a public mindset of school performance, which relies on standardized testing to demonstrate the acquisition of discrete and relatively low-level knowledge and skills, be altered?

INQUIRY QUESTIONS

1. How can technology facilitate communication between all stakeholders in the process of establishing national, state, and local standards and outcomes for student learning?

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2. How can technology encourage and enhance the establishment of reciprocal partnerships among schools, community groups, business, and industry?

3. How can outcomes be developed which recognize and value cultural diversity?

4. How can technology assist in the management of curriculum development, refinement, alignment, and articulation?

5. How can technology facilitate effective Outcome Based Education inservice for teachers, administrators, school board members, parents, and community members?

6. In what ways can technology promote the development of instructional strategies to support the mastery of expected outcomes?

7. How can technology assist in the management of the assessment, corrections, and expansions of learning opportunities for the mastery learning approach?

8. What types of technologies will facilitate student-centered, project-based, active learning focused on student outcomes?

9. What role can technology play in providing opportunities for students to participate in framing their own learning opportunities based on their personal interests, strengths, needs, and choices?

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National Curriculum Standards

English/Language Arts: Center for the Study of Reading
174 Children's Research Center
51 Gerty Dr.
Champaign, Illinois 61820

Mathematics: National Council of Teachers of Mathematics
1906 Association Dr.
Reston, VA 22091

Science: National Science Education Standards
2101 Constitution Ave. NW HA 486
Washington, D.C. 20418

Social Studies: National Center for History in the Schools
UCLA
231 Moore Hall
405 Hilgard Ave.
Los Angeles, CA 90024

Geography Standards Project
1600 M. St. NW
Washington, D.C. 20036

Center for Civic Education
5146 Fir Rd.
Calabasas, CA 91302

National Council for Social Studies
National Task Force for Social Studies Standards
3501 Newark St., NW
Washington, DC 20016

Fine Arts:	National Oversight Committee for Standards in the Arts 1902 Association Dr. Reston, VA. 22091
Physical Education:	National Association for Sports and Physical Education 1900 Association Dr. Reston, VA 22091
Foreign Language:	American Council on the Teaching of Foreign Language (no address available)

REVIEWS

Articles

Nyland, L. (1991, November). One district's journey to success with outcome-based education. The School Administrator, pp. 29-35.

The Pasco district OBE design begins with four questions:

- What do we want? (vision)
- What do we know and believe? (knowledge)
- What do we do? (action)
- What are we getting? (result/outcome)

These questions form the core of the OBE "success connection," and share much in common with the quality management process of Demming and with the curriculum development process of Ralph W. Tyler. Pasco also worked closely with John Champlin and with the National Center for Outcome Based Education during the three years of the initial implementation.

There are six essential elements of OBE: vision, knowledge, action, results, restructuring, and teaming. The original vision developed into five expected exit outcomes: self-esteem, concern for others, self-directed learning, process skills, and basic thinking skills. Next, a core of teachers was trained, and release time given so they could train others. Action plans included training in Bloom's 14-step instructional process, in Glasser's reality therapy, and in teacher teaming.

Brigham Young University and the Washington State Business Roundtable assisted in refining ways to analyze results. Restructuring sought to identify and remove barriers to desired outcomes. Teams ensure success by shared planning, shared placement of students, and shared responsibility for student discipline.

Five years later, Nyland offers some advice: involve parents earlier; set specific, measurable targets; take smaller, bite-sized steps; and, make sure to involve principals along with staff in training.

Spady, W. G. (1988, October). The basis of authentic restructuring and reform. Educational Leadership, pp. 4-8.

"The calendar and its adjuncts, the clock and the schedule, exert a pervasive influence on both the organization of schools and the thinking of those who work and study in them." Spady maintains that because of this "we behave as if the entire educational system would collapse if teaching, testing, grading, awarding of credit, and promotion did not follow the calendar-driven two-semester schedule" (4).

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OBE alters the "prevalent practice paradigm" by letting expected results, rather than time, frame the organization of education. Once we "expect" that all students will achieve mastery of core abilities, we must focus on "what" students learn, rather than "when" they learn it. "Grade in pencil, not in ink" is the motto for OBE's emphasis on second-chance learning.

Spady outlines the key operational principles of focus on outcomes, expanded opportunity, and high expectations. The article also contains a concise summary of the implications of this paradigm shift for management, teachers, and students.

The managing principal (1993, May/June). Electronic Learning, pp. 26-29.

This article described a real life scenario of the integrated use of technology to support the restructuring of education. It illustrated the use of specific technology applications to address some of the issues previously discussed in this inquiry topic. This elementary principal, Roger Coffee, effectively uses technology as a means for sharing his power, developing teamwork, and improving communication in this large school comprised of a teaching staff of fifty-three persons in three building wings and twelve portable classrooms. This scenario depicts effective integration of software applications such as Microsoft Mail, PageMaker, Microsoft Works, MacDraw, Print Shop, and HyperCard.

Math reform: No technology, no chance (1993, April). Electronic Learning, pp. 24-32.

This article emphasized the importance of the integration of technology into mathematics curriculum and instruction in order to achieve outcomes based on the NCTM Standards. Judah Schwartz contended that technology is necessary for math instruction and that its flexible nature supports a variety of instructional scenarios. James Landherr described the use of software like Geometric Supposer as an excellent tool for the development of problem-solving and reasoning skills because its flexible nature allows students to see change. And, Art Bardige discussed the role of tool software, the "next stage in the evolution of math software," in mathematics instruction. This article also serves as a scenario of technology supporting the implementation of the OBE process.

Software

The Wildcat! BBS

The electronic Bulletin Board System (BBS) can play an important role in OBE efforts. BBSs use computers, modems and telephone lines to exchange messages and computer files. The Wildcat! BBS (WC!) from Mustang Software, Inc. is an example of a powerful, well-designed BBS system. It can support up to 250 simultaneous callers, 1000 message conferences and 1000 file areas. A BBS can be as limited or as expansive as your imagination: parents can use it as a means of communicating with teachers; staff may use it as an e-mail system; and, administrators can use it to forward announcements. A strong outcome based design requires consent and communication between all of the stakeholder groups in the school community; the BBS can play a vital role in fostering that communication.

HyperCard

HyperCard is an application program for Macintosh computers which can be used to create multimedia projects. It has the capacity to integrate: CD-ROM, laser disc, sound, digitized still images utilizing the Zap Shot camera and ComputerEyes; scanned images, sound, graphics and sound from other programs like Kid Pix and Kid Pix Companion; and, full sound and motion video utilizing Quick Time. The use of multimedia tools enhances teachers' instructional methods and strategies,

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students' independent study and research, and authentic assessment. HyperCard has been used for collaborative projects engaging students in real life work situations involving higher levels of thinking processes. In the DOS platform, LinkWay is a program with similar multimedia capabilities.

IMSeries Curriculum Development

Offered by Learning Technology Systems (LTS), the IMSeries is a tool program for designing, managing, aligning, and articulating curriculum. This software has an open architecture so that national, state, and local standards may be used as a framework for the development of curriculum, assessment, and instruction. The Teacher Planner component may be used to create lesson plans derived from strategies, project ideas, and resources in this electronic curriculum. A Student Record component allows record keeping and electronic portfolio capabilities. All three of these components may be cross referenced against any set of standards, outcomes, or objectives with which the designers choose to align and articulate the curriculum. The IMSeries facilitates the design of interdisciplinary, thematic units and action research projects to assess the effectiveness of instructional strategies. In this format, curriculum may be continuously refined, revised, and enhanced. The limitation of this program is that it is complicated to use. Another curriculum management program, Educational Resources' Instructional Management Tool, is offered by Educational Resources, 1550 Executive Drive, Elgin, IL 60123, 800/ 624-2926.

IMPLEMENTATION STRATEGIES

Outcome Based Education has the potential to provide a framework for effective restructuring of our schools; however, there are several issues and concerns which must be addressed. While technology itself will not restructure education, "technology can stimulate education reform by providing what Jane David has called 'an invitation to change'" (Means, 1992). Technology promotes teachers' professional development; facilitates information access and utilization; enhances interdisciplinary and thematic instruction; and, provides opportunities for students to engage in real-life simulations, problem solving, and decision-making. Technology-enhanced learning is learner-centered, self-directed, active, and adaptable (Thomas & Knezek, 1991). Whether implementation begins at the individual classroom, school, or corporation levels, the following implementation strategies could be employed:

1. **Develop ownership and commitment to OBE.**
   Telecommunications technologies can provide support for developing an awareness of OBE philosophy, principles and processes. Electronic bulletin board services can provide a forum for community discussion. TV based video conferencing such as Picture Tel conferences provide opportunities for observation of OBE classrooms and interactive conferences with classroom teachers, students, and experts in this field. This technology also permits linking with one another for discussion of issues and implementation. Involving board members and community groups in this process will help build support and commitment and will also help diffuse controversy and objections to the OBE process.

2. **Conduct staff development and training for all stakeholders.**
   Similar telecommunications technologies provide support and follow up for staff development efforts. Picture Tel conferences provide opportunities for training and courses led by experts in OBE. Observation of OBE classrooms can provide "in action." Linking with one another for discussion of issues and implementation and connecting with experts for questions and consultation will lend long term support

that is often lacking in staff development activities. Involving board members and community groups in this process will help build community support and commitment to this effort. By facilitating communication and interaction among the various school constituencies, networking and long-distance learning technologies can help translate controversy into consensus.

3. **Tailor national and state standards to meet local circumstances and recommendations.**

   Technology can support these efforts by disseminating, discussing, and tailoring these standards to local needs by utilizing bulletin boards for communication. Distance learning technologies, such as Picture Tel, audio teleconferencing with audio graphics communications, and voice and data teleconferencing will facilitate gathering information, exchanging ideas, and interacting with organizations, units, or agencies that set these standards. Word processing, database, desktop publishing, or tool software can be used to maintain a flexible core of outcomes.

4. **Integrate curriculum, instruction, assessment and outcomes into a holistic educational program of interdependent and symbiotic elements.**

   Curriculum development and management software is beginning to appear on the market. This tool software can provide support for this implementation strategy. Thus, curriculum is no longer a static, bound document that is revised or refined on a state textbook adoption cycle; rather, it is a flexible, virtual curriculum that is revised each time teachers add, refine, or comment on outcomes, lesson plans, activities, or resources. In addition, the inclusion of the technologies for telecommunications and distance learning can provide opportunities for teachers to share ideas and lessons, as well as access data banks and expert resource persons. These same technologies may be used as learning opportunities for students to extend learning beyond classroom walls into the world and work of local and global communities. By providing immediate feedback to students, learning technologies can make all students active learners simultaneously.

5. **Integrate outcomes, assessment, curriculum and instruction through instructional technologies expands student and teacher learning opportunities exponentially.**

   Not only can the multiplicity of learning styles be addressed simultaneously through instructional technologies, but student motivation can be significantly enhanced by enabling students to direct their own learning activities. Self-actualization and learning create a fusion reaction in which the combination of the two continually creates more of each. Authentic assessment is an essential component of this implementation strategy. Technology provides unlimited opportunities for students to work individually or in small groups at both corrective and expanded learning activities. The following list suggests technology applications which will support this type of learning:

   - integrated learning systems: CCC and Jostens
   - multimedia tools such as CD-ROM, Grolier's and Comptons' electronic encyclopedias, Golden Book's First Connections (for younger children), laser discs, interactive video, HyperCard, LinkWay, and MediaText
   - telecommunications and distance learning technologies: Picture Tel for corrective and expanded courses, virtual field trips, and linking with experts
   - problem solving based software such as Mathamatica and laser discs such as Adventures of Jason Woodbury

6. **Recognize (and neutralize) potential barriers such as:**
    - Funding
    - Time
    - Regulation
    - Constituency Support
    - Organization of Schooling
    - Professional Development Requirements/Incentives

Scenario

A strategic planning committee comprised of administrators, teachers, support staff, parents, students, and community members are meeting in the board room of the school district's central office to discuss a proposal to adopt a Results Based Education approach. The superintendent has introduced the basic philosophy and principles to the group. They are engaging in a Picture Tel video conference with William Spady. The school board and community members want to see RBE in action. The curriculum director is asked to arrange a visit to a neighboring RBE district. Several members of the group are unable to attend so the superintendent asks the technology coordinator to set up a Picture Tel classroom observation and conference with students, staff, and parents at the Greely-Orange-Oregon District Schools (i.e., the GOOD School District). This district has been involved in RBE for five years. And, after the technology coordinator attended the Technology for Restructuring Workshop, this district purchased Picture Tel, multimedia, and video editing stations for every school. As partners in the effort to build a community consensus regarding RBE, the public library board, city council, regional technical college, nearby state university campus, town newspaper, local television station and two local businesses have also acquired Picture Tel capabilities. Three weeks later . . .

Several members of the Strategic Planning Committee for the Investigation of Results Based Education (the SPIRBE Committee) are focused on the Picture Tel screen. They are immersed in a virtual visit to an RBE classroom. In this class workroom they watch and listen as third, fourth, and fifth graders work on different collaborative projects. The classroom is far from quiet, but all students are engaged in their work. All around the room information is posted. MEGA Skills and Lifelong Guidelines are displayed and illustrated on student-created posters. Across the room, the five exit outcomes are similarly displayed. At the front of the room, where one might expect to find a teacher instructing students, there is a research and information center, where many types of print, student-created, and technology-based information access materials are located. Student project/assignment information is kept here along with the teacher/student instructional workstation. The inquiry questions and outcomes for the current theme of study are displayed.

At first, one parent is disturbed because he cannot locate the teacher in the classroom. An attorney from the community spots Mr. Jones kneeling on the floor beside three students working at a video editing station. He is listening to these students as they assess a video segment to decide whether to include it in the commercial for recycling that they are creating for the school TV news program. Across the room four students are jumping, clapping, and cheering. One committee member comments about this "disruptive group." The Picture Tel camera zooms in on the noisy group at a multimedia station. These students are congratulating each other on their success in importing a <u>QuickTime</u> conversion of a video clip about their community recycling project. Another group of students gathers around a table covered with a laptop computer, books, magazines, papers, and pencils. Then the interaction between those in the classroom and the SPIRBE group begins. . . .

What observations, particularly about the technological support of restructuring, would you contribute to this discussion?

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STUDENT-AS-WORKER

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Linda Steppe is the Gifted and Talented Coordinator of Linton-Stockton School Corporation. She also teaches in a multi-age classroom of gifted 4th, 5th, and 6th graders. Linda serves on the School Community Council and is a member of the corporation-wide technology committee. Linton-Stockton Elementary School is a replication site for Anonymous Group Decision-Making (AGD; a group problem solving software developed locally), and is a 21st Century and an Indiana 2000 school.

DEFINITION AND DESCRIPTION

The learning model employed in the "traditional classroom" typically has a teacher busily lecturing to students who are passively receiving, actively rejecting, or totally immune to the attempted knowledge transfer. The teacher attempts to completely control the learning. The students who choose to work toil in isolation. Student relationships are competitive and subject content is frequently fragmented and void of any real-life context. Technology is scarce or non-existent; if it does exist, it is controlled by the teacher.

The new learning model, on the other hand, has students working collaboratively on problem-based projects with the teacher acting more as a guide, facilitator, or even as a fellow learner than as a dispenser of knowledge. Cooperation rather than competition is the favored mode of operation. Subject content is often linked by encompassing themes characteristically set in authentic situations. Technology is powerful, ubiquitous, easy to use, multisensory, and most importantly student-controlled. Students are given access to rich and varied sources of textual, auditory, and visual information, are allowed to direct their learning, and are held accountable for developing a product or demonstrating a learning. Ted Sizer, while describing the fifth of the nine principles of the Coalition of Essential Schools, states:

> The governing practical metaphor of the school should be student-as-worker, rather than the more familiar teacher-as-deliverer-of-instructional-services. Accordingly, a prominent pedagogy will be coaching, to provoke students to learn how to learn, and thus to teach themselves. (1984)

This scenario of the student-as-worker and teacher-as-guide has powerful implications for K-12 education. It can help produce students who are curious seekers of knowledge, actively involved in charting their educational course, and on their way to becoming learners for life.

IMPLEMENTATION ISSUES

All teachers are familiar with change. They consider changes such as those caused by updated administrative procedures, curriculum overhauls, textbook adoptions, fluctuating enrollments, and new assignments "all in a day's work." For the most part, teachers (rightly or wrongly) keep these changes external to what goes on behind the classroom doors and therefore keep them from having a profound effect on student learning.

Changes that do have significant influence on student learnings are those that become internalized and then institutionalized by teachers, schools, and school districts. One proposed change now in vogue is the philosophy of student-as-worker. However, adoption of this instructional philosophy for one's own classroom is very problematic if proper considerations are not given to the issues and concerns generated by the change.

Since the student-as-worker model changes the very way in which students learn, there is a natural tendency to question how the relationships among teachers, students and their communities will change.

Of immediate concern is the role of the teacher. Since most teachers were trained to assume the role of "transmitter of information," it is important that veteran teachers be retrained in alternative teaching strategies. Similarly, our schools of education must adapt their curricula to include new learning models that incorporate instructional techniques outside the realm of the standard didactic method.

Secondly, the change in the teacher's instructional style can be upsetting to students. Students entering most schools are "trained" to view the teacher as the deliverer of instruction and to quickly assume the role of passive learners. The switch to an active learning role is a difficult paradigm shift

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for students and their parents. Students must be weaned from total dependence on the teacher for information. They must be taught how to find, process, and deliver or create information working on their own or in cooperative groups. Their parents must be fully informed of the reasons for the change, the benefits to be gained, and what to expect from the process as it unfolds. Regular communication about the appropriateness of student work as well as the constant reiteration of the overall aims and philosophies of student-as-worker are important keys to overcoming concerns during the implementation period.

The student-as-worker model presents some assessment issues; among these are the reliance of many states on standardized tests as measures of student achievement, the reliance of parents on traditional report cards, the futility of trying to condense the essence of a demonstration into a numerical or literal value, and the competitive nature of parents when comparing their child's achievement with others.

Another area of concern is the availability of information resources. The modern student's information environment external to school is far richer than that found in most schools. Furthermore, this deficit is magnified in poorer urban and rural school districts. Nevertheless, it is possible to begin implementing the student-as-worker model with very limited resources and then to acquire additional resources or tools when funding levels permit.

School structures may also inhibit implementation of the student-as-worker model: there may be physical limits such as poorly-designed or outdated buildings or lack of equipment; there may be procedural limits such as intractable school evaluation procedures or inflexible student/teacher scheduling; or, there may be school or employee group policies that limit initiating this model.

Finally, the implications of student-as-worker go well beyond the classroom. Experimentation with this model can be done in an individual classroom, but lasting success will depend upon a covenant entered into by all the stakeholders in the educational process. Gaining support from students, parents, community leaders, business leaders, school officials, and fellow teachers is crucial for institutionalizing this important instructional model.

INQUIRY QUESTIONS

The issues and problems related to restructuring our schools require implementing new strategies and changing the roles of all participants. However, this section will focus on examining the specific issue of student-as-worker. Following are some questions that need to addressed:

1. **What strategies can a teacher use to facilitate the student-as-worker model?**
   With teachers as guides, students are actively making educational decisions, seeking and inquiring, collaborating, and developing strategies for teaching themselves. Classroom management and teaching strategies are obviously going to be different. What new strategies are necessary to alter the learning environment and to develop the student workers?

2. **What minimal resources, if any, are essential to developing student workers?**
   Are there any specific "must have" tools? What tools will help students develop their full potential as a workers? Can existing technology be used to meet the goal?

3. **What role does technology play in creating productive student workers?**
   How can technology help to tranform a traditional student into a student worker? What technologies can help teachers develop new classroom structures and strategies that will

facilitate the changing roles of teachers and students? How can technology help students with their work and help teachers assess that work?

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Aronoff, W. and Toloudis, M. (1987, Winter). The view from the coalition classroom. American Educator: The Professional Journal of the American Federation of Teachers, pp. 22-23.

In this article the two writers compare their "essential" classroom and "school within a school" to traditional school settings. The authors deal with the concepts of curriculum planning, flexible scheduling, common planning times, student advisors, grading system choices and student-as-worker. The staff of the school chose to rename it Hope Essential High School to reflect the tie with the Coalition of Essential Schools and the work of Ted Sizer.

Collins, A. (1990). Restructuring for learning with technology. New York: Center for Technology in Education.

This article deals with eight major trends that can be identified when technology is used in the classroom. Changes in classroom structure, teacher instructional style, assessment, student learning styles and student workers are documented. Collins also discusses resistance to technology, the designs for a self-improving school, and the use of technology to foster educational reform.

Frick, T. (1991). Restructuring education through technology. Bloomington, Indiana: Phi Delta Kappa Educational Foundation.

This booklet discusses the nature of systems in education. The author's premise is that restructured schools change the very nature of several systems inherent to the operation of schools. The nature of the systems specifically deals with teacher, student and context relationships as well as the educational system and its environment.

Hansen, E. and Frederick, W. (1992). The role of media and technology for collaborative learning. Bloomington, Indiana: Indiana University.

This article discusses the different functions that specific forms of media play in collaborative learning. The difference between the technology as a tool or tutor and a convergent or divergent design is pointed out and explained thoroughly for each specific form of media mentioned. Advice is given for times when technology should be avoided in order to give collaboration among students a chance to succeed.

Pearlman, R. (1991, January). Restructuring with technology: A tour of schools where it's happening. Technology & Learning, pp. 30-36.

Pearlman's article addresses restructuring occurring in classrooms and schools in several school districts across the United States. He focuses on changes in teaching and learning models as well as structural and procedural changes that redefine the roles of students, teachers, administrators and parents in the guidance and management of schools. He gives several specific examples of students involved in project-based learning assisted by technology. He also gives several examples of schools where learning areas, procedures, and programs have been redesigned to better fit their methodologies.

Ray, D. (1991, March). Technology and restructuring part I: New educational directions. The Computing Teacher, pp. 20.

Ray, D. (1991, April). Technology and restructuring part II: New organizational directions. The Computing Teacher, pp. 8-12.

The first article in this series takes sixteen educational directives that fit the mode of restructured schools and offers ways that technology could be used to meet those directives. The directives include, among others, whole-person education, transdisciplinary education, education for collaboration, and education for metacognition and reflective practice. Some specific examples and products are listed.

The second article in the series looks at ways in which schools are dealing with organizational design in restructured schools. Barriers to using technology in restructuring schools are discussed along with strategies for enchancing the technology-restructuring relationship.

Rockman, S. (1993, March). Asking the right questions. The American School Board Journal, pp. 29-31.

Rockman's article discusses several examples of technology making positive differences in education that were unable to be captured by traditional standardized tests. His solution to measuring such anecdotal evidence is to measure a broader spectrum of student achievement. He asserts that to get better answers about computers, we need to ask better questions.

Sivin-Kachala, J. and Bialo, E. (1993). Report on the effectiveness of technology in schools 1990-1992. Washington, D.C.: Software Publishers Association.

This report, which was commissioned by the Software Publishers Association and conducted by Interactive Educational System Designs Inc., summarizes eighty-six educational technology research reviews and reports that were conducted on original research from 1990-1992. Only forty-nine of the original eighty-six articles have been published.

The report is divided into three sections:

1. Effects of technology on student achievement
2. Effects of technology on student self-concept and attitudes about learning
3. Effects of technology on interactions involving teachers and students in the learning environment

Major claims of the research show educational technology having significant positive effects on student achievement for all subject areas as well as on student attitudes and student self-concept. In addition, the changes to the learning environment brought on by the use of technology are positive, and increase student interaction and cooperation.

Thomas, L. and Knezek, D. (1991, March). Facilitating restructured learning experiences with technology. The Computing Teacher, pp. 49-53.

This article reviews the literature on restructuring and gives a brief description of desired learning experiences. It also gives specific examples of ways in which technology can improve learning experiences for students. The authors focus on telecommunication and multimedia and describes how students can become active, motivated thinkers and doers. Specific products are listed along with detailed strategies to guide students in the use of these products.

Furthermore, this article gives teachers management tips, and lesson guides to help them get their student workers started. There are also excellent charts that compare and contrast traditional learning practices with restructured learning practices. The software mentioned and the lesson guides are specific.

Thomas, L. and Knezek, D. (1991, Winter). Providing technology leadership for restructured schools. Journal of Research on Computing in Education, pp. 265-279.

This article discusses the results of a survey given to professionals in education and instructional technology. Two of the five areas of reform to which the respondents were asked to reply were curriculum and learning experiences. The respondents felt that technology provided and supported the types of student-centered learning experiences suggested for restructured schools.

Watson, J. (1990-91, December/January). Cooperative learning and computers: One way to address student differences. The Computing Teacher, pp. 9-12.

This article reports that students do their best work on computers when they work in pairs. Not only is the work better, there are also positive differences in the need for teacher input as well as increased time on task. Emperical evidence is cited for the conclusion of the article. The author also lists strategies for using groups effectively on the computer.

IMPLEMENTATION STRATEGIES

The following scenarios are offered both as an expression of the "look and feel" of the student-as-worker philosophy in the classroom and as a means of detailing some of its implementation issues. We have not limited ourselves to the impact of technology on the student-as-worker model, instead we have taken a broader view of many issues implicit in school restructuring. Although we know of no school that implements all of these scenarios, we feel technologies are available, instructional strategies are in place, and teachers are motivated to begin this task.

Scenario 1

Mary is a new teacher and has arranged to meet her mentor teacher before the school day begins in order to talk about teaching strategies. Although Mary has had little training in the use of student work groups, she feels that her Social Studies class would benefit from working on a paper by dividing the concepts and approaching parts of the paper from different perspectives. After working on smaller parts, students will combine their information to create a group report. Mary feels uncomfortable with allowing the noise level to be greater than normal and allowing her students the freedom to move around her room without her specific permission.

Her mentor teacher, Ricki, assures her that these are common concerns--concerns she also had several years ago. Ricki then describes a variety of grouping and cooperative education strategies that she has employed in her own classroom. Relieved by Ricki's assurances, Mary then turns her attention to the school's limited resources. Ricki also has concerns but points out that there are ways to use what resources are available to produce quality work while keeping the students on task. Ricki quips that the noise level may be a bit higher in her classroom, but that the fundamental learning which takes place is worth some minor initial risks. After reminding Mary that everyone is nervous when considering new strategies, she invites her to visit her language arts classroom to observe the student-as-worker model in action.

After considering Ricki's suggestion, Mary arranges to use one of her mentor days to observe Ricki's classroom. At first Mary is a bit nervous as she sits in the back of Ricki's class. She notes that the students, upon entering the classroom, group themselves and begin working even before the bell rings. When Ricki does enter, she makes a few general announcements and then begins visiting each group, giving encouragement and answering many of the students' questions with her own leading questions. Meanwhile students go busily about asking one another questions and dividing their work. Several of the students wander over to one of the three computers that have been borrowed for the day and begin typing.

Mary is at first defensive but then delighted when two students approach her and ask if they may interview her concerning information about one of Mary's favorite topics, Western Expansion in the 1860's. She is very impressed that the students have already gathered some resources from the library but explains that they need more sources and volunteers to help them. Before long, Mary is involved with the class proceedings and finds herself joining Ricki and another group discussing the political parties of the Civil War era.

Near the end of the period she notices that the students are shuffling several disks in and out of the computer in an effort to combine several smaller writings into one. Ricki makes it a point to tell Mary that she needs to have the students teach her how to do that someday. At first Mary finds it odd that Ricki is not bothered by not being "in control" of the transfer of knowledge.

At end of the day, Mary is exhausted. She has certainly had a much more active day than she would have imagined. Each period new and interesting skills were displayed by the students. What's more, she finds it curious that she is interested in trying some of the skills she saw Ricki display with the students. In her discussion with Ricki at the end of the day, she gives her a tentative decision to partner their classes for a project. They make arrangements to meet to discuss the various ways of interacting with the students. As they walk to their cars Ricki asks Mary, "So, was my classroom too noisy today?

Scenario 2

As you walk into Joe Daniel's math classroom, you are surprised to find Joe at the board giving what appears to be a lecture to a small group of students. You notice other students working, either singly or in small groups, at the back of the class. You take a seat near the back of the lecture group and soon realize that Joe is taking his prompts from student suggestions. There is a diagram on the board of what appears to be several triangles with numerical values indicating measures for some of the sides. The students are conjecturing how to find the other values. Joe cautions them that the diagram will reflect these values for only a short time. Joe begins working a mathematical equation under student direction while soliciting responses for the next logical step. Many of the students are actively using calculators. As Joe is working, several of the students get out of their seats, go to another section of the board and begin trying another approach to the problem with suggestions from a subset of the seated group.

As you scan the room your attention focuses on a pair of workers who are gathered around a computer screen. As pixels begin lighting all around the screen, a geometric figure begins to take form. One of the girls points to the screen while emphasizing that she sure didn't expect this level of repetition. After watching the screen for a few more seconds, she stops the program and begins analyzing a few of the complex mathematical lines with the help of her friend. As you observe them, they talk about the effect that certain changes might have on the picture. Finally, they begin work on changing the algorithms and then they run the program again. This time, the picture does not quite give the intended result, so the students continue to work.

You then take notice of another group of five students who are creating a device for what appears to be a physics experiment. One of the boys in the group is videotaping the proceedings. An older boy enters the room with some additional components and advises the students that a change in the placement of a spring will make a major difference in their outcomes. The students begin questioning the older student who answers their questions with others. Joe soon joins the group to check on their progress. Most of the first group of students are working at their seats. Joe directs the students to a modified diagram of the one that first appeared at the front board and asks several questions of the students who are by now adding new components to their experiment. Joe then drifts over to another corner where a single student is using computer software to simulate the physical components of the machine that is taking shape in the back of the room. After some discussion with Joe, the student communicates with the group of builders as they all gather around the computer screen and then return to make additional modifications to the machine.

Within moments, all the students converge on the machine. The students who have been working at the board are now agreeing on a specific answer and gesturing to a point in space to where they claim the machine will move. The student who has been working on the simulated machine agrees, but warns that they may not have taken fully into account the last change in the placement of the spring. The experiment begins, and all the students are surprised by the answer. None of the estimated calculations are close. The students return to the board and begin asking one another questions and continue working without prompting. Then the two girls who have been working on the computer are called over to help the small group. This process continues until finally the experimental results closely match the prediction. Joe summarizes what has occurred and adds another spring to the machine. He asks the students to be prepared to discuss the changes after they return from break. N all of the students file out of the room. One student uses the computer to communicate the results of their experiment to a group of other schools with whom they will soon be involved in an exchange program. Arrangements are made for the schools to work in teams to help polish their ideas.

Scenario 3

Carmen spots her father over the heads of the other students in the cafeteria and begins to move towards him. After a busy morning of Cultural Perspectives class, she is so refreshed and excited that it is almost more than she can contain. As soon as she is within talking distance, she begins detailing for her father the group's plan to visit a retirement community. The group is interested in studying the historical period of the Great Depression, a time indelibly etched in the memories of many of the seniors in the retirement home. The five-day journey will focus on conducting personal interviews in the evenings with the senior citizens to gather data on the architecture, clothing and literature of the period. Carmen also thought an on-line search for additional information at the library would be helpful. Although the students plan to stay in the retirement community, Carmen is somewhat concerned that their busy daytime activities of gathering data at the courthouse, taking pictures of period homes, and reading the literature will interfere with the interaction between the students and the older adults. While paying for lunch, it suddenly dawns on Carmen that it would be interesting to do a comparison between prices and salaries of the thirties with those of today. She must remember to write that idea down in her math journal. During lunch, she quizzes her father about what his parents had shared about that period in time. After a brief discussion, he turns the conversation to her upcoming apprenticeship interview.

Carmen has discussed her apprenticeship choices with her parents and with her student advisory group. With their input, she has chosen to apply for one of the select positions in the company where her father works. Her dad has met her for lunch to finalize the timeline for her application. They decide that the community service video in her school portfolio should be submitted along with that application. While at the school her father will take the opportunity to

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speak to her student advisor as to her transportation needs during the school release apprenticeship program and to insure there will not be conflicts with her afternoon French class that is involved in a teleconference with students from Paris.

After lunch Carmen checks her schedule. She notes that her science class is meeting later than normal in order to facilitate collaborative work with elementary students. The two groups have been working on a study of local amphibians. The younger students will share the content of their HyperCard stacks today while the older students will show how to add their scanned diagrams of the respiratory system to the stack. Since she has a few minutes before class, Carmen decides to spend the free time peer-editing her partner's paper on the environmental impact of the local water tables on amphibian habitat. She bids her father good-bye and reminds him that her mother will be joining her later in the day at school for their exercise class.

RESPONSE TO INQUIRY QUESTIONS

1. What strategies can a teacher use to faciliate a student-as-worker model?

Not only must the teacher provide opportunities for the student-as-worker to collaborate, inquire, and produce, the teacher must also consider new teaching strategies and classroom management techniques. The teacher needs to understand that the classroom must provide appropriate tools and resources for the students to use and adequate space in which to work. Ample time will be needed for student projects. The classroom climate must be one which will allow for student movement and discussion among pairs, small groups, or large groups. Furniture mobility and access to electricity must be anticipated. Freedom for students to use resources outside the classroom should be considered. The resources may be down the hall, in the library, accessible by phone or modem from a distance, or across town across at the senior citizen's center.

It is also recommended that the teacher establish procedures for collaborative-learning and problem-solving. Pre-production activities may include team-building and ways to reach group consensus, the assignment of roles and tasks to divide a large group project into smaller pieces, and the teaching of a problem-solving process to the students. When students are able to internalize these life-long skills, they will be well on their way to becoming student workers.

Students may also need to adjust and some time in which to do it. They need to understand the basic philosophy of the student-as-worker model when going from a passive learning role to an inquiry-collaboration mode. This philosophy also needs to be articulated to parents. Since this philosophy is based on student needs, the students, probably more so than the adults involved, will be pliant and will tend not to have difficulty "buying into" this notion of student-as-worker (Neat, 1993).

2. What minimal resources are basic to a student-as-worker?

Tools for finding, learning, and presenting seem to be essential for the student-as-worker (Niguidula, 1993). These tools and resources may be as basic as a set of encyclopedias, pencil, paper, and a library card. Technology's role here cannot be ignored, however. A word processor is usually not too difficult to find, although the student isolated at the machine is not the only way to produce work. Collaboration at a word processor is possible with peer writing or the linking of documents. Data bases and spread sheets that were developed by the student for his manipulation and purposes are another aspect of technology working for the student in his quest for answers. Desktop publishing and graphic programs can allow more creative freedom and a sense of pride in making a piece "look good." Multimedia programs can make presentation of a product much more useful and more meaningful to its audience. Moving further along in technological advances, CD-ROM reference materials (encyclopedias, atlases, almanacs, etc.), laser discs, and libraries on-line can make navigating through information a much more efficient task. Telecommunications with other classes, schools, states, and even countries can open doors for accessing information that could not efficiently be done without the support of technology. On-line pen pals can give a new perspective to a topic that could never be found in fact-based materials.

3. **What role does technology play in creating productive student workers?**

Technology's role in creating productive student workers in a restructured setting cannot be overlooked. Even though change should be systemic, broad-based, and student-oriented, the means to achieve the end should include the use of technology. Technology available in any quantities, when used in a well-thought out manner, can truly facilitate change and become a personal tool for the student-as-worker. Students can use these tools to get at the more creative, thought provoking elements of a lesson, topic, or concept. When implemented correctly technology can also be a lever to speed up the change process. A teacher using appropriate teaching strategies, classroom management strategies, and the available technology who sees her students transformed into knowledge seekers is more likely to continue and expand the use of technology in the classroom; and, the students will probably demand it!

FINAL COMMENTS

We felt that our discussion would not be complete without giving teachers specific ideas. When specific products are mentioned it is only because of personal knowledge and experience. It is not an attempt to endorse any particular product as there are likely others that do the same thing just as well.

word processors: Students can collaborate on pieces, peer write and edit, brainstorm ideas, and publish documents.

data bases: Students can use on-line data bases for inquiries, create their own to manage data, and graphically represent data.

spread sheets: Students can create their own to manipulate their numerical data for analysis.

graphic programs: Students can create visual images, import them into other documents. A program popular with elementary children is KidPix by Broderbund.

hypermedia: Students create interactive documents that can incoporate video, text, graphics and sound. HyperCard by Claris, Linkway Live by IBM, and Toolbook by Asymetrix are some programs that will do this.

simulations: Students take on roles and make decisions based on prior or researched knowledge. The Carmen Sandiego series and Sim City by Broderbund, and Oregon Trail by Mecc have been successfully used in classrooms. A new product by Optical Data called The Adventures of Jasper Woodbury is also an interesting math simulation.

video: Students can use communication skills while synthesizing and organizing information for visual representation.

probeware:	Students can perform science experiments using devices that are attached to the computer. The computer records data from the probe and may manipulate and analyze it.
telecommunications:	Students use modems and networks to link with others to discuss and study issues, concepts or topics or to search remote data bases. The National Geographic Kids Network is an example of a packaged telecommunication project organized around a topic.
applied programming:	Students use a programming language to manipulate physical objects. An excellent example of this is Lego TC using the logo language to manipulate robots or other objects constructed from Lego blocks.
thematic software:	Students use programs to study a topic from a multi-disciplinary approach. The prewritten programs incorporate math, language, science, and social studies. Voyage of the Mimi I and II are good examples of this.

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THEMATIC INSTRUCTION

INQUIRY GROUP MEMBERS

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David Bartlett has been a teacher at the Harmony School, an alternative K-12 school, for six years. He works closely at the school in developing thematic instruction for his fifth and sixth grade classes. He is also the technology and elementary coordinator. Harmony is involved with two initiatives: the Coalition of Essential Schools and the Indiana Network of Total Learning Communties.

Kay Koppel
Elementary Media Specialist
Batesville Community School Corp.
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Kay Koppel has been a media specialist in BCSC for 13 years. She is responsible for media centers in two schools (K-3, 4-5) as well as being responsible for technology in both buildings. One of her schools will be a member of the CLASS project for the 1993-94 school year.

Rhoda Meier
Coordinator of Instructional Technology
Greater Clark County Schools
601 E. Court Ave.
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Rhoda Meier has been in education for eighteen years and in her current position for nine years. She is actively involved in her corporation's investigation of various restructuring movements, including Re: Learning and the SREB program.

DEFINITION AND DESCRIPTION

Theme: A theme is an overarching concept that knits the various strands of the curriculum into an integrated, meaningful whole (Buechler, 1993).

It is understood that thematic instruction can follow any of a variety of models and that it may be done within a single discipline by relating topics within that discipline. However, we will concentrate on thematic instruction that relates two or more disciplines through the use of a common theme.

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IMPLEMENTATION ISSUES

1. Time.

There is a need for adequate time to develop the project, to implement the project and to evaluate the project. Thematic instruction takes more time to plan than traditional instruction. This time must be provided for the teacher for thematic instruction to be successful.

Time must also be provided for implementation; this almost certainly will mean that specific items in the current curriculum will be revised, compressed or deleted. A thoughtful analysis of the existing curriculum must take place to ensure that the curriculum revision is done sensibly and in concert with the school's overall vision. Evaluation of the project is an essential component, and, again, teachers must be given adequate time to do this assessment.

2. Teacher inservice.

Teachers must have adequate inservice on at least three areas: the underlying educational issues, such as learning styles and authentic assessment strategies; specific hardware/software applications; and, strategies for effective use of technology. These issues are so interrelated to effective thematic instruction that special efforts should be made to provide all teachers with opportunities for learning about them.

3. Resources.

Essential for project-based learning, available and accessible resources make all thematic instruction even more effective. We have heard teachers excuse their adherence to traditional teaching techniques by saying that they "don't have the materials to work with here" or "it just takes too much time to locate everything." Simply being available and accessible is not enough, however. Teachers often will be unaware of what is available within their own buildings. Communicating what is there and assisting in choosing appropriate materials is equally important. Additionally, most teachers do not have many opportunities to attend conferences and trade shows to learn about the newest products; teachers need a way to learn about these new products from their classrooms.

4. Other barriers.

Probably the biggest inhibitor to the adoption of the thematic approach is the perception of walls between disciplines. Teachers themselves have been taught through isolated, unrelated courses and many have little experience outside of education to help them see the connections. Often the design of the school building itself will reinforce the isolation between departments.

A second, profound influence on maintaining the status quo is the method in which students, teachers, and programs are currently assessed. Researchers and teachers agree that existing standardized tests are inappropriate measures of the learning that takes place in project-based thematic units; yet monetary rewards are based upon the results of those tests.

Other factors that can discourage thematic instruction are parental perceptions of what constitutes valuable learning and teacher resistance to change.

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INQUIRY QUESTIONS

1. What does the professional literature say about the role of technology in supporting thematic instruction?

2. What technology resources are available today that would support thematic instruction?

3. In what ways could technology be used to circumvent the barriers to thematic instruction?

RESOURCES AND REFERENCES

Bagley, C. and Hunter, B. (1992, July). Restructuring, constructivism, and technology: Forging a new relationship. Educational Technology, pp. 22-27.

Beck, R. H., et al. (1991, October). Vocational and academic teachers work together. Educational Leadership, pp. 29-31.

Brandt, R. (1991, October). On interdisciplinary curriculum: A conversation with Heidi Hayes Jacobs. Educational Leadership, pp. 24-26.

Brophy, J. and Allemna, J. (1991, October). A caveat: Curriculum integration isn't always a good idea. Educational Leadership, p. 66.

Buechler, M. (1993). Connecting learning assures successful students: A study of the CLASS program. Policy Bulletin, Indiana Education Policy Center.

Drake, S. M. (1991, October). How our team dissolved the boundaries. Educational Leadership, pp. 20-22.

Fogarty, R. (1991, October). Ten ways to integrate curriculum. Educational Leadership, pp. 61-65.

Goodman, Jesse. Indiana University, WW Wright School of Education, Bloomington, IN 47405.

Gregory, T. (1991). Walkabout day. Changing Schools, 19(2), 1-5.

Hurd, D. P. (1991, October). Why we must transform science education. Educational Leadership, pp. 33-35.

Means, B. (1992, June). Technology: A lever for school change? Paper presented at the Conference on Technology and Education Reform, Dallas.

Neat, T. Audioteleconference with the Technology for Restructuring Institute. 24 June, 1993.

Pearlman, R. (1991, January). Restructuring with technology: A tour of schools where it's happening. Technology & Learning, pp. 30-36.

Pearlman, B. Videoteleconference to the Technology & Restructuring Summer Institute. 23 June, 1993.

Ray, D. (1991, March). Technology and restructuring part I: New educational directions. The Computing Teacher, pp. 9-20.

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Ray, D. (1992, January). Removing barriers of social organization in schooling so technology can aid restructuring. Education Digest, pp. 14-17.

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Thomas, L. G. and Knezek, D. (1991, Winter). Providing technology leadership for restructured schools. Journal of Research on Computing in Education, pp. 265-273.

Thomas, L. G. and Knezek, D. (1991, March). Facilitating restructured learning experiences with technology. The Computing Teacher, pp. 49-53.

Zammit, S. A. (1992, Spring). Factors facilitating or hindering the use of computers in schools. Educational Research, pp. 57-66.

REVIEWS

We have included a short description, comments and a rating scale of 1 - 4 (1 = Not Recommended; 4 = Highly Valuable).

Bagley, C. and Hunter, B. (1992, July). Restructuring, constructivism, and technology: Forging a new relationship. Educational Technology, pp. 22-27.

This article is an excellent discussion of the three agendas of the educational reform movement (a push for restructuring schools; changing roles of teachers and learners, and a movement toward well-integrated uses of technology in the curriculum) and the way in which these issues are so intertwined that one cannot occur without the other. The author has a long, well-chosen bibliography; although some of the references are now dated, the article is worth locating for the bibliography alone.

Rating: 2.5

Beck, R. H., et al. (1991, October). Vocational and academic teachers work together. Educational Leadership, pp. 29-31.

This article is a specific description of collaborative projects involving math/business, language arts/technology and economics/science in two high schools. Although the focus of the article was not intended to be the technology used in the projects, it is a clear component of each. It may be worth looking at for examples.

Rating: 2.5

Brandt, R. (1991, October). On interdisciplinary curriculum: A conversation with Heidi Hayes Jacobs. Educational Leadership, pp. 24-26.

As editor of ASCD's Interdisplinary Curriculum: Design and implementation, Jacobs has first hand knowledge of attempts to develop interdisciplinary programs across the country. In this interview she cites reasons for the resistance to change, especially at the secondary level.
Rating: 4

Brophy, J. and Allemna, J. (1991, October). A caveat: Curriculum integration isn't always a good idea. Educational Leadership, p. 66.

This articles gives some examples of poor use of integrated curriculum and could be helpful in determining criteria for what is appropriate use of integration. Furthermore, it might be worth a quick look, although for most people it is a matter of common sense.
Rating: 2

Buechler, M. (1993). Connecting learning assures successful students: A study of the CLASS program. Policy Bulletin, Indiana Education Policy Center.

This is a valuable summary of Indiana University's 100+ page study of the CLASS project, a program for teacher-driven change at the elementary level. One of its key components is thematic instruction which is defined in the report along with the other aspects of the CLASS project. After two years of support by the IDOE, this survey shows both the positive and the negative aspects. This report is a must for anyone thinking of initiating any educational change. It shows the long- and short-term components to be considered. This summary also is a good place to start if you are "browsing" for ways to make education successful: the CLASS project components are explained as well as its basic premise that the teacher picks and chooses only the components that will work for him/her.
Rating: 4

Drake, S. M. (1991, October). How our team dissolved the boundaries. Educational Leadership, pp. 20-22.

This article gives three models of integrated instruction (Interdisciplinary, Multidisciplinary and Transdisciplinary) along with examples of each displayed graphically. Perhaps the most important part of this article is the process used to plan the curriculum. It describes how the limitations of the people involved in planning can limit the scope of the theme, and then gives recommendations on how to be more inclusive. I would recommend this for people who are team teaching or beginning to use integration for helpful tips on planning strategies.
Rating: 3

Fogarty, R. (1991, October). Ten Ways to Integrate Curriculum. Educational Leadership, pp. 61-65.

The article gives an excellent explanation of ten types of integrated curriculum with related examples of each. It also helps to define some of the terminology used related to thematic instruction. I would definitely recommend this to someone in the early stages of incorporating integrated curriculum to decide which model is the best choice for the desired theme.
Rating: 3.5

BEST COPY AVAILABLE

Goodman, Jesse. Indiana University, WW Wright School of Education, Bloomington, IN 47405

Excellent resource on thematic instruction.

Gregory, T. (1991). Walkabout day. Changing Schools, 19(2), 1-5.

Describes the unusual curriculum of Jefferson County Open School in Lakewood, Colorado. This curriculum, based on student completion of six Passages for graduation, was the model for our Scenario 3: the technology-rich school. This article, and this school, are worth investigating for anyone serious about authentic work and all other issues related to the restructuring question.
Rating: 3.5

Hurd, D. P. (1991, (October). Why we must transform science education. Educational Leadership, pp.33-35.

This article discusses how science itself has become integrated across areas within and outside of science and how rapidly knowledge changes leaving science curriculum unable to keep up. It also discusses how a variety methods of inquiry need to be taught in order to develop thinking skills required in science. I would recommend this to all levels to develop perspective on this critical area of instruction, even though it is addressed to the secondary and college levels.
Rating: 3.5

Means, B. (1992, June). Technology: A lever for school change? Paper presented at the Conference on Technology and Education Reform, Dallas.

A long paper with little about multidisciplinary work and collaborative work.
Rating: 1

Neat, T. Audioteleconference with the Technology for Restructuring Institute. 24 June, 1993.

A discussion of issues concerning the student as worker and thematic instruction. Also touched on ways to encourage change.

Pearlman, R. (1991, January). Restructuring with technology: A tour of schools where it's happening. Technology & Learning, pp. 30-36.

A good collection of anecdotes on how restructuring schools are using technology.
Rating: 3

Pearlman, B. Videoteleconference to the Technology & Restructuring Summer Institute. 23 June, 1993.

A wide-ranging discussion of topics on restructuring, with special emphasis on what particular schools are doing throughout the country to address those issues.

Ray, D. (1991, March). Technology and restructuring part I: New educational directions. The Computing Teacher, pp. 9-20.

Ray, D. (1991, April). Technology and restructuring part II: New organizational directions. The Computing Teacher, pp. 8-12.

Ray, D. (1992, January). Removing barriers of social organization in schooling so technology can aid restructuring. Education Digest, pp. 14-17.

Doris Ray's study of technology and its relationship to restructuring in fourteen schools seems to be the only study of this evolving relationship. She cites both educational and organizational (function and form) barriers to the establishment of a meaningful relationship. The Education Digest article is merely a summary of the two Computing Teacher articles and does not do justice to the originals. The shortened version gives only the solutions (Ray's strategies for change) and omits the "human interest" aspect of her survey (i.e. the actual situations she observed). By all means read the original articles!
Rating: 3

Rockman, S. Videoteleconference to the Technology & Restructuring Summer Institute. 22 June, 1993.

A discussion of barriers to technology and issues of implementation of change in schools.

Sheingold, K. Restructuring for learning with technology: The potential for synergy. The Potential for Synergy, pp. 9-26.

This is a thoughtful explanation for the need to bring together learning & teaching, well-integrated technology and restructuring. Each element is examined as well as the logical interrelationship of the three. Sheingold sees technology as a support and as catalyst for restructuring. This nicely relates to the Ray article which takes Sheingold's premise and surveys the relationships in the "real world."
Rating: 3

Thomas, L. G. and Knezek, D. (1991, Winter). Providing technology leadership for restructured schools. Journal of Research on Computing in Education, pp. 265-273.

The focus of this article is the technology-related skills needed by administrators and curriculum leaders in restructured schools. It is an excellent overview of the major issues of restructuring and technology's role in them. The results of a survey of 240 professionals who were leaders in the area of technology and restructuring are included; these include a prioritized list of technology competencies for administrators. Give this article to your less-than-current administrators.
Rating: 3

Thomas, L. G. and Knezek, D. (1991, March). Facilitating restructured learning experiences with technology. The Computing Teacher, pp. 49-53.

Good examples of how to use technology effectively, including a detailed walk-through of a hypertext/multimedia project for an interdisciplinary unit on natural disasters. Good overall explanation of the changes in teaching and learning caused by restructuring, as well as a chart of definitions of multimedia publishing programs with sample software and tools needed.
Rating: 3

Zammit, S. A. (1992, Spring). Factors facilitating or hindering the use of computers in schools. Educational Research, pp. 57-66.

A report of the results of a study of perceived factors differentiating teachers who use computers as an integral part of their teaching and teachers who did not. Access, time and support for technology planning were perceived as the most influential factors in computer use. Though the

study was done in Australia, it would be very surprising if the data would be much different in a similar study done locally.
Rating: 1.5

IMPLEMENTATION STRATEGIES

Thematic instruction is possible in any school with technology, regardless of its level of sophistication. However, technology greatly expands the possibilities for thematic projects and can be the catalyst for thematic instruction where it has not occurred before.

We see that, in terms of what technology is available, schools lie somewhere on a continuum from little or no technology to technology-rich. Thematic instruction can occur in any of these schools, but will look different at each stage.

Schools with limited technology

Schools with only a minimal level of technology can use the technology to support thematic instruction, but there are certain minimum requirements. We agree with Robert Pearlman, who states that to do project-based instruction, all one really needs is a good word processor/database/ spreadsheet program and a hypertext program. With these two tools, students can create wonderful projects involving multiple disciplines. Even the oldest computers currently found in schools can be used for this purpose, although we would recommend that more recent computers with hard drives or on networks be made available at a minimum of one per teacher and to students on a three-to-one ratio.

We also feel that a videocamera and VCR are invaluable resources for thematic instruction, and should be made available in adequate numbers to make them easily accessible for students and teachers. Similarly, audiotape recorders and CD players should be easily available.

The most basic technology is often the one least likely for schools to have readily available: the telephone. Yet if students are to make mental connections, they must be able to make human connections. Interviews with specialists in their topic of inquiry would become possible, as well as inquiries to the public library and such mundane items as emergency calls home for forgotten materials.

Another technology so basic that it is often overlooked is television, both broadcast and cable. Much wonderful information is available through television; a well-designed half-hour show can be the "kick-off" activity for a thematic unit.

Scenario 1A

A few computers
Videocamera
VCR
Audio tape player
Hypertext software

We enter Mrs. Edwards' classroom, where the theme for the month is "Discovery." Fourth and fifth grade students are working in teams of three at various places around the room. Several are clustered around the three computers along one wall; two teams are working in one corner area with a videocamera on a tripod. Two of the students are dressed in white lab coats and are hunched around

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a table with a microscope; one more wears a hat labelled "Newton" and carries an apple. Several students are sitting on the floor around the bookcase in the back, searching through volumes of an old encyclopedia, a book on explorers and several science books.

One child in the front of the room has on a headset hooked to a tape player. Suddenly he shouts, "I found it! Hey guys, this would be great theme music!" He rushes over to the video corner and plays the music for the group.

We stop at one of the computers, where three children excitedly take turns telling us about their project, a HyperCard stack about Columbus reaching the New World, told first from the viewpoint of one of his sailors, then from a Native American's point of view. It includes both commercially drawn pictures and some of their original artwork. The writing is clearly a child's, but well-organized and full of interesting information. Over in the corner some students are viewing and recording a cable program on Arctic Exploration. After they finish they will discuss how they will use portions of it for their presentation on the "Discovery" theme. Because of time restraints they will have to reach a compromise on what portions and how much of each will be used.

Just then someone rings a handbell. Everyone gets very quiet. The group with the camera is filming a scene with the two "scientists" discussing the possibility that "this drug just might be the cure for AIDS." They film it twice, then say "Okay, you can talk," and the other children relax.

The teacher explains that each child must create one project of his or her choosing on the theme. She tells us that the class must share the camera with two other groups, so the children have to have their scripts written and their costumes ready when their time arrives. They have only three more days to complete their projects, some of which are videos and some of which are computer stacks.

She tells us that the children have had lively discussions about what constitutes a discovery, whether if something was known by another person if it is truly a discovery. They have coined the term, "personal discovery" to describe situations where one person "discovers" something that another person or group of people were already aware of.

As we leave the busy classroom, Mrs. Edwards invites us to return for the presentations on Friday. Several parents will be present, she says, and the children will have planned and prepared refreshments.

Scenario 1B

Computer
Telephone, modem
Access to Prodigy and Internet
Automated card catalog

We visit Longview High School in the early afternoon, where we enter Mr. Wilson's social studies class. Class hasn't begun yet, and many of the students are frantic to take their turns at a computer hooked to a modem. We walk over and discover that they are using Prodigy, and that each pair of students is checking the current status of one stock in the stock quotations section. As each pair leaves the computer, one of them goes to the chalkboard, where he adds his number to a series of quotations from the previous hours. The other one digs out a notebook, grabs a calculator and make some calculations.

Mr. Wilson begins the class. He asks each team, "How much?" Each one responds with something similar to "Gain $252.50" or "Loss $124." Mr. Wilson explains that each team picked a stock at random two months ago and "invested" $10,000 in it. The amounts they are reporting are the net gains or losses since their first investment. He asks one student to tell what has happened to his team since they began.

"Well, our stock started going down a lot. So we decided to sell it, and we got $8460 for it. Then we bought another stock, and it was doing okay for a while, but now it's going down, too. We're trying to decide if we should wait a little while to see if it gets better, or go ahead and sell."

Mr. Wilson starts up a video about the Great Depression. During its ten-minute run, he whispers to us that they are in the middle of a unit about the stock market crash and the years afterward. Though he really had intended to end the stock quotation project by now, the students have asked to continue it to the end of the year.

Tomorrow, his class will convene in the library to begin researching their projects comparing the homeless problem of the thirties with today's homeless problem. Each team has chosen one aspect to explore, including such topics as the effect on migration, a comparison of the government assistance available then and now, and a comparison of the cost of a "market basket" of basic food items in 1932 to the same items in 1994, in both real terms and as a percentage of average income. Some of the current statistics will come from various federal agency data bases available by modem on the Internet. Older information will be located using the school's computerized card catalog. They are using the material to write a group article for the town newspaper, which the editor has agreed to publish if they make the deadline, one week from today.

Schools with intermediate levels of technology

Schools which are ready to add technology can begin choosing items which will enhance and enrich the thematic instruction. Some method of projecting projects onto a screen, such as an LCD viewer, would make the HyperCard projects in Mrs. Edwards' class much easier for the class to critique, and should probably be the next item on that school's shopping list. Other items which would help students create more meaningful projects would include a scanner, still video camera and a video digitizing board for their computer. Sound digitizing should also be available to allow students to include music and their own narration in their hypertext projects.

Students doing research for authentic projects with real audiences become very demanding about the research they use and may find the resources contained in the average school library inadequate. Technology can enlarge those resources. Along with truly accessible phone lines should come subscriptions to information services such as Dialog or CompuServe. CD-ROM drives at stations in the library or on the school network would allow access to the tremendous amounts of data stored in that format, including multimedia encyclopedias, periodical indexes, abstracts and full texts. Videodiscs can be used for straight information gathering or as a source of clips to be included in hypertext projects.

Scenario 2

Automated card catalog
Computer with modem
CD-ROM
Multimedia encyclopedia
Videocamera
VCR
Subscription to <u>Classmate</u>

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Still camera (35mm or digital)

We arrive at Magellan Middle School at mid-morning. Mrs. Woo, the principal, meets us and walks with us to the library/media center, which is in the center of the school. A dozen or so children are there, and Mrs. Woo tells us that these children are from a math class and a history class working together on a project to build a scale model of an Egyptian pyramid in the back yard of the school.

Several of the children are at the electronic card catalog stations; others are already locating their materials. One group of three children is around a computer with a modem, typing a response to a message they had received earlier from a teacher at the American School in Cairo. A second modem is being used by students to check Classmate for recent news items on archeological findings in Egypt. Some of the students are at CD-ROM stations, where they are using multimedia encyclopedias to locate information for the project.

In the glassed-in video-production room at the back of the library, six students are watching video of themselves pulling concrete blocks with a rope up various inclined planes. They stop the video frequently and make notes. These students must report to the rest of the group on the mathematical force that will be required for each ramp.

We talk to a few of the children and learn that another group of students is in the computer lab with the math teacher. Most of those students are finishing their Linkway folders on topics such as burial customs around the world, the government of ancient Egypt, and ancient structures in the New World. The classes planned the time allotments to each part of the project and recorded their plans on a computerized calendar.

As we talk, there is a flash. The "historian for the day" has taken our picture. The students take turns with this duty so as not to miss out on the other exciting activities.

Technology-rich schools

As schools become comfortable with using relatively common technology in their projects, they may find they are ready to use more advanced technology to support thematic instruction. Advanced, second-generation multimedia research systems are just becoming available which will permit much broader exploration of video and audio data than has been possible to date. Video editing software and equipment will permit students to create professional-quality presentations for broadcast over local cable channels or the school video network. Advancements in programming software will make student-generated projects much easier to create than the old hypertext projects, yet dramatically more complex.

As telephone lines are converted to newer forms capable of carrying large quantities of video and voice data, the videoteleconference will become commonplace. Students will be able to interact directly and personally with specialists in their fields of inquiry.

Scenario 3

Computers with touch screens and laptop computers
LCD viewer
Math processing software
Videoteleconference equipment
Authorware
Adobe Premiere

Columbus (multimedia research system)

At the Journey School, we have an appointment with Mr. Hernandez. As we walk down the hallway, we pass rooms with anywhere from two to twelve students, ranging in ages from about 12 to 17. In one of the rooms we pass, five students appear totally absorbed in the books they are reading. Another room contains a teacher and eight of the younger students, talking together about the graph of a sine wave that is projected onto the wall screen from a computer. He asks them how changing one number in the equation affects the graph, and they eagerly type on their laptop computers to change the graphs on their own screens. Various items on a nearby table--a tuning fork, a radio, and an oscilloscope--suggest that the group will soon be discussing sound.

In another room, a group of about ten students is participating in a videoconference. They are eagerly asking questions of the woman on the screen. We recognize her face; she was in the news last week for receiving a Nobel prize in chemistry. She is patient with their adolescent questions and provides encouragement for the students who express frustration with their studies in science. A teacher sitting with the students asks a few questions of her own, then thanks the scientist and ends the call.

We find Mr. Hernandez beginning to listen to project presentations from two students. Ten other students sit with him. The first student, Joe, has investigated Devonian Age fossils. He has used an advanced programming language, Authorware, to create a program which allows him to discuss differences in various classes of fossils found in areas near to the Journey School. The program includes QuickTime movie clips of Joe participating on a dig with paleontologists; Joe edited and compiled these clips with the help of a program called Adobe Premiere. Joe has also included graphs in his presentation to illustrate some of his data, and the graphs animate at his cue to represent the changes over time.

Marta is next. Her project is just beginning. She is interested in the influence of music on political change. She has put together a timeline on her computer which tracks the major developments in music and historically significant political changes. As she touches each point in the timeline, a brief video clip illustrating the political event is shown, with the corresponding music playing in the background. Though she argues for some cause-and-effect relationship, the other students don't agree. Mr. Hernandez tells her that she has not yet demonstrated a true tie between the two and asks her to do some more research or consider revising her topic somewhat. They make an appointment to meet later in the day to discuss her plan of attack.

Mr. Hernandez explains to us that each student at this school must complete eight "Journeys" in order to graduate. The Journeys are thematic inquiries, must fall into certain categories, and are chosen with the help of an advisor. They all involve independent research, and most involve trips of a week or two to authentic learning sites. The students have some basic technology available to help them in their inquiries: computers everywhere, video production studios, and high-end multimedia research systems.

These twelve students are Mr. Hernandez' current group of advisees. They will stay with him until they graduate, or until they decide they would rather work with another faculty member. Most children complete their Journeys by around age 17 or 18; some finish earlier, while others take longer. Graduations can occur at any time of the year and are celebrations for the one student who has completed the program.

Suggestions

All of the technology in these scenarios, including scenario three, is available today. There is a minimum level of technology that can rapidly promote thematic instruction: the hypertext program and computers (Pearlman, 1993; Rockman, 1993). Technology that adds to the resources available to the student, either for research or for production, enriches the thematic instruction process.

Thematic instruction can only be moderately successful until a school has made other necessary changes as a part of their restructuring effort. Once a school-wide move has been made to well-designed competency-based instruction and to a firm commitment to authentic assessment, other necessary changes will follow. Rigid structures of time and subject area will begin to dissolve and thematic instruction will become a daily part of the school experience for every child.

To encourage that process of change, schools need to think of technology in its role as a tool for inquiry and production. Newer computers, with enough power to access video and audio information as well as text, should be made available. As schools plan to add additional hardware and software, items should be chosen which can enrich or facilitate student research and/or expand the capabilities of student production stations.

Earlier in our discussion of thematic instruction, we identified several implementation issues. There are many ways schools can address these issues; we list only a few here.

1. Time.

   Lack of time for planning thematic instruction is a key complaint of teachers attempting the process (Buechler, 1993). Time for planning can be squeezed out of the existing day by creative scheduling, by looking at existing non-instructional time in new ways, and by combining blocks of time currently assigned to two or three separate subjects. Students can also become involved in the planning and older students can take on a larger share of the planning burden.

   Time can also be found by using technology such as E-mail to expedite, or make unnecessary, administrative meetings. Any technology that serves to make the teacher more efficient when dealing with administrivia, such as attendance and grades, may provide a few more minutes for planning and implementing thematic instruction.

2. Inservice.

   One of the best technologies for inservice is the automobile. Educators learn so much by visits to other schools that its importance cannot be overemphasized. To make such visits more effective, the visitors should have done some prior reading and learning about the site and time during the visit should be set aside for conferring with the teachers in the school (Neat, 1993). Where visits are not possible, videotape can provide a "visit" to a school and the telephone can help with follow-up questions.

   Well chosen conferences can be very effective inservice tools. Again, where participating in a conference is not possible, videotapes can bring important pieces of the conference to the school. Commercially prepared videotapes for professional development are readily available through interlibrary loans and regional education centers.

   Hands-on inservice with hardware and software is essential. Teachers must at least have an understanding of the capabilities of the technology in order to use it effectively in teaching. They do not have to be experts, however, and one of the best ways to get technology used quickly is to let a few students learn to use it, then have them teach the teacher and their classmates.

Bulletin board systems where educators share ideas can be terrific places to learn about technology. Teachers should be encouraged to use such systems frequently.

To facilitate the problem of teachers being unaware of what is within their own buildings, it is important that someone in the building have responsibility for disseminating information to the staff. This may best be done by holding regular inservice sessions on particular hardware or software. This person would be a natural choice to coordinate purchases of additional resources.

3. Resources.

The greatest need a teacher who is attempting thematic instruction has is for resources (Goodman, 1993). Technology can help this problem in a variety of ways. On-line services such as Classmate can be wonderful resources for information. In addition, to keep from reinventing the wheel each time, technology can help by using data bases to keep track of lists of resources used in previous projects and by using electronic bulletin boards to share ideas for thematic projects, teachers can develop a rich library of thematic units.

Teachers should be reminded to use people and materials available locally (library, parents of students, etc.) and especially, the talents of staff members of the school. Again, it would be wise to develop a corporation or building data base of such resources and make it accessible to all staff members.

Teachers and students can certainly access the tremendous information-delivery power of CD-ROM. Electronic encyclopedias and the many new multimedia packages provide a wealth of material for research and student production. Of course, much print material is available with suggestions for thematic units. This material could be used as a springboard for making the technology connection.

4. Other barriers.

As they see models of interdisciplinary instruction through visits, videotaped inservice, or inservice sessions in which such instruction is used, teacher perceptions of walls between disciplines can begin to change. Methods of assessment need to be changed to become more relevant to the curriculum, not the driving force behind the curriculum.

Parental reservations can be alleviated with determined use of existing communications, such as the local media, school newsletters, and videotaped presentations at parent nights. The old standby technology, the telephone, can be a major force for changing parental perceptions.

FINAL COMMENTS

Learning is very difficult in a vacuum; it needs context to be meaningful. Thematic instruction is one strategy for providing that context. Technology greatly expands the contexts available.

Jesse Goodman has stated that "thematic instruction requires thoughtful people; technology cannot make thoughtful people of those who are not." Technology can, however, help people identify qualities in themselves that they did not realize they had. When properly used, it is a tool of creativity and a tool for exploration.

Thematic instruction should demonstrate how the parts connect to the whole, how all things are interrelated--a ripple of cause and effect. The whole purpose is to pique interest and create passion for learning. Where there is no passion, no amount of flashy technology will create it, but it can awaken passions that have been hidden from view.