DOCUMENT RESUME

ED 327 476 SO 030 499

AUTHOR Barnes, Marianne B., Ed.; Woods, Lynn, Ed.
TITLE Florida Council for the Social Studies Annual 1989-1990.
INSTITUTION Florida Council for the Social Studies, North Palm Beach.
PUB DATE 90
NOTE 70p.
PUB TYPE Guides - Non-Classroom Use (055) -- Collected Works - General (020)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Curriculum Development; Educational Television; Elementary Secondary Education; Interactive Video; *Interdisciplinary Approach; Learning Activities; Mass Media Effects; Problem Solving; *Science and Society; Science Education; *Social Studies; Student Educational Objectives; *Teaching Methods; Technological Literacy
IDENTIFIERS Florida

ABSTRACT

A series of essays on science, technology and society (STS) education written for teachers are presented. The essays include: "Interactive Video: Bringing the Latest Technology into the Classroom" (Homer L. Krout II; Phillip Horton); "Hypermedia: What's All the Hype About" (Kenneth T. Wilburn); "How to Get the Most Out of Classroom Instructional Television" (Gerri Levine Turbow); "Social Studies, Technology and Problem Solving: A Dynamic Trio" (Janet Bosnick); "A Science, Technology and Society Journey" (Ron D. Townsend; Mary Lou Van Note); "Reflections on an STS Summer Institute" (Colleen Wilson); "Building Bridges across Science, Technology and Society" (Ann H. Stoddard); "Soft on Tech" (Lynne S. Schwab); "STS as Energy Education" (David E. LeHart); and "STS in the Elementary Classroom: A Conversation with a Teacher" (Lehman Barnes; Terry Brock). (DB)

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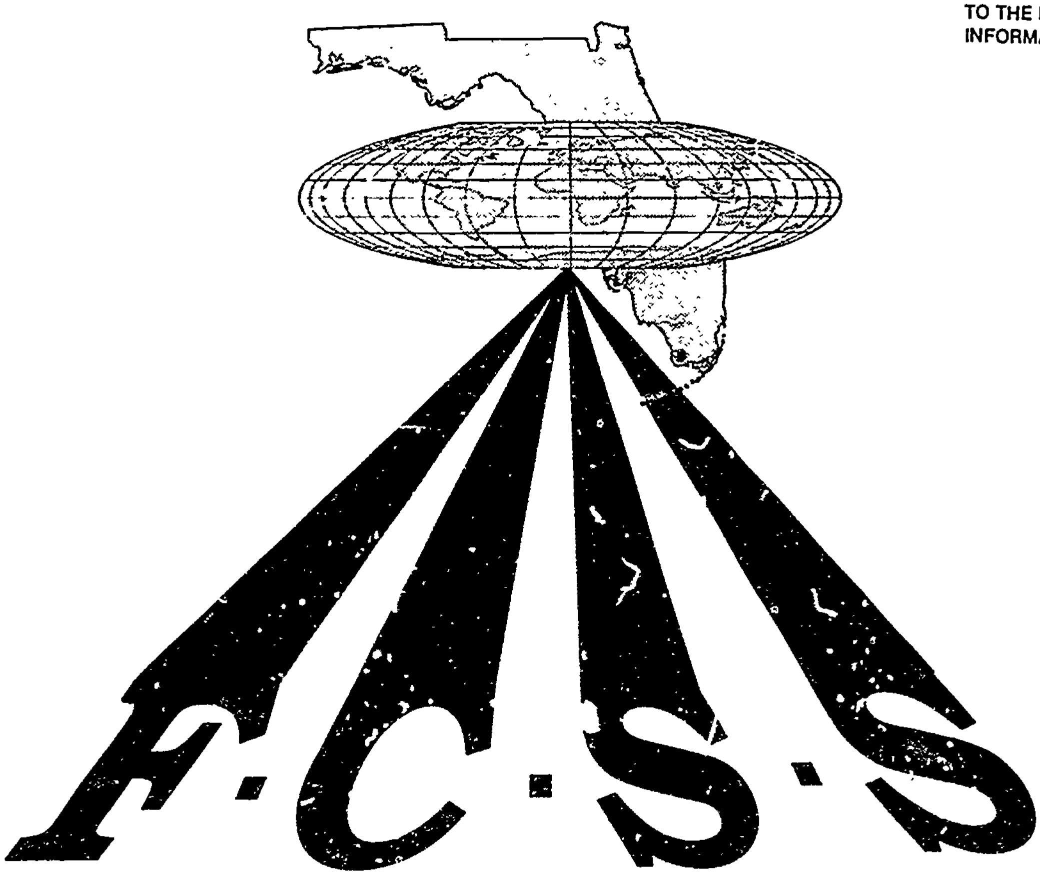

ANNUAL 1989-1990

FLORIDA COUNCIL FOR THE SOCIAL STUDIES

F·C·S·S

Marianne B. Barnes
and
Lynn Woods
EDITORS

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CONTENTS

PRESIDENT'S MESSAGE

J. Doyle Casteel

Science, technology and society (STS) is the organizing theme for this - the sixth in a sequence of annuals produced by the Florida Council for the Social Studies. Within this theme, one may find four concepts. *Science* refers to the disciplined pursuit of understandings related to topics deemed to be significant by communities of scholarship, e.g., biologists, physicists, geographers, historians and psychologists. *Technology* refers to the use of knowledge gained for the purpose of increasing the power of human beings as they interact with their environment and with one another. *Society* refers to the institutions, e.g., politics or religious faith that people use to progress through the cycles of life in a manner that they perceive to be logical, moral and rational. *STS* refers to and reminds us that science, technology and society coexist in our culture, our space and our time.

Because science, technology and society coexist, they tend to continuously interact with one another within geographical regions, within historical eras and even within our contemporary politics. For example, science has increased our understanding of how human beings perceive, conceptualize and act. This knowledge can be and has been employed to create wants where no initial desire existed. This knowledge has been used to manipulate public opinion. Progress in this dimension has led us from the Lincoln and Douglas debates to the sound bites of contemporary political campaigns. Societal applications of scientifically derived understandings are not necessarily amoral or immoral. Applications of science to human affairs, however, should lead us as social studies teachers and human beings to raise moral questions.

This is to say that we, as teachers, need to be continuously alert for those opportunities that enable us to help our students acquire the concepts, the skills and the rules of social criticism. All teachers, not just the social studies or the science teacher, need to help students understand the following predicables:

1. Neither pursue nor apply knowledge in order to oppress. (To violate this rule is to practice injustice.)

2. Neither pursue nor apply knowledge in order to discriminate. (To violate this predicable is to deny human equality.)

3. Neither pursue not apply knowledge in order to exploit or enslave. (To violate this standard is to deny liberty.)

Learning to apply these predicables within the context of STS interactions is the essence of social criticism. Learning to apply these rules to such contexts is critical to the pursuit of justice, equality and liberty in our open society.

The present annual is one that the FCSS can present to its entire membership with pride. The editors, Marianne B. Barnes and Lynn Woods, have provided us with both theoretical and practical essays worthy of time and thought. And these essays are directed to all levels of precollege teaching. As teachers read and discuss these essays with their colleagues, their understanding of STS, their power to teach the concept and their liklihood of doing so morally will be enhanced. This will accrue to the benefit of their students, to the benefit of their profession and to the benefit of their (and our) science, technology and society.

As President of the FCSS, I want to express the gratitude of the FCSS Board of Directors and the entire FCSS membership to the editors and to the authors who have so diligently and graciously invested the time and effort to make this annual possible. We congratulate them for having completed a difficult task. We appreciate their leadership and their professionalism. We also appreciate the leadership and the professionalism of our membership.

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INTRODUCTION

Marianne B. Barnes, Ph. D.

Worshipped in the 1960's and feared in the 1970's, technology has become an entity which we cannot live with and cannot live without. Status in a world economy and major political decisions are linked to a country's technological prowess. Can we build a calculator which is smaller, faster, cheaper, better? Will genetic engineering solve the world's food problems? Can the life of a child be fulfilling without video games? Can a computer really *think* and even generate *art?* While we live life in the *fast lane* of technological revolution, we may do so with ambivalence. Are we losing sight of beauty and simplicity? Is the cost worth the benefit?

These questions are not answered simply. They cannot be answered by scientists, social scientists, technologists or the average citizen alone. If there has ever been a time for interdisciplinary thinking - problem identification and problem solving - the time is now, every day. As teachers, we are in positions to model creative approaches to studying science, technology and society (STS); to make STS relevant to our students' lives by immersing them in community concerns; and to interact with one another as we learn from the perspectives of colleagues who have been schooled in the various disciplines.

Do we teach a *dil...ed* course by using an integrated interdisciplinary approach? I think not. Current research in the cognitive sciences tells us that people learn and remember best when their attention is engaged and they learn to make connections among ideas. If we concur with concerns about American schooling, ranging from students' lack of facility with problem solving, inability to take risks and ineptitude in working as productive members of a group, then we need to devise experiences in which our students practice these vital behaviors. The STS approach offers opportunities for creative group work geared toward dealing with real problems.

But what of the knowledge needed to give more than surface attention to complex problems? Students need to learn the unifying themes and basic concepts in the disciplines. If not grounded in the knowledge bases of the disciplines, the STS movement will surely fade. Members of a society must draw upon the assets of a collective memory of wisdom and experience before they can make good decisions.

How does one approach STS issues in a thorough, innovative, sensitive fashion? The journal, *Social Education*, provides guidelines and strategies in its April/May 1990 issue. This yearbook provides additional insights by Florida contributors who share diverse backgrounds as they comment on processes, tools and impacts associated with STS. Krout and Horton describe levels of videodisc use as they promote using technology to teach about technology. They discuss the merits of interactive video, as does Wilburn, who demystifies hypermedia and matches it to the nature of the social studies. By providing a practical *utilization plan*, Turbow argues for the appropriate classroom use of instructional television; ITV can make life easier and more rewarding for the classroom teacher.

Describing computers as tools for learning, Bosnick dwells on problem-solving techniques, compilation of databases and the use of simulations. Cognizant of the need for students to solve relevant problems, Townsend and Van Note describe an STS teacher summer institute that builds teachers' interactive video skills as they prepare to teach middle school students in a summer camp setting.

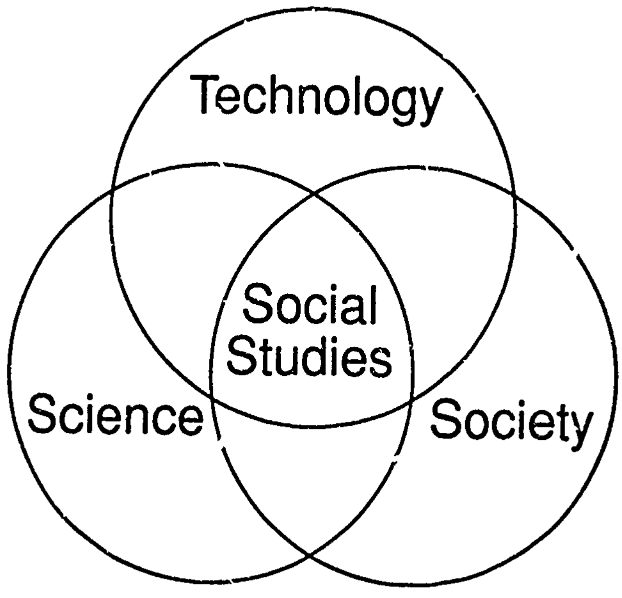
An STS summer institute is the focus of observations by Wilson, who participated in a two-week experience for social studies and science teachers highlighting STS in the local community.

Specific activities based on technological change and the sharpening of student research skills are provided by Stoddard, while Schwab looks at the *soft* dimension of technology and its link to our humaneness and *mindfulness*. LaHart focuses on energy education and the need for informed and responsible environmental action; he argues that energy education can have a major impact on K-12 education.

Using an interview format, Brock and Barnes consider STS in the elementary classroom from the perspective of a teacher who has been *doing STS* for many years.

I personally appreciate this opportunity to have compiled this compelling, challenging set of articles. As a *science* person, albeit one with an interdisciplinary bent, I am honored to have been asked to edit a yearbook for social studies teachers - truly an interdisciplinary gesture! For their suggestions and help in editing, I give special thanks to Lehman Barnes and Diana Mason.

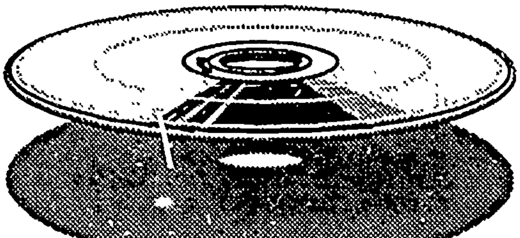
Marianne B. Barnes, Ph.D. is a professor in the Division of Curriculum and Instruction at the University of North Florida.



INTERACTIVE VIDEO: BRINGING THE LATEST TECHNOLOGY INTO THE CLASSROOM

Homer L. Krout II
and
Phillip Horton, Ph.D.

Multimedia and interactive video education are getting much attention in educational publications and from the educational community. The recent production of inexpensive videodiscs such as *The '88 Vote* (an ABC news production on the 1988 Presidential Campaign), *King: From Montgomery to Memphis* (the life and times of Dr. Martin Luther King, Jr.) and *The Great Quake of '89* (an ABC News special report on the 1989 San Francisco earthquake) have the potential for adding depth and perspective to the social studies curriculum. This paper introduces a general concept of what interactive video is, briefly describes the necessary hardware and software, presents some prospective applications of videodisc technology to the social studies curriculum and discusses an ongoing project in which elementary teachers are developing their own videodisc and interactive video programs.



Interactive Video - A Subset of Multimedia Education

Most teachers have used some form of multimedia education. In its broadest sense multimedia education refers to the use of audio and/or video media separately or in combination. It is the integration of text, audio, graphics, still images and moving pictures into a product to supplement the teaching and learning process. Interactive video, a type of multimedia education using a videodisc and videodisc player, presents information in a *real-time* (immediately responsive) mode allowing the user to *interact* with what is being presented. It also implies two-way communication, with the user controlling the speed and pattern for presenting program information. Interactive video can be used in a stand-alone mode or in combination with computers and hypermedia controlling software.

Interactive video is not a new fad nor is it even a breakthrough for education. The concepts of interactive video and hypermedia as a programming tool have been around for years. Hypermedia refers to the grouping of information into units consisting of almost anything you can envision (word dictionaries, encyclopedias, documents, graphics, sound). These units are stored on a computer disk, video tape, videodisc or other type of video or audio media. Software developed with a hypermedia program or authoring system uses a combination of these units and a video-imaging system to provide an interactive learning source.

The *interactive* part is what makes this such an exciting and dynamic form of multimedia education. Properly used it can supplement education and training at almost any level. The ABC news videodisc, *The '88 Vote,* could be used to present the issues and trends of the 1988 presidential election. Video sequences of the candidates attempting to persuade audiences, sequences comparing individual positions on topics and even ABC news reports can be accessed and presented in a real-time mode creating a dynamic classroom presentation.

What Are Videodisc Levels?

Interactive video, using a videodisc, presents information in various formats referred to as Levels I, II, III or IV. Level I is limited to presenting information contained solely on the videodisc. At this level, information is presented by individual frames, segments or complete discs. The presentation is controlled totally by the operator using a hand-held remote. Level II is a self-contained system with a videodisc player, videodisc and monitor. Limited external control is allowed, usually from a monitor with a touch-sensitive screen, as control instructions are embedded on the videodisc. Level II systems are commonly found in malls, airports and other heavily traveled areas where a maximum number of people are exposed to the information. Level III involves a combination of computers, software and a videodisc system that allows interaction between the user and the media. Level IV interactive video is concerned with the integration of artificial intelligence into the interactive video process. Levels I and II are the most widely used in the elementary classroom and provide a reasonable span of usefulness and complexity.

Controlling a Videodisc

To use a Level I interactive video, a videodisc player, videodisc and remote control are needed. Videodisc players have either a wired remote, an infrared remote or, in some cases, a barcode reader. The remote control is used to key in the number of the frame or sequence of frames wanted and send the command to the player. The videodisc player advances the laser stylus to the proper frame or sequence of frames and the result is displayed on a TV screen connected to the player. Typical search times for videodisc players sold for educational use fall well within the five-second period required to move from frame 1 to frame 54,000 on a 12" videodisc.

A videodisc player can also be controlled using a barcode reader similar to ones found on check-out counters in supermarkets. A barcode is created with a computer program containing a series of instructions sent to the player via infrared or through a connecting cable. Passing the barcode reader over the barcode results in the instructions being temporarily stored in the reader. An example of this is the command 1400SE1500PL. When coded into a barcode and read using a barcode reader, this command instructs the player to search for frame number 1400 and play from that frame to frame number 1500 and then stop.

1400SE1500PL

Videodisc player implementation occurs when the barcode reader is pointed at the player and a transmit button is pressed. Instructions are retained in the reader for a short period of time or until another barcode is read. The advantage of a barcode reader is that it has the capability of sending more complex instructions to the videodisc player. The Pioneer LD V2200 is an inexpensive videodisc player for which a barcode reader can be purchased. Educational prices for this system, player and barcode reader, generally fall under $900.

Are All Videodiscs Created Equal?

Educational videodiscs are typically produced in a Constant Angular Velocity (CAV) format or a Constant Linear Velocity (CLV) format and in either 8" or 12" sizes. CAV and CLV refer to how the information is stored on the videodisc. Twelve-inch videodiscs in a CAV format have up to 54,000 frames of information (30 minutes of video) with two accompanying channels of audio per side. They can be accessed frame by frame. Twelve inch videodiscs in the CLV format have up to 60 minutes of video with two channels of audio per side. They do not have frame-by frame access, but are designed so that video sequences of varying lengths, called chapters, are shown in their entirety. The initial series of frames on a videodisc contain instructions, credits and lists of chapters found on the disc. Additionally, many videodiscs are accompanied by a written contents list with appropriate chapter and frame numbers. Either disc, CAV or CLV, is easily accessed in the Level I or Level III interactive mode.

Videodisc players capable of being used in the Level III interactive video mode have a built-in command set allowing a computer program with an internal set of commands to exercise control over the videodisc. The computer communicates with the videodisc player through a connecting cable using the computer program. Video sequences are projected on a TV screen or on the computer monitor using a computer video overlay card. Computer software either allows direct manipulation of the command set through the connecting cable or uses the command set as part of computer-aided instruction supplementing a lesson with video stills or sequences from a particular videodisc. Level III interactive video programs developed using a hypermedia language, such as *HyperCard or HyperStudio*, make use of the full technological potential of computer and videodisc technology.

Are Videodiscs Costly?

Videodiscs such as *The Great Quake of '89*, offering a pictorial view of a current event of catastrophic proportions, or *Van Gogh Revisited*, providing a comprehensive view of a great artist, or those mentioned earlier in this article, cost less than $70 each. Unfortunately, the price of interactive video software has not come down as rapidly as the costs of videodiscs themselves. Level III interactive video programs are generally sold as a package with a particular videodisc and software for the appropriate computer. These programs range in complexity from those that essentially perform the function of a remote controller to ones that provide true interactive learning, even to the point of providing students with the capability for developing and saving their own mini-interactive video learning sequences. Costs for these programs range from around $300 to well into the thousands. Fortunately, there are several inexpensive computer programs on the market that allow teachers with little or no programming experience to develop their own Level III software. These include *HyperCard* for the Macintosh, *Linkway* for MS-DOS systems and *Tutor-Tech* and *HyperStudio* for the Apple IIe and Apple IIGS.

Videodiscs and Student Learning

The developments in interactive video suggest that "the informa[illegible] revolution should be part of the social studies curriculum" (Searles, 1983). Numerous studies have been conducted to determine if interactive video does, indeed, enhance classroom instruction. While most of this research is connected to the training programs of large corporations or the military, some research has been done in the classroom. There is no evidence supporting the use of interactive video to the exclusion of other instructional methods, however, there is evidence to suggest that the use of interactive video to supplement other methods of instruction warrants the expenditure in time and money for equipment, videodiscs and software. Research tends to support the use of Level III interactive video for small group learning, individualized instruction for progressive or slow learners and Level I interactive video to support or highlight objectives in large group learning. Permanent interactive video work stations allow students to browse, learn, explore and take advantage of the complexities of hypermedia and interactive video at their own pace. The combination of video and two separate audio channels has led to the development of videodiscs containing video sequences with accompanying audio in two different languages. Outside of the classroom, a Level III system set up in the media center provides student access to a wide variety of information. For example, a Level III system using the videodisc *Van Gogh Revisited* allows students to quickly accomplish research that would ordinarily take hours of library time.

Can Videodiscs Be Produced Locally?

The need for inexpensive Level III interactive programs and videodiscs is recognized by administrators and educators at all levels of our educational system. The Florida Department of Education and the Science Education Department of Florida Institute of Technology have recently undertaken a project to satisfy this need. The Florida Science

Videodisc Project began in September of 1989 and culminated in August of 1990 with a five-week workshop. As part of the project, an 8" videodisc was produced. Images were transferred to the disc from 35mm slides and VHS tape footage. Each of the 30 Florida teachers involved in the project submitted material for inclusion. Subject areas included energy, weather, geology. physics, oceanography and geometry. During the five-week workshop, the project participants used this videodisc as the source of video images to develop Level I and Level III interactive video programs for the Macintosh, MS-DOS system, and the Apple IIe and IIGS. This software, along with the Florida Science Videodisc, is available to any teacher or school at a nominal cost. It is anticipated that this program will continue for several years and that videodiscs and programs will be produced in other subject areas.

Interactive video has the capability of contributing significantly to reinforcing objectives in the learning process. Development of Level III software, production of inexpensive videodiscs, and the use of simple hypermedia programs or authoring systems allow teachers to integrate this new technology into the classroom with a minimum of effort.

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Homer L. Krout II is a graduate research assistant and Phillip Horton, Ph.D. is an associate professor in the Department of Science Education at Florida Institute of Technology.

HYPERMEDIA: WHAT'S ALL THE HYPE ABOUT?

Kenneth T. Wilburn, Ph.D.

Hypermedia can bring near magic to your classroom, and it is easier than pulling rabbits out of a hat! If you have attended any of the major professional conferences during the past few years, you have probably been overwhelmed by the computer- multimedia hoopla! Every other booth in the product display area is crammed with the latest *must have* in interactive video technology. From such diverse sources as CNN and ABC news to the National Geographic Society comes a bewildering array of products to enhance learning and help the beleaguered teacher compete in our MTV society. If you are as busy as I suspect, you may have had some of the same reactions that I did when confronted with these new teaching toys. *How will I find the money to purchase the hardware? Is there an electronics wizard in my school who can hook up all those wires? When will I ever have the time to learn how to use the system?* As a recent convert to the use of hypermedia applications, let me share with you how easy and very useful hypermedia can be. In a multifaceted discipline like social studies, where the step-by-step process of other teaching fields such as mathematics is seldom applicable, hypermedia is a wonderful teaching tool.

Why is it that only a few teachers are aware of the capabilities of hypermedia? Is it because of technology overkill? The displays at professional conferences are exciting and illustrate the upper limits or current technology, but somehow they seem technologically overwhelming. They often hide the simple, inexpensive and easily applicable structure of the hypermedia program. Contrary to what computer salespeople would like to have you believe, **you don't need an expensive computer, videodisc player, software or weeks of intensive training to use a hypermedia teaching tool in your classroom.** If your current computer can operate a word processor, you probably have all the hardware you need to develop basic hypermedia applications. If you understand how to effectively use transparencies, flash cards or slides, you understand the basics of hypermedia development.

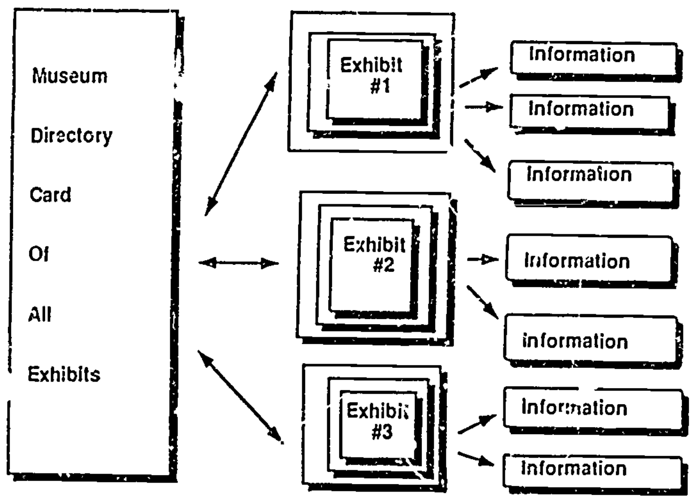
What Is Hypermedia?

Imagine that you are at the entrance to the Florida State Museum. You are standing in the foyer looking at the visitor s guide to the different exhibits in the museum. You can choose the exhibits that interest you, and you can choose to see them in any sequence you desire. Some exhibits in the museum are primarily visual, some require reading, and others may use prerecorded sound and pictures. However, all exhibits have a common theme, the history of Florida.

In our analogy, the hypermedia program is represented by the museum. The different screens supporting the hypermedia application serve the same functions as the individuals exhibits.

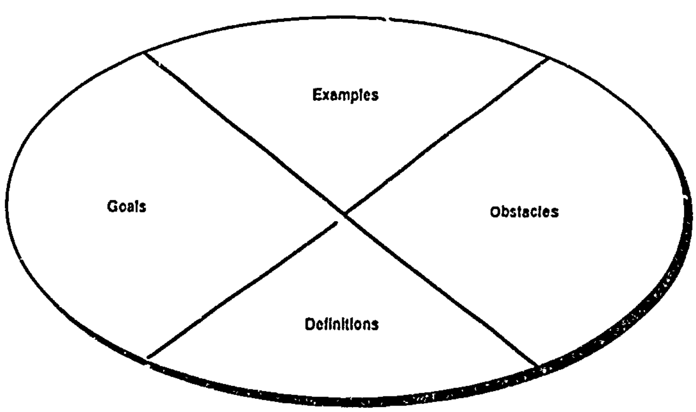
In other words, hypermedia programs are easy-to-use computer software applications with specifically developed informational screens (exhibits) around a common theme. Of critical importance is that hypermedia allows the viewer to browse through the exhibit screens in a personally chosen sequence or to be purposefully guided from one exhibit to another. (Figure 1 illustrates a simple design format for a hypermedia teaching tool.)

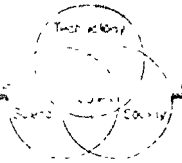
Figure 1. Hypermedia Design



The first screen the student sees in a hypermedia program is a museum directory screen of all the available exhibits. When an exhibit of interest is chosen, the student is automatically exposed to a predetermined stack of information. This information is arranged on the computer screen much like flash cards or transparencies. For example, Figure 2 is a *museum entrunce screen* developed by a graduate student for a class presentation on *Restructuring Florida's Schools*.

Figure 2. Restructuring Florida's School - A Sample Directory Screen





By simply using the *mouse* and *clicking* on one of the pieces of the pie graph, the viewer is taken to an exhibit on that topic. The underlying screens of information contain text and graphs. The application contains about 60 different screens produced on inexpensive hardware without any knowledge of computer programming.

Why Would I Want to Use Hypermedia in Teaching Social Studies?

Most of the social sciences are categorized by learning theorists as "ill-structured domains" (Spiro, 1987). In contrast with the well-structured domains of the hard sciences, the social sciences are composed of more interdependent concepts. Learning these concepts involves significant context-dependent variations and requires one to respond to multiple situations and applications. The teaching emphasis in social studies is not on the retrieval of rigid, precompiled knowledge, but rather on the interconnectedness of things. Students must realize that human social behavior is understood only through the integrated study of history, geography, economics, psychology and sociology.

Hypermedia is an ideal medium for demonstrating and comprehending the complexities of the social sciences.

Developing a Hypermedia Lesson

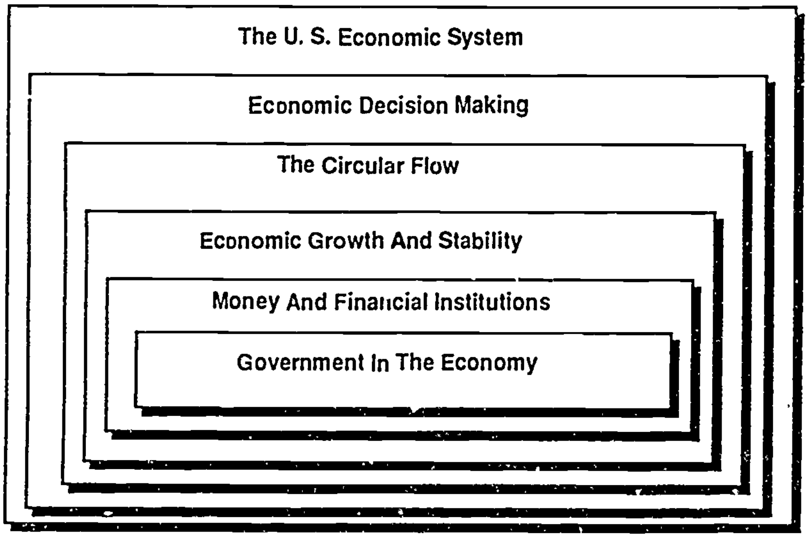
One of the best ways to plan and develop a hypermedia lesson is to begin with a simple set of 4" x 6" note cards. When you sit down at the computer to execute your design with the hypermedia program, each note card is developed into one screen of information. As Figure 1 illustrates, begin by developing your museum foyer card. This card serves as the guide to all the other exhibits and contains the basic navigational tools (known in hypermedia talk as *buttons*) that allow students to browse through all the other cards.

The second step is to briefly sketch out the information that appears on each of the other cards. Pay particular attention to where the primary fields of text, pictures or buttons are located. The user (student) must clearly recognize how to navigate from one card to the next and then back again to the primary directory screen. Remember, if your information looks cluttered or confusing on a 4" x 6" note card, it will have the same effect on the computer screen. As your skills in hypermedia grow, you will learn how to use animation, color and graphics to focus the student's attention and to *hide information* behind *pop-up buttons.*

An Example

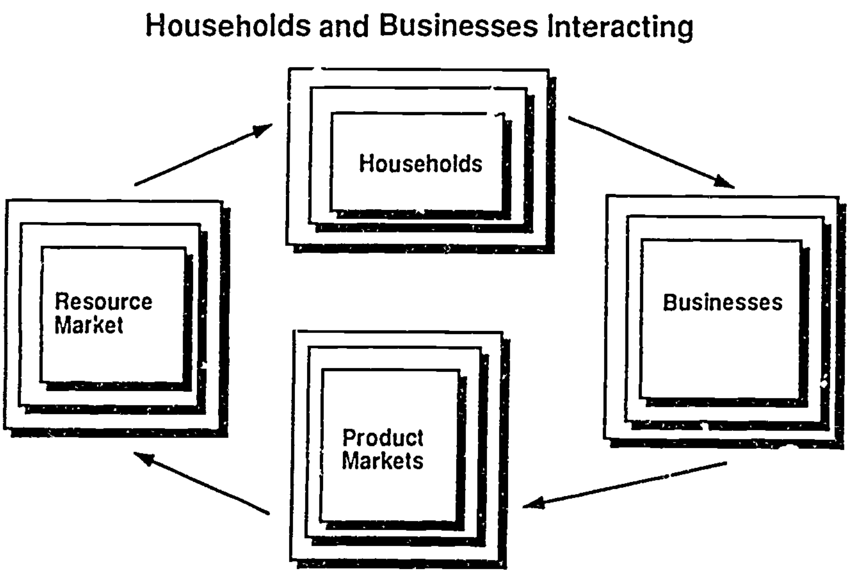
A social studies discipline that illustrates the criteria of an *ill-structured domain* and lends itself easily to the hypermedia teaching tool is economics. Figures 3-5 provide an outline of the major components needed to develop a hypermedia presentation. The content is adapted from an economics lesson suggested by Banaszak and Brennan in *Teaching Economics: Content and Strategies.* The theme for the lesson is "The U.S. in the World Economy." (Figure 3 is the museum directory or exhibit selection screen.)

Figure 3. The U. S. In The World Directory Screen



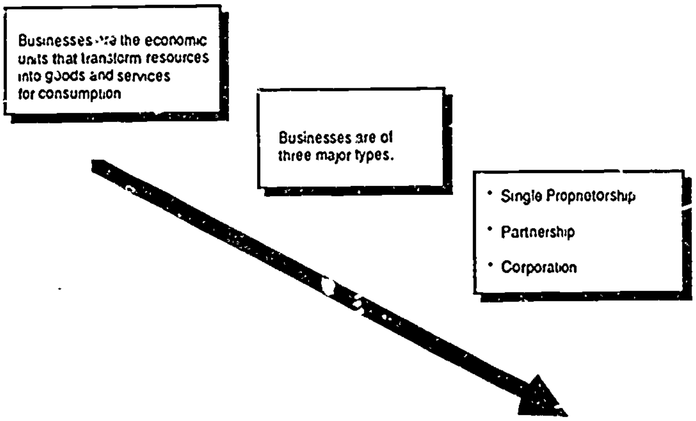
The lesson contains six major topics. By *clicking* on one of the exhibit topics, such as *The Circular Flow*, the student is taken to a subtopic directory screen (Figure 4) containing the four main concepts of the *Circular Flow* topic.

Figure 4. Directory Screen ForThe Circular Flow Topic



Now the student chooses which aspect of circular flow he/she wishes to learn about first. If the student chooses the *Businesses* subtopic (the right-hand choice in Figure 4), then the text information presented in Figure 5 is seen. At this screen the decision sequence ends, and the student is presented with information related to the role of business in the economic cycle.

Figure 5. Business Sub-screens



In this example, the hypermedia lesson provides basic information as well as showing the student the following relationships:

* There are six major aspects of the topic *The U.S. in the World Economy* (Figure 3).

* The concept of *circular flow* deals with the relationships among households, resource markets, product markets and businesses (Figure 4).

* Businesses:
  - are the units that transform resources into goods and services;
  - are of three major types; and
  - the three types are single proprietorship, partnership, and corporation (Figure 5).

These three screens provide the framework for developing a complete hypermedia teaching tool illustrating the role of the United States in the world economy. The student moves from screen to screen by simply pointing with the *mouse and clicking.* All of the screens in the hypermedia program can be created without any knowledge of programming. Once a group of hypermedia screens (known as a *folder* or *stack*) has been developed, the screens can be expanded or rearranged to keep the lesson current.

The critical elements of this presentation technique are its flexibility and its ability to visually illustrate relationships. As compared to traditional directed teaching, printed materials or classroom-developed video tape, the structure of the hypermedia lesson promotes cognitive choices and fosters a flexible approach to learning and instruction (Jones, 1990).

What Hardware and Software Do I Need?

If you have access to a computer, videodisc player, video camera digitized still camera, and the appropriate hardware and software to connect and coordinate all those instructional development tools, you are both forturnate and atypical. Although ideal, all that hardware is not necessary to enable you to use hypermedia as a presentation or learning tool. The hardware that you must have, as a minimum, is a computer with two disk drives. The computer should be (a) an IBM/MS-DOS compatible computer, (b) an Apple IIe or Apple IIGS, or (c) an Apple Macintosh.

The type of computer determines the particular hypermedia program needed. With the IBM and compatible computers, the hypermedia program is IBM *Linkway* and may be purchased directly from an authorized IBM products distributor. The Apple IIe and Apple IIGS computer use a similar program named *Tutor-Tech Hypermedia Authoring System* that is marketed by Techware Corporation of Orlando, Florida. Both the IBM *Linkway* and the *Tutor-Tech* programs sell for less than $150. The originator of this type of program, Apple Computers Inc., distributes its *HyperCard* program free with the purchase of any Macintosh computer.

Although all of the above-listed programs achieve similar results, each program, like different word processors, has its own unique set of key strokes that enable one to design and develop hypermedia presentations. The good news is that once you grasp the rationale for one of the programs, it is easy to shift from one computer type to another as your school system responds to the ever-changing field of educational technology. Like most teaching and learning tools, speed and skill increase greatly after developing your first hypermedia presentation. If you need more help than the software manual provides, you can find a variety of helpful texts at your local computer store.

There are few instructional tools that seem to be specifically designed for the interrelated, situational, abstract world of the social sciences. But if there is a tool that is ideal for helping students visualize the critical concepts of the social sciences, it is hypermedia.

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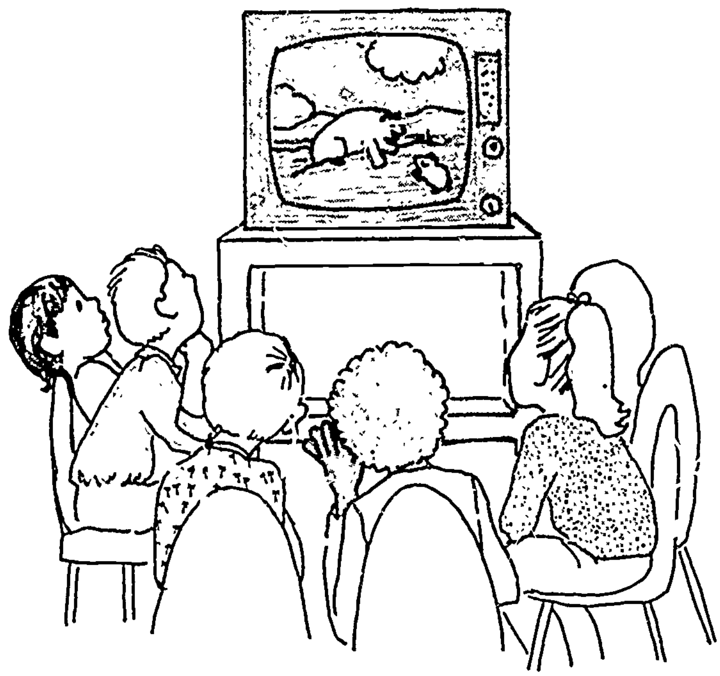
Kenneth T. Wilburn, Ph.D is an associate professor in the Division of Educational Services and Research at the University of North Florida.

HOW TO GET THE MOST OUT OF CLASSROOM INSTRUCTIONAL TELEVISION

Gerri Levine Turbow, Ph.D.

The teacher plays many roles: evaluator, provider, facilitator, communicator and motivator. One way to enhance these roles in the classroom is to utilize that remarkable teaching resource - Instructional Television (ITV).



How Can ITV Enable Student Learning?

Teachers often ask the appropriate questions: *How can ITV assist me? Can it help increase my students' desire to learn? Will it enhance instruction?* For one thing, television brings the world into the classroom. Imagine what an American history class can learn about the Civil Rights movement if you lead them on a field trip back to the 1950's; or how much more elementary students begin to understand about the ecological processes if you teach the class from a canoe in the Everglades. Television makes these *impossible* scenarios possible by providing access to such unique learning situations.

Through experiences which are recorded, stored and played back, ITV brings the widest view of reality into the classroom. Presentations of contemporary and historic news footage, dramatic enactments, interviews, and close-ups of artifacts and experiments enable students to travel to the moon, to an assembly line or to a battlefield. A television documentary about the 20th century or life in the Middle Ages can be the tool that gives students the invaluable learning experience of *seeing* and *hearing* history.

Television demonstrates. It uses the multiple screen to give clarity to the relationships between objects or abstract concepts. Close-up, time-lapse photography and animation make otherwise invisible phenomena visible. Television brings the written word to life. Not only does the ITV lesson bring meaning to drama and poetry, but it provides immediacy to a political debate, historical document or the drama of a courtroom.

How Does a Teacher Access ITV Resources?

If, as an evaluator, you believe that classroom TV brings essential learning to your students, your role as provider takes center stage. You now ask where do I find appropriate programming and support materials for my classes? The ITV/R Department of the Florida Department of Education Public Broadcasting, other networks and production houses provide schools with resources and information. Closer, however, to the teacher is the school media specialist or the school's designated ITV representative, and most particularly, the school system's Instructional Television resources consultant. These sources screen programs and supply previews, teacher guides, broadcast schedules, equipment information, utilization workshops, and consultations with teachers.

How Can ITV Be Used Effectively?

As a facilitator, concerns center around the most effective way to use ITV programs. To receive the fullest possible benefit from the program, students need to be directed and focused by the instructor. This focus helps break the passive viewing habits created by commercial television.

Assistance in integrating the program in a lesson plan is available in a range of ITV support print materials. Comprehensive program guides offer overall content and curriculum information. Teacher guides for individual series provide a synopsis for each program, specialized vocabulary, discussion questions, and suggested pre- and post-viewing activities. Many guides also list recommended related readings, AV materials and reproducible student handouts. It is up to the teacher to choose among these resources to target specific educational goals.

An ITV Utilization Plan

In the preparation of an ITV lesson, you function as the communicator. A simple six-step ITV Utilization Plan can provide the framework for your classroom instruction.

ITV UTILIZATION PLAN

Step 1. Determine the instructional objective

Step 2. Select the program meeting that objective.

Step 3. Plan a short pre-lesson activity (vocabulary, pertinent issue) to prepare students for program content.

Step 4. Use *the hook* (a specific bit of information to listen or look for during the program).

Step 5. Play the tape.

Step 6. Plan a follow-up activity to extend and enhance the lesson objective. (Answer student questions concerning program; seek responses *to the hook.*)

To help assure the success of the utilization plan, Access Network offers these suggestions:

A. Be specific about your viewing objectives before showing the program. Students focus their attention better if they are aware of what to look for in the videotape.

B. Use the stop and pause buttons to highlight program segments. This helps break the passive viewing habit created by commercial TV and focuses attention on your purpose for showing the program.

C. Since ITV programs generally include more material than can be digested in a single viewing, show the program in its entirety once, and then, after reviewing specific learning objectives, show selected portions again. This allows students to take notes or to focus attention on an item of particular importance.

D. Both for viewing comfort and for note-taking convenience, television should not be viewed in a dark room. Reflected light on the screen, however, should be avoided.

E. Ensure that all students have a clear sight line. Adjust your controls to assure clear audio and video reception.

As the motivator, select effective ways to integrate ITV programming into the Utilization Plan. Take advantage of the established motivational strength of the telelesson and its ability to help students visualize difficult concepts by matching programs to curricula and by using ideas and suggestions in the support print materials. Programs always should be teacher-directed. The teacher - not the telelesson - controls selection, pace and focus.

Some Utilization Plan Examples

The following are three examples of ITV Utilization Plans:

A. Florida Studies - Grade 4
B. Geography - Middle School
C. Science/Technology/Society - Senior High

PLAN A - GRADE 4

PORTRAIT OF AMERICA: FLORIDA (1 program/50 minutes)

This program is designed in 5-10 minute segments, with Hal Holbrook as host. It examines the cultural history of Florida, the impact of the railroad on the state's growth, business and cultural development, and conservation and ecological questions of importance to the Everglades.

Step 1. *Lesson Objective*
Name the many peoples who have inhabited Florida and contributed to its culture and history.

Step 2. *Program Selection*
PORTRAIT OF AMERICA: FLORIDA - *Adaptation*
The contributions of the Seminoles and Cubans are presented.

Step 3. *Pre-Activity*
Handout a picture of the five flags that have flown over Florida. Ask students to identify the flags and then the people who named such places as Tallahassee, Jacksonville, Ft. Caroline, St. Augustine.

Step 4. *The Hook*
Name four descriptive words the narrator uses to describe Florida.

Step 5. *Play tape.* (10 minutes)

Step 6. *Post-Activity*
Answer questions raised by the program; seek responses to *the hook.* Divide students into groups to list reasons why, despite change, personal danger and risk, people decide to

1) leave their homes and move to a new country to live.

2) stay in their homeland despite serious obstacles.

List and discuss the groups' reports in class.

PLAN B - MIDDLE SCHOOL

GLOBAL GEOGRAPHY (10 programs/15 minutes)

The content of this series is based on the themes of location, place, relationships within places, movement and regions. Each program focuses on an individual or family of a specific region, representing every part of the world.

Step 1. Lesson Objective
Consider the question: Why do countries seek products from other countries?

Step 2. Program Selection
GLOBAL GEOGRAPHY - *Japan: Why Does Trade Occur?*

Step 3. Pre-Activity
Introduce the terms *import* and *export*.
Ask students to suggest products they use that are imported into the USA from other countries.

Step 4. The Hook
Listen for two products named in the program which Japan imports and two which it exports.

Step 5. Play tape. (15 minutes)

Step 6. Post-Activity
Answer questions raised by the program; seek responses to *the hook*. Have students answer the question: Why does trade occur? List specific products and evidence noted in the lesson. Refer to the pre-activity list and add to it products imported into their immediate community, as well as products the community exports to other places. What wants/needs do these products fill (energy, food, fashion)?

PLAN C - SENIOR HIGH

INTERACTIONS (4 programs/20 minutes)

The program describes the interrelationship of science, technology and society. The goals of the series are 1) to make students aware of the complexity of science and technology issues in their lives, and 2) to encourage students to become participating members of society who apply what they learn as decision-making citizens.

Step 1. Lesson Objective

Describe two plausible but different ways that transportation may develop in the future.

Step 2. Program Selection

INTERACTION - *The Auto*

Step 3. Pre-Activity

Ask students to log their own or families' travels for one week. This should include all ways of moving from one location to another (walking, bicycle, bus, auto). Discuss logs.

Step 4. The Hook

What do statistics in the program reveal when comparing personal auto travel with the use of mass transit?

Step 5. Play tape. (20 minutes)

Step 6. Post-Activity

Answer questions raised by the program; seek responses to *the hook*. Divide students into groups. Suppose an essential element needed to manufacture cars has disappeared from the world markets, therefore, Americans are deprived of their automobiles. Develop a solution to an autoless society.

Communicate with Your Media Specialist

Instructional television has a full repertoire of programming in every subject area. Communicate your questions and requests for services or information to your media specialist or ITV resources consultant. Utilize the unique strengths this teaching tool provides to motivate your students. Then evaluate the results of this new partnership in your classroom instruction.

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Gerri Levine Turbo, Ph.D. is an instructional television resources consultant with Duval County Public Schools.

SOCIAL STUDIES, TECHNOLOGY AND PROBLEM SOLVING: A DYNAMIC TRIO

Janet Bosnick, Ph.D.

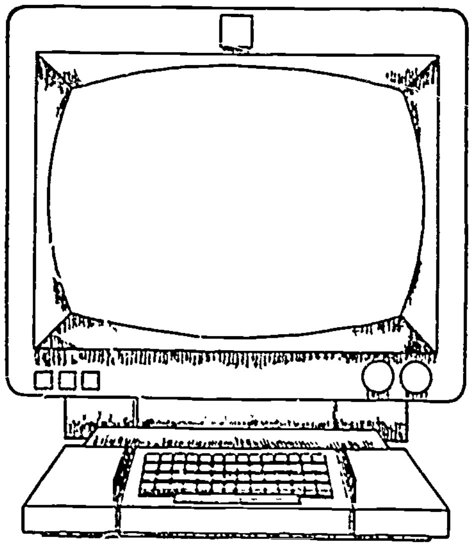
The availability and use of microcomputers in classrooms across the United States are increasing at an almost phenomenal rate. Balajthy (1988) reported a study indicating that "the number of computers in U.S. K-12 schools increased to 2 million in 1986-87, and increase of 25% over the previous year..." (p.242). However, the mere presence of computers in classrooms is not an accurate indicator of the amount or nature of their utilization in the instructional environment. Dickey and Kherlopian's (1987) South Carolina study disclosed that "a large percentage of teachers (grades 5-9 mathematics and science) with access to computers reported that they did not use them..." (p.13).

Elementary Curriculum Infusion

The infusion of computer skills into the elementary school curriculum is probably the single best approach to modernizing instructional strategies to reach today's youth. Real infusion is more, however, than the acquisition of basic computer literacy; it is more than learning to run software programs; it is more than providing computer learning stations. Real infusion fosters the use of the computer as a natural teaching and learning tool. Advancement in teaching, learning and school management will occur when educators begin to see and use the computer as an integral part of instructional design, implementation and management processes. Infusion encourages the development of a contextual basis for the skills often taught in isolation and reduces the reliance on abstract methods of teaching. Teachers most commonly use computer-based drill and practice programs that progress in small increments to teach recall and recognition of factual knowledge through repetition. Programs such as Hartley's *Game of the States*, where students test their basic map skills, are a typical low-level use of the computer as a tool for learning.

The Computer and Discovery Learning

Computer-assisted instruction based on the principles of discovery learning has been slower to evolve. The development of microworlds and programming environments such as LOGO, simulation, and database programs have expanded opportunities for students in areas of computer use and problem solving not available in the past. Problem solving is the application of previously acquired knowledge and skills to new and unfamiliar situations through the use of reasoning, comprehension, logic, and the methods, procedures, and strategies essential to reaching a desired end. It is a stated goal of many curricula. Polya (1980) considered the ability to solve problems as the specific manifestation of intelligence in his statement: "If education fails to contribute to the development of the intelligence, it is obviously incomplete. Yet intelligence is essentially the ability to solve problems..." (p.1). Subsequent to the 1983 publication of the report from the National Commission on Excellence in Education, *A Nation at Risk*, numerous reports on the status of education indicated that problem solving, both its processes and skills, was not being adequately addressed in classrooms. Problem-solving episodes provide the contextual framework for an interdisciplinary approach to the development of many topics within the social studies curriculum.



Using Simulations

Simulation programs help facilitate the integration of content and process. *Oregon Trail* is a simulation program produced by Minnesota Educational Computing Consortium. Decisions must be made about the number of oxen to be used, amount of ammunition, food and supplies. Unexpected events occur (*e.g.*, hostile riders, broken wagon wheels and floods) and force travelers to take decisive actions. Different outcomes reflect the chosen courses of action and allow students to experience the consequences of their decisions. While the program is intended to teach about life in the 1840's, much more can be teased out by posing questions that require thought, research, problem solving and cooperative decision making. *What diseases did the people of 1840 face that do not exist today? Who was responsible for finding cures for these diseases? What was the average rate of travel by wagon? How did travelers communicate with other people in the region? How did modes of communication change from 1840 to today? What made these advances possible, and which people are credited with the inventions? What influenced you to want to kill the hostile riders? Is killing ever an acceptable action? What factors do we anticipate when planning a trip with our family today?* Keep a log of the day's events. Turn the computer off before completing the trip and have students create original endings to scenarios.

Deciding and Sharing

These questions and activities require students to select the best sources, both technological and others, to find answers. Children quickly learn that there are many ways to address problems and that some solutions are better than others. Decision making about which technology is most appropriate for a given situation is also worthy of attention.

Students share their stories and findings in the form of a newsletter generated by using a desktop publishing program. This presents even more questions. *How was the printed word addressed in the 1840's? Will we have the printed word in 2025? What will we have instead of books and newspapers?*

Other simulation programs, such as those in the *Decisions* series by Tom Snyder Productions, provide platforms to integrate subject areas within a problem-solving context. This series includes programs on television ethics, colonization, immigration and the Civil War, and requires students to set priorities and to make decisions within those frameworks. Students learn that decisions in life are often complicated and not always a case of acting within personal belief systems.

Using the Database

Database programs are another valuable resource. Frequently databases are used to access information such as the largest state in area in the United States, the country that exports the most grain and the city with the largest population. The value of databases is minimized when they are used to find information that has no meaning other than to answer uninteresting or meaningless questions. Learning becomes more meaningful when students find solutions to questions or problems for which they want to know the answers. Daily news can become more interesting when challenged. For instance, suppose the news reported a major manufacturer's decision that each state must produce its own Ninja Turtles if they are to be marketed. Students might identify the issues that led to such a decree, determine what Ninja Turtles are made of, research if the state has the resources necessary to manufacture them, and assess the extent of the target market in relation to the worth of the venture.

Ultimately, students can gather data about their schools, neighborhoods and towns to create their own databases using simple application packages. The applicability of activities to *real-life* is heightened by virtue of the information attained (content) and by the increased understanding of problem-solving strategies and their relationship to technological tools.

Computers As Learning Tools

Computers are tools for learning. Children should be competent users of technology in retrieving useful information to solve problems or to answer questions. However, they must also have the skills to determine important and necessary information, to select appropriate tools for accessing the information, and to effectively use these tools to evaluate and communicate their findings. Highly developed problem-solving skills coupled with technological advances enhance the learning experience. As teachers, we must become skilled at providing these meaningful opportunities in our classrooms if we are to prepare our children for the world awaiting them.

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Janet Bosnick, Ph.D. is an assistant professor and director of the College of Education and Human Services Learning Laboratory at the University of North Florida.

A SCIENCE, TECHNOLOGY AND SOCIETY JOURNEY

Ron D. Townsend, Ph.D.
and
Mary Lou Van Note

Robert E. Jones (deceased), a former principal and friend of education once said: "Education is not a destination; it is a journey."

The Journey Begins

Our STS (Science, Technology and Society) journey began in July of 1989 when we took a trip to the Georgia Institute of Technology, host of a national STS conference.

We left Orlando using jet propulsion, hydraulic valves, computer-assisted flight control; in the Atlanta airport we traveled along on people movers - synthetic rubber, gears and gear ratios, electrical motors; we then reached the hotel via an internal combustion engine powered by a petroleum derivative and stopped by disc brakes. Once inside the hotel, we used the elevators containing pulleys, levers, weights and counterweights, and we were kept cool by means of freon gas that had been compressed, and so on. Needless to say, science and technology are ever apparent in our society, and they are an integral part of our lives and thought patterns. Both of us believe that the societal perspective is an essential link in providing opportunities for today's youth to develop their own personal and social efficacy in a scientific and technological society.

Social *Actions* and *Reactions*

For each scientific principle and each technological application in our journey, there were social gains and losses such as time advantages for individuals traveling by plane, possible ozone depletion due to the use of freon and jet engine vapors, and the potential for major climate shifts affecting the productivity of farms and thus urban food supplies. In the latter case, urban life as we currently know it might not be feasible. Many decisions about the allocation of economic resources need to be made if major climatic shifts eventually happen. Categories of concern are farm subsidies, price ceilings and floors, jobs people will have if the urban environment is changed and attitudinal changes people will have to make. Should we change our way of life so that the *eventuality* does not even happen in the first place? As a basic premise of western scientific and social thought, all actions and reactions are linked. Thus, a scientific principle applied to technology affects the values, attitude, jobs and even the history of everyday people. This critical concept needs to be a central focus as the application of STS concepts, methods and strategies are developed. STS is not a panacea for science and social studies education. It is part of an ongoing process for giving individuals the tools by which they can determine for themselves and their society the path they would like to take.

Teacher and Learner Needs

To proceed with the application of STS concepts, we felt that teachers needed to increase their acquisition of knowledge, the application of research techniques, the utilization of cognitive process skills, and the development of values and attitudes as they relate to Science, Technology and Society.

All of the sciences, whether *hard* or *social*, exist because of human activity, human curiosity and human intelligence. Thus, a need to blend the two is a reasonable activity if one believes that education is a process in which the teacher and the learner engage in examining issues by gathering facts and data, hypothesizing, analyzing, evaluating and generating solutions. Students need to make sense of their world and have the knowledge necessary to continue those types of activities throughout their lives.

An STS Summer Institute for Middle School Teachers

With these beliefs in mind, we felt that the time seemed right for a summer institute to examine Science, Technology and Society in an academic setting. First, we looked at our existing curricula and determined that a middle school setting would be a reasonable place to begin, as the middle school organization has greater opportunity to engage in interdisciplinary teaching. Most teams have language arts, social studies, science and mathematics as the core academic content areas and the probability of science and social studies teachers working with one another would be high as the team members teach the same students and generally plan at the same time. In addition to the physical and logistical settings, we also examined the discipline content areas of grades six and seven. The social studies program in our district begins with an introduction to the social sciences in grade six and geography in grade seven; in science, students study general and physical sciences. Since geography uses the *hard* sciences (geology, ecology, climatology) to examine man's use of space (which has both a social and natural component) and man's interaction and interrelationship with the environment, we felt that ecological and environmental issues should serve as our focus for beginning the integration of STS into the curriculum.

An Interactive Video Approach

Science Quest: EcoVision is an interactive laser disc video/computer project, developed in cooperation with Florida State University, the National Science Foundation and Houghton Mifflin Publishing. We determined that this program would be used to address the interdisciplinary aspects of the two curricula. Next came the development of a two-week summer institute to present teachers with the basic underpinnings of STS, based upon the philosophy that STS processes and content should be learned simultaneously via research, investigation and active problem-solving activities. The local environment and the forces that shape that environment would become the main foci. (The summer institute component document is included at the end of this article.)

A Science Summer Camp Follow-Up

Once the initial phase of inservice was developed, we readdressed the question of how teachers could successfully apply their knowledge in an academic setting with middle school students.

One of the major reasons for the failure of curriculum change to make a lasting difference is the lack of time for the participants to apply their knowledge and skills in a setting that is supportive and non-threatening to both the teachers and students.

Therefore, we applied for a DOE-sponsored Science Summer Camp grant that would allow the teams of teachers to work with a maximum of 20 students to implement some of the strategies, processes and techniques of Science, Technology and Society. We were fortunate to be funded for the project. Now teachers would learn about STS and use their knowledge to implement instructional activities with *real live* students in the two weeks following the summer intensive institute.

The Summer Camp began the week following the Science, Technology and Society Summer Institute. The program is a nine day, nonresidential camp housed at each middle school in the county for four and one-half hours per day. The goals of the camp are (1) to work within a strengthened interdisciplinary middle school curriculum emphasizing research processes applied to both environmental issues and to personal life experiences, (2) to provide realistic, simulated ecological research opportunities using exciting state-of-the-art technology, followed by ecological field studies; and (3) to broaden career horizons for all students by assuming the roles of scientists, technicians and decision makers.

To accomplish the goals, students and teachers identify a local Science, Technology and Society topic; design a research study to investigate it; conduct limited research using Science Quest databases and data collected in the local environment; and develop a position paper in the form of an electronic presentation designed to promote student understanding of an environmental issue and its connections to political, social, geographic and economic factors. If students are able to recommend and effect change within their own community, the camp will have been a success. If that degree of success is not attained, students will have had the opportunity to examine an environmental issue, to identify various viewpoints, to collect basic data, and to suggest alternative solutions for environmental issues which reflect personal, societal and scientific perspectives.

Expectations for the Classroom and Beyond

Our expectations are that the science and social studies teams will utilize the STS materials and strategies within their regular classrooms during the 1990-91 academic year. In addition, the teams will be asked to share their knowledge, perspectives and results with their academic peers during inservice activities planned for 1990-91. Further integration will occur as materials, planning time and interest allow.

A Cooperative Effort

It should not go unnoticed that the Florida Department of Education's Tom Dunthorn, Social Studies Program Consultant, and Martha Green, Science Program Consultant, were instrumental in organizing, recruiting, encouraging and supporting the teams of science and social studies supervisors who attended the STS conference held in Atlanta. It is without question that the Florida State University IMS (Interactive Media Science Project) team, George Dawson, Sue Mattson, et.al., were instrumental in program implementation. We would not have been able to venture as far as we have without their support and dedication.

Our education has not been a destination; it, too, is a journey. We still have many roads to explore. Some may have roadblocks; some may be dead ends; some may diverge into other woods. We will have to do as others have done, we will have to make choices.

Useful Resources

Environmental Resource Directory: A Guide to Environmental Materials Through Governmental Agencies in Florida. (1988, December). Prepared by the Interagency Environmental Educational Coordinating Committee of the Florida Council on Comprehensive Environmental Education with the assistance of Karen Griffin.

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Ron T. Townsend, Ph.D. is the supervisor for science and computer-assisted instruction and Mary Lou Van Note is the supervisor for social studies. Both are employed by Marion County Public Schools.

Component #: 5-12-19-5-10
5-13-08-5-10

Title: Science, Technology & Society

Director: Townsend
Van Note

Status: New
Points: 60
Certification: Middle, High School Grades Science or Social Studies, Biology, Physics, Earth/ Space Science

GENERAL OBJECTIVES (goals):

This component is designed to increase middle/senior high science/ social studies teachers' acquisition of knowledge, application of research techniques, utilization of cognitive process skills, and development of values and attitudes related to Science, Technology and Society.

SPECIFIC OBJECTIVES (measurable):

1. Define the three concepts - science, technology and society.
2. List interrelationships among science, technology and society.
3. Describe in detail at least three major concepts in science and technology that are associated with significant social changes and scientific issues.
4. Define issues and values.
5. Compare and contrast issues, facts, definitions and values.
6. Compile a list of significant changes resulting from particular technologies.

7. Use graphic representations to show interconnections among technology, society and social change.
8. List three technological systems and social systems affected by the development of particular technologies.
9. Follow a step-by-step procedure to analyze the facts of an STS case study in which there is a conflict or dilemma.
10. Project the effect of a specific new technology by discussing and evaluating its positive and negative consequences.
11. Identify and analyze information from STS in the news media.
12. Contrast coverage of STS issues in the various media.
13. Develop surveys, opionionnaires, questionnaires and other sampling techniques.
14. Properly administer data collection instruments and record data.
15. Collect and display data from field experiences.
16. Utilize experimentally obtained data from measuring instruments to draw inferences and conclusions.
17. Select and investigate an STS issue. Make inferences, draw conclusions and formulate recommendations.
18. Identify major advances in ecological STS issues and discuss their effects on the environment, energy production, bio-medical developments, local and state economies, and other areas of technology.
19. Discuss the role of technology in causing and reducing environmental problems.
20. List at least ten STS issues facing your local county and state today, and discuss global interactions of each issue.
21. Identify the effects of social, economic and governmental actions on science and technology.
22. Present an oral description of an STS problem and potential solutions.
23. Use the electronic interactive *Science Quest* program to identify a specific STS problem.
24. Use the flexibility of the computer/videodisc interactive *Science Quest* ogram to conduct simulated research on an identified STS problem.
25. Determine the *scientific context* (facts, principles, conceptual schemes, models and inquiry skills) that are applicable to an identified STS problem.
26. Determine the *personal context* (ways scientific facts and principles are useful in everyday life) as applied to an identified STS problem.
27. Determine the *societal context* (the role and use of the content and methods of science in decision making on societal issues and questions of public policy) as applied to an identified STS problem.
28. Determine the *technological context* (application of the knowledge and methods of science for commercial or utilitarian purposes) as applied to an identified STS problem.

29. Compile an electronic portfolio from *Science Quest's* image and database showing interactions among the various contexts (scientific, personal, societal and technological).
30. Identify a local STS problem and design a research study to investigate it.
31. Conduct a limited research study of an identified STS problem using *Science Quest's* database as well as data collected in the local environment and community.
32. Develop a position paper and electronic presentation designed to promote community awareness and/or intiate change necessitated by an investigation into a local STS problem.
33. Design strategies for integrating STS research procedures into a summer science and technology camp for middle and high school students.

GENERAL DESCRIPTION/ACTIVITIES

Based on the philosophy that STS process and content should be learned simultaneously by having both arise out of research, investigations and active problem-solving activities, the institute will involve participants in flexible interrogation of their environment and the forces that shape that environment.

After a brief introduction and open discussions on general definitions of science, technology and society, participants will be introduced to the flexible simulation procedures offered through *Science Quest*, combining the processing power of the computer with the visual capabilities of videodisc. Participants will be able to consult with experts and use a variety of online references including computer simulations, film clips, field guides, atlases and a videopedia.

After compiling an electronic portfolio of related information, participants will design and conduct a mini-field investigation on a local STS issue and prepare a position paper and electronic presentation on the identified issue using available computer/ videodisc/ videotape equipment.

EVALUATIVE PROCEDURES:

Achievement of specific objectives will be determined by use of pre- and post-test (80% mastery), satisfactory completion of assignments, demonstration of acquired skills through research applications (simulated and field), and the development of a final position paper and electronic presentation on an identified STS issue.

Participants and consultants will assess the degree to which specific objectives have been addressed by the component activities through completion of the Marion County Public Schools Staff Development Activity Evaluation Form.


STS?
Who does it?
Who cares?
Why is it?
What is it?
NEW
TEACHE
INFO
PACK
INSURANCE

REFLECTIONS ON AN STS SUMMER INSTITUTE

Colleen Wilson

Well here it is...the hot new trend, expression, movement or thrust of the 1990's! STS! *What is it? Why is it? Who does it? Who cares?* Quite possibly, if I remain ignorant long enough or just pretend not to notice, this trend, too, could pass. Besides I'm a science teacher. I teach science. I teach the scientific method. My students do science projects (although sometimes not too terribly clever or original ones - but projects just the same), and we do science experiments. My curriculum is outlined and mandated. Why, there's barely time for all the objectives, so I couldn't, even though I might like to, add something else. STS - the wave of the future? Not likely; why, it's probably like that old idea of ungraded schools or something, and everyone knows that was a crazy notion.

STS - Science, Technology and Society...what does it mean? Well, if I had been asked to comment on STS two weeks ago, my response would have paralleled that of the preceding paragraph. Now that I have two weeks worth of knowledge and practical experience, I know how important STS is in drawing kids into meaningful learning situations. I believe this might really be something...maybe. STS is an eclectic approach that has the potential to look at issues from more than just a scientific perspective. It uses technology as a hook to study science concepts and their effects on society and daily living. STS employs a critical-thinking/problem-solving base for the whole issue, not just the scientific side, the technological side or the social science side. In essence, it is the in-depth, interdisciplinary treatment that today's multifaceted issues deserve.

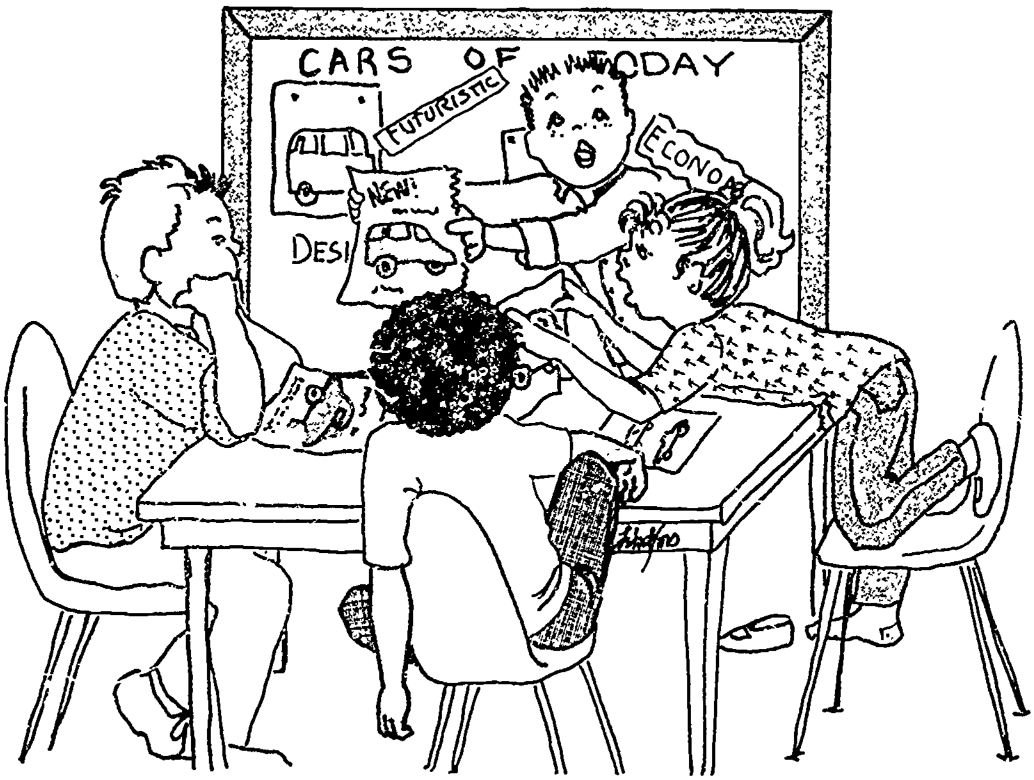
Many Sides to Each Issue

Consider the issue of cigarette smoking. How many sides does this one topic have? Let me name seven. (1) the health of the smoker; (2) the health of the passive smoke inhaler; (3) the right of industry to produce, market and advertise; (4) the governmental ability to regulate businesses and to mandate clean air; (5) the rights of minor children living with a smoker; (6) the issue of legal, harmful, addictive drugs versus illegal drugs; (7) the societal smoking trends from the G. I. cigarette rations in the 1940's to the new assertive nonsmoking public rights. Total issue treatment can not be handled from just a science insight; a clear picture can not be painted just by presenting a historical time line. Whole issue treatment includes the seven separate facets listed among others. Perhaps one of the major strengths STS has is that complete treatment does not stop after the various sides are presented; the real study just begins!

Creating Excitement

Those old Bloom levels of critical thinking can be usefully employed in STS. Now is the time to get kids actively involved in resolving these issues. Let them use the newly planted *data bank* seeds - to grow answers. Let them brainstorm, debate, listen to speakers, make site visits and see people on all sides seeking resolutions. People learn best and remember most by doing!

How long can apathy last when the issue in question is of the real world? This isn't just geography class, it isn't just science or health class. This is real life! Why, this approach even creates a much more exciting environment for teachers! If STS gets a response from us shrewd imparters of knowledge, it can and will capture students' attention and start their journey toward knowledge acquisition and use!



Getting Started with STS

Ok, so all this sounds fine, but I still have a curriculum and state-adopted textbook. There are no chapters on STS issues. *Where do I start? How do I find time? What about resources and materials?*

Once again I will draw from my recent (two-week old) idea bank. Find areas that interest you...water pollution, buying the best car for the money, land zoning, endangered species, quality education, beach erosion. *What triggers a response in you? Does the issue have several sides? Can you think of a speaker for each side? What about field trips - site visits?* Surely, there is some information in your library. Bet your kids know something about it...whether it's wrong or correct, at least it's a starting point. Present the sides and help your students to form and support opinions. If the issue requires a solution, allow the kids time to plan and maybe try to implement their own solutions.

Got the idea of what STS is and how powerful *struggling* with an issue can be? Today's person must understand the different options available, weigh the options and then make informed decisions. Businesses are requesting problem solvers and people who want to be involved. Help students learn how. Isn't that what we are all about?

One more thing! When it comes to evaluation (Bloom's highest cognitive level), don't get bogged down with a scantron computer sheet and a typed examination. Ask the kids what they learned, and use their responses to revise and plan the next STS issue to be studied. Good luck on our newest adventure in learning!

Colleen Wilson is a special education teacher at John Gorrie Junior High School in Jacksonville, Florida.

BUILDING BRIDGES ACROSS SCIENCE, TECHNOLOGY AND SOCIETY

Ann H. Stoddard, Ed.D.

Over the past ten years, science educators have developed an innovative approach for addressing the acquisition of knowledge, skills and attitudes necessary to cope with the scientific and technological aspects of social problems. The STS approach shares several commonalities with social studies education, namely an emphasis on common concepts, the use of the scientific method of inquiry, problem-solving techniques and decision-making skills. A recent issue of *Social Education* targeted STS and social studies. Richard Remy (1990) cited reasons why social studies educators should be concerned about STS. To prepare students for citizenship, social studies educators should focus on understanding science and technology in society, on engaging in civic decision making, on making cognitive connections, and on developing a common memory.

STS and Social Studies

Philip Heath (1988), suggested three ways to infuse STS content into the social studies curriculum. incorporate STS content into the existing curriculum, add STS content as an extension to the lesson or generate a separate course on STS. Since the latter two consume time that is not generally available, this article considers the first option.

An interdisciplinary approach to STS helps to develop students' understanding of and ability to apply content. Science originates in questions about the natural world, whereas technology originates in problems of human adaptation to the environment. Both areas apply methods of inquiry and problem solving to propose explanations and solutions (NCISE, 1989, p. 195). These solutions lead to social applications and personal action. One curriculum specialist sees the social studies as a point of integration for STS because the social studies curriculum should "address pervading social problems reflectively so as to develop social insight, power, and responsibility" (Tanner, 1990, p. 195).

How to Organize for Instruction

There are many ways to organize STS content so that it comes alive for students. Addressing content with a problems approach lends itself well to cooperative learning models such as STAD, Group Investigation and Jigsaw. These models accommodate STS topics and bring students together in groups as human beings to solve human problems. Students learn how to become responsible for their own learning and responsible for teaching others. Cooperative learning models also make students feel that learning is fun.

While serious new environmental problems emerge, the old ones remain with us. Some of the more pressing environmental problems become key understandings in an STS related curriculum: change in global climate that may result from the greenhouse effect; smog; acid rain; the garbage/landfill crisis; permanent loss of tropical ecosystems;

presence of toxic residue in foods; water contamination; hazardous chemicals in industrial and household products; and disposal of radioactive and hazardous waste.

After key understandings are identified, teachers indicate how the understandings relate to the social studies content being studied. For example, when primary students are studying about communities, any of the topics can apply. If cooperative learning models are being used, share with each group the information, the ground rules and expected behavior. Explain the method to evaluate student learning. Encourage students to process the information actively and think critically about it. They develop the skill of relating the information to their current knowledge within the problem-solving or decision-making context.

Activities Based on Technological Change

Activity 1

Four technological changes in our society have had a tremendous social and environmental impact: the telephone, the paper-making machine, the automobile and the space shuttle. Introduce this content as a data retrieval chart to be completed in groups. (The following is an example of a data retrieval chart. Students working in groups fill in the effects and impacts of various inventions.)

Invention	Effects on Society	Impact on Environment
Telephone	Linked governments around the world	Altered landscape
Paper-making machine	Provided the printed word to the masses	Reduced timberland
Automobile	Changed lifestyle of people	Produced air and noise pollution
Space Shuttle	Deployed communication satellites	Led to development of solar power

Activity 2

Use events such as the Mount St. Helens eruption or the San Francisco earthquake and link them to tools and impacts.

Event	Tool	Environmental Impact	Social Impact
Mt. St. Helens eruption	seismograph	forest destruction; melting of glacial ice	loss of jobs; loss of homes; growth of tourism

Activity 3

Group activity: Using a scale from 0-10 (0=no impact, 10 = maximum impact), estimate the magnitude of the technical and social impact of each invention. Compare your individual ratings with those in your group. Then select one invention to study in-depth. Report your findings to your group.

Invention*	Magnitude of Impact	
	Technical	Social
video cassette		
color television		
helicopter		
polaroid camera		
velcro		
computer		
ballpoint pen		
cellophane		
radial tires		
plywood		
fuel injection		
heart pacers		
cloning		
power steering		
laser		
barometer		
hydrofoil		
condensed milk		
telephone		
automobile		

*Modified from *Technology: An Introduction* by Paul Devore

Activity 4

The list of inventions from Activity 3 can be used in a similar activity.

1. Select an invention that has made your life better.**
2. List several positive and negative impacts the invention has made
3. List ways to counter the negative impact.
4. List ways to take advantage of the positive impact.

Invention	
Positive impact	Ways to take advantage
Negative impact	Ways to counter

5. How can you control the advantages and disadvantages?
6. Share your results with someone in the class who selected the same invention.
7. Report to the large group.

**Modified from *Impact of Technology* by Jerry Belistreri

Activity 5

Fifty Simple Things Kids Can Do to Save the Earth is an excellent source to use for STS content when teaching about the changing earth, environmental problems and social issues. The following chart could be useful in planning lessons or in guiding students to pursue further areas of investigation. Students can suggest other cells in the chart.

Social Issue	Technology	Science
Recycling paper	How paper is made	Study of trees and plants
Preserving water	How the toilet tank works	Water cycle
Saving energy	How a battery works	Energy from chemistry

The final section of this book includes seven experiments that children can conduct alone or with teacher guidance.

Other Activities

These activities lend themselves to sharpening student research and synthesis skills.

1. Consider the importance of each of the following persons who contributed to the preservation of the planet. Explore their ideas.
   Henry David Thoreau
   Howard Odum
   Theodore Roosevelt
   Rachel Carson
   Bruce Ames
   Edith Efron

2. Trace the route of Lewis and Clark's western exploration of the United States on a map. Read excerpts from their journal. *What was their view of the U. S. wilderness in the early 1800's? What technology was available to them? What was the social impact of their expedition?*

3. On a map, locate Alaska, Brazil, Chenobyl and Three Mile Island. Research the stories about oil spills, deforestation and nuclear fallouts. *What are some results of each event?*

4. Using the information found in #3, role play or simulate one event. Have groups represent each of the following: a community group, a media group, a legal group and a defendant group representing companies. Prepare an initial fact sheet that includes relevant and irrelevant facts so that students can choose what is important. Through research, students complete fact sheets.

5. Have students prepare STS posters that illustrate inventions, such as television, the telephone, a heart pacer and the ballpoint pen.

6. Have students write plays or short stories about a futuristic society that has evolved through addressing or not addressing concerns about earth problems: acid rain, air and water pollution, greenhouse effect or garbage accumulation.

7. Ask students to interview parents, grandparents or other persons to obtain information on a social issue they have chosen to investigate. Illustrate the responses using pictures, charts or graphs.

8. Use commemorative stamps that focus on the environment to teach about it. Each student selects the stamp that he/she wants to research.

9. Plan a field trip to Silver Springs, FL. Using Howard Odum's article, introduce his ideas...that humans should have a scientific understanding of nature so that they can better control nature for their own human purposes. Prepare a study guide for students that helps them observe and describe the biostatic ecological community at Silver Springs. Include a section focusing on the social impact (movie making and tourism) and technology (old car museum).

10. Use the computer game, *Oregon Trail*, to promote decision making and to discuss the social impact of the use of the trail. *What technology was available to the pioneers? How has the use of the trail affected us today?*

11. Have students interview city officials, politicians and engineers on a specific environmental issue. *What role does technology play in the issue? How does the issue affect our lives?* Report to the class.

12. Have students discuss how people would live in space. Include all aspects of life.

13. Play the games *Energy and Environment - Pros and Cons* and *Techno-Consequences - Pros and Cons*. During the debriefing session, discuss the future possibilities of energy or technology and the social impact that might occur.

Resources

These resources are useful in lesson/unit planning:

BOOKS

Schneider, Stephen. *Global Warning*. Sierra Club, 1989.

McKibben, Bill. *The End of Nature*. Random House, 1989.

Myers, Norman. *The Primary Source: Tropical Rainforests and Our Future*. W. W. Norton, 1984.

Carson, Rachel. *Silent Spring*. Fawcett, 1962.

Massini, Giancarlo. *SOS Save the Earth*. Grossett, 1972.

Jennings, Gary. *The Shrinking Outdoors*. Lippincott, 1972.

Gialeam, Ada & Frank. *The Mystery of the Everglades*. Random House, 1972. (I)

Ross, Pat. *Whatever Happened to the Baxter Place?* Pantheon, 1976. (I)

Dennis, Landt. *Catch the Wind: A Book of Windmills and Windpower*. Four Winds, 1976. (I)

Adler, Irvin. *The Environment*. John Day, 1976. (I)

Turner, Ann. *Heron Street*. Harper, 1989. (I)

I = intermediate readers

FILMSTRIPS (FS), FILMS (F) AND VIDEOS (V)

Air Pollution. (FS) Knowledge Unlimited, Madison, WI

Cities in Space. (FS) Center for Humanities, Mount Kisco, NY

Water Pollution: Causes, Effects and Remediation. (FS) Center for Humanities, Mount Kisco, NY

Clear Water: What's in it for you. (F) Modern Talking Pictures, St. Petersburg, FL

Recycling: A Way of Life. (F) Modern Talking Pictures, St. Petersburg, FL

Can We Fish Again? (F) U.S. Environmental Protection Agency, Chicago, IL

Not Just Another Spiel. (F) U.S. Environmental Protection Agency, Chicago, IL

You, Me and Technology. (V) Agency for Instructional Technology, Bloomington, IN

Acid Rain: The Choice Is Ours. (V) Center for Humanities, Mount Kisco, NY

Energy and Nuclear Power. (V) Center for Humanities, Mount Kisco, NY

Conclusion

Teaching about the relationship of science and technology to human societies can be one of the keys to successful citizenship education. Using STS applications to content allows educators to meet other goals of social studies education (NCSS, 1989). Students see themselves as part of the total human adventure as they develop critical attitudes and perspectives to analyze the human condition on this planet. Time spent with STS issues promotes a view that students, as problem solvers and decision makers, have the ability and opportunity to influence the conditions under which they live, for the present and for the future.

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Heath, P. (1988, September). *Science/technology/society in the social studies.* ERIC (Report No. E00-50-88-8).

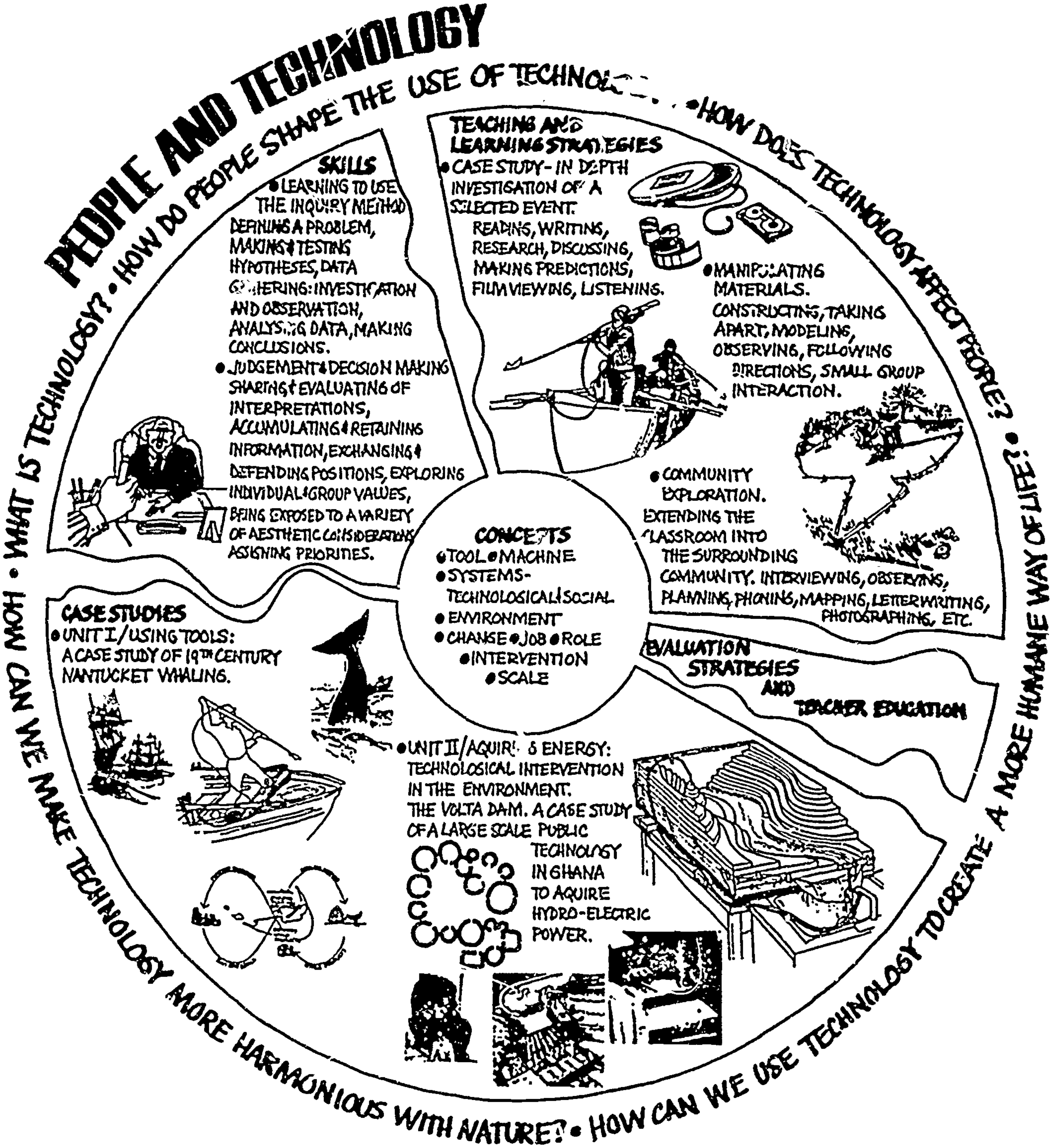
National Center for Improving Science Education. (1989). *Science and technology for the elementary years: Framework for curriculum and instruction.*

National Commission on Social Studies in the Schools. (1989). *Charting a course: Social studies for the 21st century.* Washington, DC: NCSS.

Remy, R. C. (1990). The need for science/technology/society in the social studies. *Social Education*, 54, 203-207.

Tanner, D. (1990). The curriculum frontier. *Social Education, 54*, 195-197.

Ann H. Stoddard, Ed.D. is a professor in the Division of Curriculum and Instruction at the University of North Florida.



PEOPLE AND TECHNOLOGY
HOW DO PEOPLE SHAPE THE USE OF TECHNOLOGY? • HOW DOES TECHNOLOGY AFFECT PEOPLE? • HOW CAN WE USE TECHNOLOGY TO CREATE A MORE HUMANE WAY OF LIFE? • HOW CAN WE MAKE TECHNOLOGY MORE HARMONIOUS WITH NATURE? • HOW CAN WE MAKE TECHNOLOGY • WHAT IS TECHNOLOGY?
SKILLS
• LEARNING TO USE THE INQUIRY METHOD
DEFINING A PROBLEM, MAKING & TESTING HYPOTHESES, DATA GATHERING: INVESTIGATION AND OBSERVATION, ANALYSING DATA, MAKING CONCLUSIONS.
• JUDGEMENT & DECISION MAKING
SHARING & EVALUATING OF INTERPRETATIONS, ACCUMULATING & RETAINING INFORMATION, EXCHANGING & DEFENDING POSITIONS, EXPLORING INDIVIDUAL & GROUP VALUES, BEING EXPOSED TO A VARIETY OF AESTHETIC CONSIDERATIONS, ASSIGNING PRIORITIES.
TEACHING AND LEARNING STRATEGIES
• CASE STUDY - IN DEPTH INVESTIGATION OF A SELECTED EVENT.
READINGS, WRITINGS, RESEARCH, DISCUSSING, MAKING PREDICTIONS, FILM VIEWING, LISTENING.
• MANIPULATING MATERIALS.
CONSTRUCTING, TAKING APART, MODELING, OBSERVING, FOLLOWING DIRECTIONS, SMALL GROUP INTERACTION.
• COMMUNITY EXPLORATION.
EXTENDING THE CLASSROOM INTO THE SURROUNDING COMMUNITY. INTERVIEWING, OBSERVING, PLANNING, PHONING, MAPPING, LETTER WRITING, PHOTOGRAPHING, ETC.
CONCEPTS
• TOOL • MACHINE
• SYSTEMS - TECHNOLOGICAL & SOCIAL
• ENVIRONMENT
• CHANGE • JOB • ROLE
• INTERVENTION
• SCALE
CASE STUDIES
• UNIT I / USING TOOLS: A CASE STUDY OF 19TH CENTURY NANTUCKET WHALING.
• UNIT II / AQUIRING ENERGY: TECHNOLOGICAL INTERVENTION IN THE ENVIRONMENT. THE VOLTA DAM. A CASE STUDY OF A LARGE SCALE PUBLIC TECHNOLOGY IN GHANA TO AQUIRE HYDRO-ELECTRIC POWER.
EVALUATION STRATEGIES AND TEACHER EDUCATION

SOFT ON TECH

Lynne S. Schwab, Ph.D.

We all get images of sharp points when we think of technology; or, at the least, we do not get images of softness. Actually, people can still be experiencing softness while they work with technology. Activities involving technology can bring out our humaneness. Imaginative experiences that help us understand and build technological systems in humane ways are possible. Creative processes can be learned by practicing the processes, using things that are technological.

This article gives examples of classroom activities that elementary and secondary teachers can use with their students without a great deal of outside preparation or background These activities help introduce teachers to ways technology can become a friend and ally, if technology at first seems a bit frightening. They are from the Introductory Teacher's Guide of a year-long curriculum project *People and Technology* developed by the Education Development Center in Cambridge, Massachusetts. The project, developed in the early 1970's was directed by Ruth MacDonald.

Reaching into the past provides interesting perspectives. Once having jumped in, teachers may feel the fun of activities like these and be inspired by the responses of their students to work on developing more activities. A current EDC contact person who is familiar with the curriculum is Mille LeBlanc. The project activities are in the public domain.

Technological Activities That Bring Out Our Humaneness

This activity is based upon a pile of junk you and your students bring to class. While sitting in a circle, you spill it out in the center of the floor. Each student selects one item and describes how a person and the item are alike. For example, a student may select an eraser because the student likes to change his/her mind.

After all the students and the teacher respond, the teacher asks the students to summarize common characteristics. The same activity can be used to describe ways that a person and the item are different from each other. Then students are asked to comment on ways that people are different from tools.

Imaginative Experiences That Help Us Understand and Build Technology

<u>Activity 1</u> *Speak for a Tool*

Each student brings in a tool about which he/she knows something. The following questions are posted. Students speak as if they were the tools answering whichever questions they wish, including some spontaneously asked by the group.

Questions: What do you do?
How do you work?
Who uses you?
What is your most common disease?
What are the people like who use you?
What value are you to people?
How do you affect people's lives?
What tools were used before you came along?
How do you feel about the people who use you?

Discuss the following questions:
What is a tool?
What are some of the relationships between people and tools?
How extensive is the man-made world? Was it always that way? Will it become more so? What might the effect be?
Is a building a tool? a highway? a song?

<u>Activity 2</u> *If I Were a Hammer*

Play or show the words to the song, *If I Were a Hammer,* and discuss its meaning. Then have students imagine that they are tools or technological devices and describe how they would like to be used to make a better world. Students may use any form they wish: poem, song, letter, collage, painting, cartoon, essay, construction, sculpture, play, speech, interview, music, picture essay. (Students can assume any kind of surrounding.)

Sample tools/devices: building, TV, airplane, camera, computer, pen, air conditioner, bicycle, jackhammer, bell, lamp, wire, power plant, pipe, car, knife, typewriter, radio, oxygen, tank, paper, box, fence, gun, table, sign, pane of glass, clock, sheet of paper, wheel, guitar, piano, newspaper, ladder, safe, flag, book. (Pick from a hat.)

After informal presentations, have students discuss what happened and their thoughts and feelings about what happened.

Creative Processes to Practice Using Technology

Explain to the students that many inventions and ideas have come to people when they used a four-part creative process:

1. Messing around - familiarize self with problem and materials
2. Incubation/relaxation - walk away from task and do something relaxing - often some dreamlike image or some words or feelings will come to you
3. Insight about theory or idea - while relaxing, some image, word or feeling may come; however, the meaning may not be clear at first. During insight, the mind suddenly figures out the meaning.

4. Verification and modification of theory or idea - use the scientific method to verify or modify the theory or idea.

Activity 1 *Making a Tool*
(Use the four-part creative process.)

Everyone brings in junk material and, working individually or in teams, creates a tool that is real and works. Demonstrates how it works to the others. Allow time for tools to be tried out by others.

Materials: wire, string, clothespins, straws, glue, straight pins, tongue depressors or popsicle sticks, tacks, sheets of cardboard, magnets, elastic bands, paper clips, flat sticks, dowels, tin cans (#10), paper tubes (mailing tubes), small mirrors, safety pins, roll of brown paper, masking tape, scissors.

Discuss observations about the following: the new tools as a whole, any particular tool, the tool-making process, people as tool makers, the usefulness of the tools and things that happened to the students while making their tools.

Activity 2 *Making a Tool Better*
(Use the four-part creative process.)

Students, in groups of at least five, take ten minutes to brainstorm about ways a particular tool can be improved. They list ideas generated without discussing the ideas. Then each group's recorder reads off its ideas.

Have each group discuss the kinds of improvements that were suggested. Then raise these questions:

> What is an improvement anyway?
> Is a change an improvement?
> Would any of the improvements be bad for someone?
> Is it always better to be faster? cheaper? safer?
> Can things be improved by making them slower? less safe?
> From whose point of view is an improvement to be judged?
> Do tools that work better make life better?

Letters can be written to manufacturers with suggestions by students.

Understanding and Developing Human Nature

As Peter Dow (1973), in the *People and Technology* "Tooling Up" Teacher's Guide points out, Jerome Bruner felt that there were two ways people could better understand and further develop human nature. The first was to contrast people with animals, and th.

second was to contrast people with tools. The activities in the curriculum *People and Technology* provide examples of the latter.

Thinking and Acting As Decision Makers in Technological Societies

Dow continues with the statement: "Technology today offers us an opportunity to choose between competing human values; those choices cannot be left to the *experts* and the powerful, if democracy is to be preserved. It is our hope that a course of this kind can help young adolescents think clearly and act effectively as decision-makers in an increasingly technological society. If so, we will have achieved a liberating curriculum" (p.2).

So activities about technology can help us both understand our humaneness and use that humaneness to contribute to a more humane technological society.

Mindfulness

Activities about technology inherently involve students in consideration of the process as well as the outcome. The unfortunate norm in our schools has been an overemphasis on outcomes.

Harvard psychology professor Ellen Langer, in *Education for Outcome*, develops the argument that this single-minded pursuit of a goal, instead of developing mindfulness about the processes involved, encourages overemphasis on success or failure, a condition which can lead to *mindlessness* about everything else (1989).

The significance of this mindlessness is addressed in Langer's latest book, *Mindfulness*. An example of the effects of mindfulness on residents in a nursing home follows:

"Some residents were given tasks that required even a small amount of mindfulness, such as caring for a plant and making small decisions about their daily routines. A year and a half later, not only were these people more cheerful, active and alert than a similar group in the same institution who were not given these choices and responsibilities, but many more of them were still alive. In fact, less than half as many of the decision making, plant-minding residents had died as had those in the other group. This experiment, with its startling results, began over ten years of research into the powerful effects of what my colleagues and I came to call MINDFULNESS, and of its counterpart, the equally powerful but destructive state of mindlessness." (1989).

Based upon studies like these, student activities about technology can be regarded as having the potential to affect *mindfulness* and to enhance both our humaneness and our abilities to use and to grow humane technological societies.

The use of imagination and the creative process in activities about technology has the grain to grow *mindfulness*. Let us get to it before it is too late.

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Education Development Center. (1973). *People and technology*. Cambridge, MA

Langer, E. (1989). *Mindfulness*. Menlo Park, CA: Addison Wesley.

Lynne S. Schwab, Ph.D. is a professor in the Division of Curriculum and Instruction at the University of North Florida.

STS AS ENERGY EDUCATION

David E. LaHart, Ph.D.

Elementary and secondary schools have long been identified as an important target for *energy education*. Recently the U.S. Department of Energy has joined other state and federal agencies in producing instructional materials designed for use by classroom teachers. In addition, dozens of industry groups have produced *energy education* materials emphasizing their points of view about energy including renewable energy technologies.

Results of National Studies

The current agency emphasis on developing supplemental energy education materials often does not consider recent studies of education in the United States. States are now mandating which instructional objectives should be taught. In addition, 90% of the teachers use textbooks as their primary source of instruction 90% of the time. *What time is there for energy education?*

In the past decade there have been over 100 studies on education in the United States. Commissions have been convened. Task forces have been charged. University presidents have deliberated. Captains of industry have investigated.

Politicians have promised. Occasionally even teachers have been asked for opinions.

The conclusions of these studies gain momentary headlines or a 30-second analysis on the evening news. Then they are forgotten until the next study provides its provocative pronouncements on the state of education in America.

We have learned a lot. The nation is at risk. *The International Science Report Card* compares U.S. students enrolled in science courses with students in other industrial countries. These advanced, college-bound students scored 13th (last) in biology, 11th of 13 in chemistry and 9th of 13 in physics. U.S. scores were equal to students from Thailand and Singapore; Canadian students score a full 10% higher on standardized tests.

While performance on the *National Assessment of Educational Progress* (NAEP) has shown a slight increase in the 1980's, the test data indicate the increases involve knowledge of basic facts, not higher cognitive skills. In fact, NAEP officials warn that a "majority of 17-year olds are poorly equipped for informed citizenship and productive performance in the workplace, let alone post-secondary studies." It is against this backdrop of an *educational crisis* that promoters of energy education are attempting to develop new ideas and strategies for teaching about energy.

Simple experiments and demonstrations serve as models that apply to real-world problems. Many developing countries have health problems related to poor sanitation. Solar heated water can reduce these problems.

Studies about education in the U.S. often conclude that most teaching is geared toward preparing students to take another course. Yet, 70% of students plan to stop taking classes when minimum school requirements are completed. It seems that a more reasonable goal for teaching is to develop scientific and technological literacy among all students. This seemingly simple recommendation requires a profound change in education. It involves relevance.

The national movement towards relevance in education operates under the Science, Technology and Society (STS) umbrella. At the state level, departments of education are structuring goals and objectives, curriculum frameworks, course requirements and teacher certification standards along STS guidelines. Florida, Maryland, Michigan, New York, Washington and Wisconsin stand out as the leaders in promoting STS at the K-12 level. Illinois, Indiana and Pe ylvania are in the process of developing and implementing similar standards. This movement presents an unparalleled opportunity for energy educators.

Piel (1984) has synthesized the many concepts of STS instruction into eight major areas: Energy, Population, Human Engineering, Environmental Quality, Natural Resources, National Defense and Space, Sociology of Science, and the Effects of Technology. This scheme not only includes energy as a topic per se, but includes a plethora of places to infuse energy as a topic for study, discussion and investigation. art (1986) identified several successful techniques to help teachers integrate energy ncepts into existing instructional strategies. They include:

* helping teachers design instructional activities that *fit* into existing course frameworks and student performance standards;

* reviewing existing textbooks for misinformation and inappropriate applications of energy technologies;

* assisting with the development of teacher-designed instructional materials; and

* providing inservice training.

The idea of working with teachers is a critical part of any integration effort. Teachers simply do not have time for instructional *add-ons*. To be successful, energy education efforts must find a nitch in a overcrowded, constantly changing K-12 curriculum. Those of us who advocate education as a change agent need to recognize the dozens of interest groups that seek to impose their ideas and values through education. We are all competing for the attention of teachers and student time. The social responsibility perspectives of STS have become widely accepted, therefore, Science, Technology and Society instruction provides a vehicle.

Students learn how to connect solar electric cells to various electric loads. Technology has improved the efficiency of the cells and the efficiency of the loads.

Education and Action

Most advocates of energy education feel that an informed person makes energy decisions based on knowledge and personal values. There is some evidence to support this hypothesis. From the research of Sia, Hungerford and Tomera (1986), it appears that responsible environmental action is mainly a function of four factors:

1. knowledge of environmental issues
2. knowledge of action strategies to resolve issues
3. the skills to take action
4. the possession of certain affective qualities and personality factors.

After an extensive review of the literature, Rubba and Wiesenmayer (1988) concluded that if STS education is to guide learners in the development of the knowledge, skills and affective qualities needed to make decisions and take actions on social issues in a responsible manner, education must directly address these capabilities. Learners should develop the ability to investigate and take action. This means that students must go beyond the use of classroom discussions, lectures, audio-visual resources and lab exercises. This doubles the challenge for advocates of energy education. Developing *curricula* for teachers will not satisfy the teachers' need. Untested instructional materials, designed by advocates and thrust upon the educational system, will largely go unused. Proponents of actions that are biased are carefully avoided by knowledgeable teachers.

The Next Step

People, including teachers, are constantly barraged with an assortment of energy facts, myths, information and misinformation. Industry-sponsored instructional materials are available from dozens of associations and foundations, but energy education continues to be plagued by the tendency to promote, not educate. Most classrooms do not need video tapes or computer simulations if these are to be used in isolation. Today's need is to work with teachers on issues that are relevant to kids.

Today's students have an unbelievable sense of urgency; they want and expect quick action; they are easily incensed. The *Sesame Street* generation wants to be involved. Recent studies about education clearly show that old solutions to new problems are not effective.

The next step for energy education is to ground it in STS instructional programs. The job is a big one. Successful approaches involve teachers. The most successful strategies involve the private sector. For example, private sector grants enable teachers to participate in energy education workshops and conferences; awards of materials increase the number of laboratory experiences students receive; and *adopt a school* programs help the private sector gain broader perspectives of problems and opportunities in public education.

Teacher education is the key to implementing an effective STS program. These teachers are doing an activity from the Florida Middle School Energy Education Project.

Conclusions

Energy education can have a major impact on the K-12 instructional programs if:

* teachers are involved in program design and development;
* constraints to implementation are identified before programs are designed;
* instructional strategies are framed in an STS context;
* instructional materials are based upon teachers' needs, not an expert's perceptions;
* action components are carefully designed and included as necessary parts of instruction;
* program validity is determined by adequate field testing, and
* the energy industry supports teachers instead of propaganda.

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David E. LaHart, Ph.D. is principal instructor of the Florida Solar Energy Center at Cape Canaveral, Florida.

STS IN THE ELEMENTARY CLASSROOM
A CONVERSATION WITH A TEACHER

Lehman Barnes, Ph.D.
and
Terry Brock

(In the following, Lehman interviews Terry. Terry begins with her beliefs about STS).

Brock:

"Quite simply, everything is hooked to everything else. I can't fathom how any one area can be completely isolated from the others. For example, to me, science is the study of everything in the world. It is a way of thinking about the world and analyzing what is observed using our senses. Science and technology play a huge role in helping people understand a societal issue - in fact, we limit our thinking if we say a societal issue when what we are dealing with, at the very least, is a science, technology and society (STS) issue."

Barnes:

"You are suggesting that since our opportunities and problems, our work and our play, and our interactions with each other are interconnected in so many ways, then we teachers must invite children to take an integrated, interdisciplinary approach to learning about our world, its inhabitants and their interactions. The triad of science, technology and society can and does provide an important framework for our curriculum and our instruction."

Brock:

"Exactly! My students were involved in our annual rocket day this past spring and, at the end of the day, I asked them to review their journals to reflect on what they had been doing during their rocket studies. The list of topics, activities, skills and disciplines was quite lengthy and the children were very impressed with themselves. Some that immediately come to mind:

-reading the instructions for rocket making

-reading the history of rocketry and propulsion

-being a part of current *history making* as members of the Young Astronauts Club and as a part of the NASA video-link

-becoming familiar with ancient astronomers and the current dilemmas of the Hubble telescope

-discussing and writing out their plans for making and testing rockets

-designing and testing the rocket; revising, retesting

-wrestling with the issues of safety, expense, and priorities, both with the school's rocket day and the nation's space program

-having many opportunities to brainstorm, to ask questions, to analyze, to problem solve

-discovering new vocabulary and new ways to express oneself

-learning concepts of energy and motion, of Isaac Newton and his life and place in history

-learning that many individuals and groups in industry, government and education are involved in this cooperative enterprise

-planting space seeds in a garden near the school and making twice-a-week observations and measurements of their growth

-engaging in small group efforts (three to five classmates) as the main vehicle for learning; for developing skills in team planning, implementing, critiquing and reporting"

Barnes:

"I did chat with several of your students during the week after the rocket day. Many of them had a sense of this whole notion of integration, remarking that we really get into all the different subjects when we study a topic. We learn so much more by doing something that makes sense to us. We educators often use the expression *learning how to learn;* the learning how to by doing, to analyze by analyzing, to think critically by thinking critically, to solve problems by solving problems, and by applying one's knowledge and skills to an immediate, practical, hands-on, current situation. How do your fifth graders demonstrate to you that they are learning how to learn?"

Brock:

"Let me tell you about our school pollution study. With a few materials (slides, vaseline, sticks), groups of four or five youngsters sampled several locations around the school-the office, the teachers' lounge, the stage, the lunchroom, our room, the boys' and girls' restrooms. Each group planned the study, set up their own sampling stations and collected the samples undetected. They analyzed their data and prepared a report to share with the other groups in the class. The report judged by the class to be the most useful was shared with the principal and others for their information and reaction."

Barnes:

"That's great, here was pollution in the classroom and the restroom, not in the abstract. And, as we mentioned while talking about the rockets, students were reading, writing, planning, problem solving, sciencing, and imaging, while experiencing the vigor and joy of learning".

"Certainly your description of these projects suggest an integrated model of teaching and learning. You don't simply select a topic and then grab a concept or skill from each of the major disciplines. It seems that your planning is, in a large part, a response to the activities of the children. They get interested in some topic, and you are one of their sources, their advisor, prodder, challenger and facilitator. Do you plan it that way?"

Brock:

"I continually plan and adapt as the need arises. I must stay flexible and learn to live with ambiguity. Of course, you have some ideas about the direction the students may be headed but, often, they will leap faster and farther than you might expect. Plus they will take some side trips along the way."

Barnes:

"What about this group experience? You mostly talk about group activities and somewhat less about individual learning and even less about learning in which you talk and everyone else listens. Is there something important or necessary about this group process in an STS learning experience?"

Brock:

"Small-group learning is a fundamental component of my classroom. I begin the year by inviting the class members to form groups of three to five individuals, working with the people they like and learning to function in a group. There is emphasis on self help and group support for each group member. The student is an individual learner and, at the same time, a group learner."

Barnes:

"I would think that STS is a natural in this kind of setting. In science, we attempt to explain phenomena, and in technology, we are concerned with proposed solutions to human problems. The human endeavors to explain and solve have implications for social application and personal action. The small-group setting, the mini-society, if you will, is a fertile ground for learning to be skillful at proposing explanations and solutions and for considering potential applications and actions."

"You know, you might be accused of making learning relevant! Seriously, is there a danger of missing out on fundamental knowledge while dealing with topics of current interest to the students?"

Brock:

"There is always that danger, but remember, everything is hooked to everything else. The kids want to know about drugs, so we learn about drugs. While we wrestle with this big social problem pertinent to all my students, we need a knowledge base for our discussions and evaluation of the issue. So we study the body and spend some time with the brain and how we think it works, including neurons and dendrites. Neurons are cells; this realization naturally requires the learner to take a meaningful look at cells, at cell anatomy, physiology and function. Understanding cells gets us into molecules and atoms and elements and compounds and their interactions. I observe that it is much easier for the students to understand how *crack* can make an addict after one usage because the students already know about atoms, molecules, cells, neuron cells, dendrites and chemical changes."

Barnes:

"Another strong argument for relevant learning, but do you worry that students are not covering the material necessary to pass the required standardized tests?"

Brock:

"On the contrary, I find that my students do better on the annual spring tests than they used to do when I spent 52 minutes on reading, 37 minutes on math, etcetera. Writing, computing and problem solving in the midst of a project immediately relevant to one's life is a much stronger impetus to writing, computing and problem solving than day after day of worksheets and the like. My typical assignment on the chalkboard in the morning is a question to be answered, not a requirement to be followed."

Barnes:

"Rocketry, pollution, drug education, science, society, technology, integrated learning, small-group interaction, learning how to learn - challenges and opportunities for the teacher. You also mentioned living with ambiguity. I would believe that you must allow yourself, out of a personal commitment and necessity, to be open, and allow your students to be free."

Brock:

"Yes, we should provide a framework, but avoid directives and boundaries. The students can grow in a classroom that functions openly, where there is respect for logic, evidence and diversity."

Barnes:

"Tell me, how did you get to be this way; by this I mean integrated, practical, adaptable, reflective and facilitative? Where were you when I was in fifth grade?"

Brock:

"As a child, I was a collector, a sorter, a take-it-aparter. I built go-carts and had a stamp collection. My parents gave me broken appliances so that I could tinker. I got involved in my father's electrical apprenticeship. At the time, I did not fit the typical image of the young female. I am still a collector the latest is a skull collection. And I encourage my own students to collect, to sort, to take apart, to look for patterns, to debate, to seek answers, to look for the connectedness of things, to seek evidence, to negotiate, to propose solutions and to take action. I guess I have been an integrated learner most of my life."

Lehman Barnes, Ph.D. is an associate professor at Florida State University. Terry Brock is a 5th grade teacher at Alimacani Elementary School in Jacksonville, Florida.

Prepared by the School Board of Palm Beach County
Graphics Center and Printing Services